THE

CHEMICAL NEWS

AND

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(WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE.")

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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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Analysis of a Recently-Imported Mineral Substance, by Dr. T. L. PHIPSON, *F.C.S., &c.*

UNDER the denomination of "West India phosphate"—a term applied to an extensive variety of phosphatic materials which find their way to the agricultural world in England—a peculiar substance has been met with in commerce during the greater part of last summer; it is said to be imported from America and to consist principally of phosphate of lime.

I have received samples of this substance during the year 1865 from several well-known commercial firms, and have made a considerable number of analyses of the "new product." A mean result of the whole of these analyses (the results of which are very similar) give it the following composition in 100 parts:—

		Atomic Ratio.
Sulphate of lime	65·00	0·956
Water	13·50	1·500
Magnesia	19·00	0·950
Oxide of iron and alumina	0·85	
Chloride of sodium	0·70	
Sand	0·45	
	99·50	

It is not difficult from this to see that it contains all the substances usually found in marine boiler incrustations. The above analysis leads to the formula,—

$$(2\dot{\text{Ca}}\dddot{\text{S}}+\dot{\text{H}})+2\dot{\text{Mg}}\dot{\text{H}}$$

1 atom of "Boiler sulphate" + 2 atoms of hydrate of magnesia.

$2\dot{\text{Ca}}\dddot{\text{S}}+\dot{\text{H}}$ is the "boiler sulphate" of the late Professor Johnston (the author of "The Chemistry of Common Life"); it is here combined with two atoms of hydrate of magnesia, the hydraulic qualities of which are well known.*

It is rather a novel kind of industry to scrape out the boilers of the large steam ships and send the product into commerce as "West India phosphate"! This will serve as another example of the importance to agriculturists of having the nature of every "new product" carefully investigated.

The above mineral substance presents itself in moderately hard fragments more or less cylindrical, concave, or convex, having a finely stratified structure. Some of the fragments have the appearance of certain fossil shells; others, again, are quite different. It is readily and completely soluble in acids. Distilled water extracts from it a notable amount of chloride of sodium.

In recent times the composition of marine boiler incrustations has been investigated by M. E. Cousté in his admirable memoir, "Recherches sur l'Incrustation des Chaudières à Vapeur" (*Ann. des Mines*, 1854), and again by Professor Voelcker in a paper read at the British Association this year (*vide* the journal *Cosmos*, October 18, 1865). Neither of these authors appear to me to have recognised the true composition of these deposits, but they both agree in stating that carbonate of lime, so common in fresh-water incrustations, is entirely absent in salt water deposits.

TECHNICAL CHEMISTRY.

New Processes for Covering Metals with an Adhering and Brilliant Coating of Other Metals,† *by M.* FRED. WEIL.

THE author begins by observing that the galvano-plastic processes employed for depositing metals one on the other have the disadvantage of being expensive and requiring apparatus expensive to keep in repair, and which, as is usually the case with cyanuretted baths, are unhealthy for the workmen.

The process proposed and employed by M. Weil consists in the use of baths formed of metallic salts or oxides held in alkaline solution (sodic or potassic), and usually in presence of organic matters, such as tartaric acid, glycerine, albumen, or any other inoffensive substance which prevents the precipitation of the oxide by the fixed alkali. The deposit generally takes place at the ordinary temperature, but sometimes at a higher temperature. According to the author, his processes of the coppering and bronzing of iron, cast iron, and steel, are of special importance; he can, moreover, vary at will the colours and tones, and produce a series of results which it has hitherto been found impossible to produce, either directly or in a durable manner.

Coppering.

Composition of the Coppering Solution.—In ten litres of water dissolve:—

Crystallised sulphate of copper	350	grammes.
Crystallised sodioo-potasic tartrate	1·500	"
Soda lime containing from 50 to 60 per cent. of free soda	800	"

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* In the mineral Predassite, analysed by M. Damour (*Bull. de la Soc. Geol.*, 1846), we have a compound of carbonate of lime and hydrate of magnesia. I should also state that both Mr. W. R. Johnson and Professor W. B. Rogers have found Professor Johnston's "boiler sulphate" in nature.

† *Annales de Chemie et de Physique*, iv., 374.

This solution, which always gives very satisfactory results, contains nearly two equivalents of tartaric acid to one of oxide of copper.

Action of Various Metals on this Solution.—Iron, cast iron, and steel, as well as the metals whose oxides are insoluble in potash and soda, undergo no change when introduced into these baths. For coppering, the zinc or lead is plunged into the bath, care being taken that the iron, cast iron, or steel articles should not touch each other, but that one of them should be in contact with the zinc. The copper was thus deposited upon, and strongly adhered to the iron.

The coating of copper increased within certain limits with the duration of the immersion. The author feels bound to admit that galvanic action alone will not effect the coppering of iron, cast iron, and steel, under the foregoing conditions.

In fact, the metals whose oxides are insoluble in potash or soda, and form only one basic oxide, become covered in the baths with but a pellicle of copper, the thickness of which does not increase with the length of time of immersion.

Pure tin introduced into the cold solution does not become coppered; by contact with zinc it oxidises; the protoxide of tin there formed reduces the copper solution, and protoxide of red copper is precipitated. The liquid holds no copper in solution after an excess of tin has been for some time immersed in it.

Process for Coppering.—The iron, cast iron, or steel articles are thoroughly cleansed by acidulated water;[‡] they are then washed in plain water, and finally in water made alkaline with soda; then cleaned with a scratchbrush, again washed, and plunged into the copper bath in contact with zinc.

The articles are suspended in the copper bath by means of zinc wire; they should be immersed from three to seventy-two hours, according to the colour, quality, and thickness of the copper coating to be deposited. A tap is then turned in the lower part of the apparatus, the cuprous liquor drawn off, and the coppered articles washed in water. They are then taken out, cleaned with a scratch-brush, and dried, first in sawdust, then in a stove.

It is much more economical to use zinc wire than zinc plates.

To keep the bath of one strength while operating on a large scale, the author, by the advice of M. Dumas, arranges his apparatus in a particular way, so that the liquid is renewed from below, and flows away drop by drop, or in a fine stream from the upper part, the level being kept constant.

Renewal of an Exhausted Bath.—After a great number of copperings the exhausted liquids are revived as follows:—

Precipitate the zinc in solution by sulphide of sodium, not in excess, and re-charge the solution with sulphate of copper. The constant saturation of the coppering bath may be effected by the following means:—

Introduce into the reservoir containing the cuprous liquid a cylinder furnished at the upper part with an india rubber valve, opening upwards. The liquid should contain hydrated oxide of copper, and the plug be controlled by a sort of ballcock floating in the liquid of the reservoir. In proportion to the diminution of the density of the liquid from the effects of the coppering, the floating ball descends, and by so doing opens the plug. The liquid enters the cylinder and dissolves the oxide of copper; it should be shaken, and when the bath is restored to its normal density the valve will re-close.

The raw materials, of a certain value, which enter into the solutions of copper—that is to say, caustic soda, sodio-potassic tartrate or glycerine, serve thus for an indefinite time.

The advantages attributed by the author to his process, when all the precautions indicated are attended to, are:—

1. The perfect adherence of the copper deposited on iron, cast iron, and steel.
2. The rapidity, simplicity, and economy.
3. The faithful reproduction of the most delicate details.
4. The beauty of the colours.
5. The harmlessness and stability of the solution.
6. The power of repairing articles coppered or covered with any other metal by the author's processes.[§]

Ordinary Bronzes.—Yellow bronzes bronze in beautiful tints in copper baths without contact with zinc.

The alloy which has been found to furnish the most beautiful tints by the action of cuprous baths was formed of,—

Copper	83
Zinc	14
Lead	0·6
Tin	1·3
Nickel	1·1

Bronzing of Red Copper.—The bronzing of red copper, even when galvanic, is effected by contact with zinc, by varying the nature of the salt of copper and the proportions of alkali and of sodico-potassic tartrate.

Zincing.—Copper or coppered metals may be covered with zinc by immersion in a concentrated solution of potash or of soda heated to 100° in presence of metallic zinc.

The coating of zinc deposited is fixed and brilliant.

The author considers the metal thus deposited to be less attackable by acid liquids than ordinary zinc.

Tinning and Leading.—Copper and coppered metals, as well as cast-iron, iron, and steel, may be tinned and leaded in contact with zinc, by means of a salt of tin or lead dissolved in a strong solution of potash or caustic soda at 50 or 100° Centigr.

A deposit of pure tin or lead is not obtained in this way, for it contains zinc. To produce a deposit of pure metal of increasing thickness, place in the vessel containing the solution of tin a porous vase holding the alkaline lixivium and the metallic zinc. Plunge the article to be tinned into the outer vessel, and establish communication between the article and the zinc by means of a conducting wire. To revive the lixivium after it has become saturated with oxide of zinc, precipitate by sulphide of sodium.

True Bronzing.—Iron, cast-iron, steel and other metals may be covered with a coating of alloy of copper and tin (true bronze) by an operation effected without the aid of heat.

This result is produced by adding to the copper bath some stannate of soda, or a solution of bichloride of tin, previously treated with a sufficient quantity of soda; immersing the article in contact with zinc determines the deposition of bronze.

[‡] The water acidulated with sulphuric acid to 2° B. The action should be continued from five to twenty minutes.

[§] For this purpose clean the damaged part with an alkaline lixivium, surround the part with an elastic cup containing the solution, and touch the object with a zinc wire; a fresh deposit is then formed on the metal.

Alkaline Baths Containing other Metals Instead of Copper.—Tartro-alkaline baths containing, for instance, cobalt or nickel, instead of copper, form no adhering metallic deposit in presence of zinc; they disengage hydrogen. Copper, or metals previously coppered, if heated, become covered with a white metallic deposit, consisting of an alloy of zinc and cobalt, zinc and nickel, &c.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 21.

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

In continuation of our report of last week we have now to give an abstract of the interesting discussion which followed the reading of Mr. James Yates's communication "*On the Best Material for Mural Standards of Length.*"

Dr. De la Rue conceived that the form and material to be used in the construction of mural standards would depend in a great measure upon the objects sought to be accomplished by the Committee of the British Association; whether, in fact, a *mètre-a-bout* or *mètre-a-trait* was contemplated; for, in the first place, he could see no objection to the plan he had already carried out in Bunhill Row, which was to use the cast-iron fitted with perpendicular studs of hard gun-metal, one of these studs had been fixed rigid, whilst the other was adjustable. The distances between the uprights might represent the English yard and foot, in comparison with the metre, half-metre, and deci-metre. With respect to the second method of displaying a standard of length, which appeared to offer advantages for comparison with other scales, it would be necessary to have the metre accurately divided throughout its whole length, and supported with its ends free. In the event of a great number of such standards being required, it appeared to the speaker possible to employ the electrotype process, and to produce in copper several copies from one original.

Dr. Hugo Muller said that he had considerable experience in the working of the electrotype process, and feared that there would be a difficulty in detaching the electro-deposit from the original metallic bar without impairing the accuracy of one or both measures. Upon the score of hardness and definition of the engraved surface, the electrotype copper would probably be found satisfactory.

Mr. Yates having stated that his object was twofold—that of familiarising the British public with the difference between the yard and the metre, and of presenting mural standards for purposes of comparison which should be of the highest attainable accuracy,—

The President believed that the use of cast-iron, painted as a protection against rust, would serve the rougher out-door purposes, whilst a more costly description of material might be required for the veritable standards of reference for scientific use; it appeared to him impossible to secure more than ordinary accuracy in a mural standard exposed in a public thoroughfare, and the effort to do so would be so much labour lost.

Mr. Hutchinson spoke of the necessity of adopting some fixed temperature at which the metallic bars should be accurately adjusted, for the mural standards would vary in winter and summer.

Dr. Frankland raised the question whether the metals were best fitted for the purpose in view? It appeared to him that glass and porcelain, especially the latter, were superior both on account of their being less expanded by heat and, as a rule, less costly. He had requested Mr. Casella to send for the inspection of the members some of his exquisite porcelain scales, such as he commonly used for barometers and thermometers, and upon which the weather appeared to have no influence. One of the thermometers (on the table) had been exposed out of doors for upwards of three years, and there was no sign of deterioration in the porcelain scale. If he was correctly informed, the graduations were produced by covering the entire surface of the porcelain with a *resist*, or wax cement, upon which the lines were scratched with a needle point; the plate was then immersed in hydrofluoric acid, and the etched lines were filled in with a black fusible composition and afterwards fired. For the purposes of a mural standard the porcelain scales could be mounted on a slab of slate; they would then be both conspicuous and durable.

Mr. Casella gave some further particulars relative to the manufacture of graduated scales upon porcelain, and stated his opinion that there would be no difficulty in getting a smooth surface of the requisite size and imitating upon such a basis the fine lines and divisions which were to be seen in Mr. Yates's standard brass metre. The speaker concluded by announcing his intention of preparing at once a porcelain metre scale by way of experiment.

Dr. Russell inquired the degree of temperature to which it would be necessary to expose the porcelain for the purpose of burning in the pigment of which the divisions were to be composed? However fusible the vitreous compound, he should much prefer to fill in the lines with the ordinary engravers' black wax, although this material might require occasional renewing.

Dr. Williamson coincided in this opinion. He thought that the subsequent process of firing would be very likely to cause a contraction of the porcelain.

Mr. Sabine's experience respecting the metres at present offered for sale showed discrepancies by different makers of from ·75 to 1 m.m. on lengths of only 300 millimetres. The rate of expansion in glass was $\frac{1}{1200}$ part for the range of 0° to 100° C., or about half that of copper between the same degrees of temperature. The speaker sketched upon the black board an elaborate contrivance for compensating the elongation of a glass bar by taking advantage of the pressure exerted upon one of its extremities by a copper bar of half the length, fixed in the same right line.

Mr. Siemens thought it unwise to trust to the wall remaining permanent when the mural standards were fixed against it, and he thought that the period of twenty years (as hinted by Mr. Yates) ought to be exceeded if a sufficiently substantial erection were designed. The principles which should govern its construction were circumscribed by the question of cost. Platinum was the best material; it was unalterable, and was known to expand $\frac{1}{1200}$th part from 0° to 100° C., or about the same as marble, and only half that of brass, cast-iron, and other metals. With regard to the mode of mounting, the speaker thought it should be at the same time both a *mesure de bout* and a divided measure; and for the purposes in view it would not deemed practicable to introduce any special means of compensating for temperature. Aluminium bronze did not appear to withstand the action of the atmosphere better than other kinds of copper alloy ordinarily known as bronze.

Mr. Becker offered a suggestion to the effect that one end of the metre scale might be mounted "*de bout,*" and the other extremity divided, and arrows placed to indicate different degrees of temperature. A measure brought to such a scale for accurate comparison would commonly be many degrees warmer than the standard itself; but if laid in contact and made to coincide at the one extremity, a correct reading of the error, if any, would be seen by the aid of a magnifying glass as soon as the metallic bars were both of the same temperature.

Dr. Matthiessen considered the word "standard" could not be well applied to mural measures, and that from fear of scratches a divided scale should not be placed in an exposed position, but that the *mètre-a-bout* would be preferable. In alloys, the rate of expansion is determined by the mean of the metals composing them. There was an objection to the use of metals on account of their liability to be stolen. Platinum and gilt brass were out of the question from this consideration alone; but it was known that brass becomes brittle by age, and soon tarnishes. Gilt coatings could not be depended upon since the difference in the rates of expansion was so great that a variation amounting to 40° Centigrade would be sufficient to loosen the gold.

Mr. CASELLA said that he had lately asked the opinion of Messrs. Matthey and Johnson upon the cost of a platinum yard, and the possibility of using a tube of this metal filled up with lead or an alloy of inferior value. Their estimate of the cost of such a compound bar was about 4*l.* per yard, and they stated that the necessary divisions could be gilt upon the surface of platinum.

Professor ABEL referred to the use of platinum for protecting the vents of certain descriptions of breech-loading ordnance, and, from its indestructible nature under the corrosive and mechanical influences of the gases from gunpowder, augured well of its application to the manufacture of standards of length, etc. He would be inclined to place reliance in the alloy known as bronze or ordinary gun-metal.

Respecting the degree of accuracy which the proposed mural standards were expected to possess, Mr. SIEMENS made the remark that their legality as standards of reference would depend upon their being correct.

Colonel SYKES, who was instrumental in obtaining the Parliamentary sanction for the legal use in England of the new metric system, stated a case to show the importance of a magistrate being enabled to refer to a standard of acknowledged accuracy when adjudicating upon a disputed contract made upon the new legal system.

Dr. DE LA RUE observed that the carpenters' two-foot rule was liable to a constant increase in length, which sometimes amounted to one-fortieth of an inch error on the side of excess.

Professor LEONI LEVI, as a member of the British Association Committee, explained that their object at present was the diffusing of information among the people, and they were only working until the Government thought proper to act. They were restricted to the small amount of 50*l.*, which would not go far towards providing standards of gold and platinum, but might be made available for the erection of several conspicuous mural tablets in black and white.

Professor WAY offered an opinion to the effect that any attempt to aim at extreme accuracy in the proposed mural measures would be undesirable.

Mr. CASELLA described the course now open to the public for securing the accuracy of thermometers and other graduated instruments by reference to approved standards at the Kew Observatory. At a very moderate extra cost the purchaser could have his instruments verified and a table of errors furnished him so that he might be guided to a truthful result. In like manner the speaker suggested that the Kew establishment should be put in possession of standards of, if need be, legal accuracy, and the public could then refer to them in matters of disputed weights and measures.

Mr. YATES, in reply, stated that the term "mural standards" had been used by the Astronomer Royal to designate the kind of measures which the Committee had in contemplation. He conceived it would be impossible to secure accuracy to $\frac{1}{10}$ m.m., and would be content with metres which were true to half a millimetre, which was as near as he considered essential for commercial use. He did not antlcipate the destruction of the wall against which the measures were to be fixed, for in the National Gallery and elsewhere the standard metre, yard, &c., were at the present time to be seen in a satisfactory condition, and the mounting was of course a point of prime importance. The standard metre which was exhibited at the meeting was of accurate measurement when reduced to the temperature of melting ice. Mr. Becker and himself had that day compared it with the platinum standard metre in the possession of the Royal Society, and they agreed in considering it correct. With regard to aluminium bronze, which was at one time very favourably spoken of, he was sorry to find that from the experience of several gentlemen then present it could not be relied upon. Mr. Yates concluded by referring to a diagram or table of the new system of weights and measures, drawn up by Mr. C. H. Dowling, C.E., and published by Messrs. W. and A. K. Johnston, of Edinburgh.

The speaker was warmly applauded, which the PRESIDENT interpreted as an anticipation of his intention to move a vote of thanks to Mr. Yates for his communication, which had elicited a most interesting discussion, and had been the means of securing a full attendance. The meeting was then adjourned until Thursday, 18th January, when Dr. J. H. Gladstone will read a paper "*On Pyrophosphotriamic Acid.*"

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

December 12, 1865.

R. ANGUS SMITH, *Ph.D., F.R.S., &c., President, in the Chair.*

MR. J. BOTTOMLEY said that a recent paper upon the employment of the internal heat of the earth led him to consider what might be the condition of the atmosphere when coal, lignite, anthracite, and all other forms of vegetable fuel should be so exhausted that the human race would be compelled to resort to this source of heat. The numbers obtained led him to the conclusion that the exhaustion of the coal fields implied more than the depriving of the human race of a ready source of warmth—namely, the alteration of the atmosphere to an extent that would ultimately prove fatal. As the latter assumption seemed to him to be repugnant to reason, he would infer that long before the exhaustion of the coal fields, the carbonic acid in the atmosphere beyond the limits of safety to life, would have been decomposed by vegetation; moreover, as plants decomposed water, there would always be some combustible compound of carbon and hydrogen; in other words, there will and must be abundance of fuel in the world in all ages, if not of so dense a character as anthracite and coal, yet of some nature intermediate between those fuels and vegetable tissue, the origin of all varieties. The effect of vegetation in maintaining the purity of the atmosphere has long been known. The assumption that this agency is sufficient to furnish an abundant and perpetual supply of fuel to mankind involves no new principle, but it tends to establish a new inference upon principles already acknowledged. Liebig states, in his "Chemistry in its Application to Agriculture and Physiology" (3rd edition), that the quantity of carbon existing in the atmosphere amounts to more than the weight of all the plants and of all the strata of mineral and brown coal existing on the earth. This would seem to favour the notion that the mineral and brown coal available for combustion would not affect the atmosphere to any serious extent if consumed. He has assumed more carbonic gas to exist in the atmosphere ($\frac{1}{1000}$ by weight) than many authorities would allow. Moreover, since the book was written enormous deposits of fuel have been discovered. In another passage Baron Liebig seems to favour an opposite view, for he states—"In former ages, therefore, the atmosphere must have contained less oxygen, but a much larger proportion of carbonic acid, than it does at the present time, a circumstance which accounts for the richness and luxuriance of the earlier vegetation." Dumas and Boussingault say, in their book on the chemical and physiological balance of organic nature, "If we suppose, then, that the whole of the carbon was diffused through the atmosphere in the shape of carbonic acid prior to the creation of organised beings we shall see that the atmosphere, instead of containing less than the one-thousand part of its bulk of carbonic acid as at present, must have contained a quantity which it is not easy to estimate, but which was perhaps in the proportion of 3, 4, 5, 6, and even 8 per cent." Mr. Hull, in his "Coal Fields of Great Britain," taking 4,000 feet as the depth capable of being worked, estimates the supply from the English and Welsh coal fields at 60,000,000 tons for 1,000 years. In the same book it is stated that the American coal fields are 72 times greater than the English and Welsh. In the reports furnished to the Admiralty some years back, by Dr. L. Playfair and Sir H. De la Beche, there is given a table showing the average composition of Welsh, Newcastle, Lancashire, Scotch, and Derbyshire coal. The mean of these numbers is as follows:—Carbon, 80·40; oxygen, 7·16; hydrogen, 5·19. Subtracting from the amount of hydrogen the quantity corresponding to 7·16 of oxygen, there remain as combustible material in one part of coal—carbon, 0·8040; hydrogen, 0·0421. For combustion it requires 2·4828 parts of oxygen, and produces 2·9480 parts of carbonic acid. Sir J. Herschel, in his "Meteorology," takes as the approximate weight of the atmosphere 11×10^{18} pounds. If we take as the amount of oxygen in the atmosphere 23·04 per cent. by weight, and as the amount of carbonic acid ·05 per cent. by weight, the following numbers are obtained (assuming 1×10^{14} pounds as the unit of measurement):—Weight of atmosphere, 110,000; oxygen contained 25,344; carbonic acid contained 55; weight of coal, 98·112; oxygen required for combustion, 243·59; carbonic acid from combustion of coal, 289·23; total carbonic acid, 344·23; ratio of oxygen to carbonic acid at present, 460·8 to 1; ratio after combustion of assumed quantity of fuel, 72·9 to 1. The last ratio can of course only be regarded as an approximation, but when we take into account all the available fuel in the world—wood, peat, lignite, coal, anthracite, also the quantity of carbonic acid evolved from volcanic districts—and remembering the opinion of a member of this Society, that we know little about the difficulties likely to be encountered in mining operations at a depth of 4000 feet—there seems little reason to doubt that the ratio of the oxygen to carbonic acid would be reduced considerably below the number above stated, and that the quantity of carbonic acid in the atmosphere would reach a point much beyond that at which it becomes deleterious to human life. It seems, then, more reasonable to take the alternative, and maintain that the carbonic acid will be deoxidised, and that there will always be an abundance of fuel.

ACADEMY OF SCIENCES.

December 18.

M. Thibierge presented a note "*On Boiler Incrustations,*" in which he suggested a means of preventing their formation. It is seldom that we can speak of a suggestion in the same high terms as we can of this. M. Thibierge's device is perfect, and if universally adopted would put an end to the inconvenience of incrustations for ever. At the same time, we are unable to say that the suggestion is altogether novel. No doubt it is quite original to M. Thibierge; but the same brilliant thought is often born in many brains, and we think we can confidently state that at least one great philosopher has proposed the same means as here suggested. The author, however, has evidently studied the question profoundly, and has arrived at the indisputable conclusion that the crusts consist of the earthy and saline matters once held in solution in the water, but thrown out by the evaporation. How, then, can we prevent these from being deposited on the bottom and sides of the boiler? Clearly by getting rid of them before the water enters the boiler. In other words, feed the boiler with distilled water. Can any means be more perfect?

M. Poey gave "*A Description of an Ozonograph and Actinograph intended to Register Half-hourly the Atmospheric Ozone and the Chemical Action of Light.*" It consisted, of course, of drums to carry the papers, and clockwork to move them, with arrangements to admit air and light to the papers. All our readers can imagine these arrangements.

M. Poitevin presented a note "*On the Simultaneous Action of Light and Oxygenated Salts on the Violet Subchloride of Silver, as applied to the Production on Paper of Photographs with Natural Colours.*" He exhibited some proofs prepared in the following way. Having obtained a layer of violet subchloride of silver on the paper, by the action of light on the white chloride in the presence of a reducing agent, he applies to the surface of the paper a liquid composed of one volume of a saturated solution of bichromate of potash, one volume of saturated solution of sulphate of copper, and one volume of a solution containing five per cent. of chloride of potassium. This paper is dried and kept in the dark, and it will keep good for several days. In this mixture the bichromate of potash is the principal agent, the sulphate of copper facilitates the action, and the chloride of potassium preserves the whites which are formed. In copying paintings on glass, the exposure to direct light need only last five or six minutes; but the time must to some extent depend on the transparency of the picture to be copied, and it is easy to watch the development of the image on the paper. The paper is not sufficiently sensitive for use in the camera. To preserve the pictures it is only necessary, first, to wash them with water acidulated with chromic acid, then to treat them with water containing bichloride of mercury, afterwards with a solution of nitrate of lead, and lastly, well wash them with water. After that they will not change in ordinary light, but will, however, turn brown in direct sunlight.

M. Houzeau presented another communication "*On Atmospheric Ozone,*" in reply to M. Frémy. He stated that he had often tried the silver test for atmospheric ozone, and had never by that obtained an indication of its presence. This, however, he contended, was no proof of its absence; for he had found the test of no value for detecting minute quantities of ozone. He had, for example, passed a litre of oxygen, containing perhaps 0·010 grm. of ozone, over a plate of silver, and found it to blacken the metal. But after diluting a similar amount of ozone with fifty litres of oxygen, the silver remains bright, although the mixture smelt strongly of ozone, and the author's paper gave distinct indications of its presence. In answer to the objection that the instability of ozone would insure its destruction as soon as found in the air, M. Houzeau suggested that its production might be incessant, and, further, that its dilution might even render it stable. Sulphuric acid and iodide of potassium, he said, when greatly diluted, have no action on each other; they may even be boiled together without producing any decomposition. In conclusion, the author said there was no *à priori* reason for denying the existence of ozone in the atmosphere; but still he was anxious that the question should be thoroughly investigated, as suggested by M. Frémy.

M. Schloesing sent a communication "*On the Production of High Temperatures by Means of Gas and Air.*" The author builds up a furnace with bricks, and encloses the object, crucible or tube, in as small a space as possible. He then directs the flame down upon the object, as in one of Mr. Griffin's last inventions, and by carefully regulating the supply of gas and air obtains a heat sufficient to fuse porcelain to a transparent glass. We shall give a description of the way in which the author arranges his furnaces.

MM. Beaujen and Mène sent an analysis of the scales which peel off in making iron hoops. They consist of a mixture of proto- and peroxide of air ($Fe_2O_3,5FeO$).

M. Penabert exhibited some "*Some Photographs on Opaline Glass.*" They were ordinary photographs, not vitrified; but the exhibitor asserted that they were permanent and unchangeable. The following is the process by which they are taken:—The opaline glass is first coated with ordinary (positive) collodion *at least a year old*, and then immersed for three minutes in a sensitising bath composed of seven grammes of nitrate of silver to every hundred grammes of water, and sixteen grammes of pure nitric acid to every 2000 grammes of such solution. The glass is exposed in the camera for fifty seconds. The ordinary solution of protosulphate, diluted with two-thirds of water and one-fifth of pyroligneous acid, is used as the developer. The picture is fixed with a very dilute solution of hyposulphite, toned with very weak sulphide of ammonium, and well washed. The author remarked that the unalterability of these pictures is so great that they resist the action of acids to such an extent that it is impossible to use the same glass twice.

December 12.

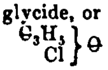
Dr. Crace Calvert sent a note "*On the Hydraulicity of Magnesian Limestones.*" The Great Dinorben Mining and Cement Company, it seems, work some magnesian limestones in Anglesea, and make excellent hydraulic cements and stucco. Dr. Calvert sent analyses of the rocks employed by the Company, which we quote:—

	Hydraulic cement of Carigcract.	Hydraulic lime of Port Cyn-for.	Stucco, Hells-mouth.
Carbonate of magnesia .	61·15	55·23	15·86
„ lime . .	21·41	33·99	72·23
„ iron . .	8·76	3·85	3·21
Silica	5·58	5·58	2·70
Alumina	2·07	2·27	
Organic matter and water .	1·10	3·40	6·00
	100·00	100·00	100·00

The analyses show that the hydraulicity of the rocks is in proportion to the amount of the carbonate of magnesia they contain. That best for hydraulic cement contains 61·15 of carbonate of magnesia, that for hydraulic lime 55·23, and that for stucco 15·86. The author states that he has compared the strength of these products with the best Portland cement and blue lias limestone, and found them to be quite equal, although very different in chemical composition. According to the above results, the best stone for the hydraulic lime must be regarded as a dolomite; the best for hydraulic cement a magnesian limestone which contains 20 per cent. more carbonate of magnesia than any dolomite yet analysed. Dr. Calvert confirms M. Deville in the statement that the calcination must be managed carefully. The heat must be raised to redness gradually, and maintained there until all the carbonic acid is driven off. At a higher temperature either some combination between the lime and magnesia takes place, or some molecular change occurs which destroys the hydraulicity. The calcined product must be ground very fine. The finer the powder the better the cement sets.

M. H. St. Cl. Deville made some remarks, in which he expressed his opinion that although the hydraulicity of the Carigcract rock must be mainly ascribed to the magnesia, yet he considered that the silica present must also be beneficial.

M. P. Truchot presented a note "*On the Compounds of Chlorhydric Glycide with Acid Chlorides and Anhydrous Acids.*" Chlorhydric glycide, or epichlorhydrine—



$$\left.\begin{matrix}\text{Ꞓ}_3\text{H}_5\\ \text{Cl}\end{matrix}\right\}\text{Ɵ}$$

unites directly with acetic, butyric, valeric, and benzoic chlorides, and forms aceto-, butyro-, valero-, and benzo-dichlorhydrines. Anhydrous acetic acid also combines with epichlorhydrine, and forms diacetochlorhydrine.

M. Jodin sent a note "*On Some Properties of Formic Acid.*" Free formic acid possesses, to a greater extent even than carbolic acid, the power of preventing the formation of living organisms in fermentable or putrefiable matters. In combination with lime or an alkali the acid disappears.

NOTICES OF BOOKS.

Chemistry for Students. By ALEXANDER W. WILLIAMSON, F.R.S., F.C.S., &c. London: Macmillan and Co. Oxford: Clarendon Press. 1865.

"THIS little book," we quote from the preface, "is intended to supply to students of chemistry an outline of the most interesting and useful facts pertaining to the Science, and of the most important ideas which have been got from a study of those facts." The first of these intentions, we may say, is completely fulfilled; and if the second is not, to our notion, so successfully carried out, it is simply because of the limited space the writer has allowed himself for the development of the ideas.

"The method of exposition," we again quote from the preface, "differs from that which is adopted in most other treatises of Chemistry; for I describe and compare individual facts, so as to lead the mind of the reader towards general principles, instead of stating the general principles first, and then proceeding to illustrate them by details." We must confess to a lingering prejudice in favour of books in which the general principles are stated first. "This book is intended for the use of beginners in chemistry." We imagine ourselves a beginner, and, commencing at Chapter I., read "Oxygen (O_2, $O = 16$)." Oxygen, of course, we know at least by name. Every schoolboy has some acquaintance with it, and knows its principal properties. But what does "O_2, $O = 16$" mean? The "beginner" will find out when he gets to Section 35 and further; but up to this point will, if he think at all on the subject, be completely puzzled.

We must next allude to the chief distinctive feature of the work—its nomenclature. To mature chemists, so excellent, in the main, is this nomenclature, no doubt about a substance can possibly arise. But the book is written for beginners, who are referred to other works for fuller information; and here a difficulty arises. How will a student recognise a body under a totally different name? One of the books the beginner is referred to is Gmelin's "Hand-book." Now, suppose a student, who has read no other book than the one now noticed, wishes to know something more than is here taught about "carbonic sulphide," will it ever occur to him to look in Gmelin for "bisulphide of carbon?" or how will he recognise "hydrosodic sulphate" under the name of "bisulphate of soda?"

It must be plainly understood that we are not finding fault with Professor Williamson's nomenclature. Quite the contrary: we should be happy to see it come into general use. We only mention these things now as illustrations of the inconveniences of a change—inconveniences which are, however, unavoidable in an age of transition.

The Preface from which we have already quoted does, indeed, suggest a remedy for the confusion. The book, it says, "is not intended as a substitute for *vivâ voce* teaching, but rather as a guide and aid to Students and Teachers. A judicious teacher will amplify the brief explanations and descriptions which I give, and show experimentally the reactions and transformations which I mention." He would also, of course, supply the synonyms of the various bodies described; and thus, when extended oral teaching is listened to as the book is perused, all the difficulties vanish.

Some time ago we remarked that a teacher could not do better than adopt a manual, and go straight through it with his class, amplifying and experimenting as the nature of the subject required. We can strongly recommend this book to all teachers who are disposed to adopt such a plan.

We should have been glad to have made some quotations, and had marked passages for extraction—one, in which the metallurgy of iron is excellently described in a very short space: and another, on the distinctive characters of organic and inorganic bodies. For these we hope to find space on another occasion, but now can only earnestly recommend the book especially to the attention of teachers, who will, we have no doubt, soon perceive its merits and recommend it to their students.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

2580. T. V. Lee, Macclesfield, Cheshire, "Improved methods in the manufacture of candles and other illuminating bodies from peat and petroleum."—Petition recorded October 7, 1865.

2741. W. Clark, Chancery Lane, "Improvements in the manufacture of paper from marine vegetable matters." —A communication from P. E. Gégnon and C. M. Gagnage, Boulevart St. Martin, Paris.—October 23, 1865.

2812.—J. Baggs, Chancery Lane, "Improvements in preserving provisions, and in the apparatus connected therewith."—November 1, 1865.

3069. A. C. Duncan, Manchester, "Improvements in the treatment of madder for dyeing and printing."

3078. W. Clark, Chancery Lane, "Improvements in the manufacture of materials for decolouring sugar and other saccharine matters."—A communication from C. J. Gaade, Boulevart St. Martin, Paris.—Nov. 30, 1865.

3110. R. A. Brooman, Fleet Street, London, "Improvements in dyeing, printing, and other operations based on chemical reactions."—A communication from M. Paraf-Javal, Thann, France.—December 4, 1865.

3163. A. Parkes, Birmingham, "Improvements in preparing compounds of xylodine or gun-cotton, and in the apparatus employed."—December 8, 1865.

3183. E. Morewood, Stratford, Essex, "Improvements in coating metals, and in apparatus to be used for this purpose."—December 9, 1865.

Notices to Proceed.

2019. P. Robertson, Jeffrey Square, London, "Improvements in brewing and distilling, also in drying yeast, and in the apparatus employed."—Petition recorded August 4, 1865.

2057. J. Gale, Devonshire Terrace, Plymouth, "Improvements in preparing and treating gunpowder, in order to render the same unexplosive and to protect it from damp."—August 8, 1865.

2070. L. Schad, Warrington, "Improvements in the production of violet colours from magenta for dyeing and printing."—August 9, 1865.

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.—August 18, 1865.

2606. J. A. Léon, Liverpool, "Improvements in means and apparatus to be employed in the manufacture of sugar." Partly a communication from A. H. Leplay, Paris.—October 10, 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."—November 28, 1865.

3071. W. Thompson, Dublin, "Improvements in fining, purifying, and mellowing spiritous liquors by combining therewith other substances for the production of a new spirituous or vinous compound therefrom."—November 30, 1865.

CORRESPONDENCE.

A Word of Explanation to Young Chemists.

To the Editor of the Chemical News.

Sir,—I beg to enclose you a printed copy of a letter by Dr. Hofmann, published in the *Berlin News* (*Berlinische Nachrichten*), on the subject of Dr. Phipson's account of the poisonings by mercuric methide at St. Bartholomew's Hospital. Dr. Phipson's article having been copied from *Cosmos* into several German journals, it naturally excited a very powerful sensation, not only in scientific, but in general circles throughout Germany, which Dr. Hofmann, as will be seen, has endeavoured to allay. Thinking that many of your readers may be interested in his letter, I forward it to you. I am, &c. Chemicus.

Sir,—Under the title "A Warning to Young Chemists," several German newspapers have extracted an article by Dr. Phipson, published in the Parisian journal *Cosmos*.

This warning is connected with a narrative of the unfortunate fate of two young chemists—one a German from Marburg, Dr. C. Ulrich; the other an Englishman, Mr. T. Sloper—who have been the victims of poisoning by mercuric methide, in consequence of which the former has died, and the other lies ill beyond all hope of recovery.

The sad fate of these two young men has excited the deepest sympathy in scientific circles both in England and the Continent. The writer, who was living in London at the time of the occurrence, has especial reasons to regret it, since he had known Dr. Ulrich for several years, and highly esteemed him as a persevering and talented young chemist.

From the circumstance that he was acquainted with the whole course of events so far as Dr. Ulrich was concerned, the undersigned considers it his duty, in the interest of truth, to say a few words on this lamentable event, unprecedented in the annals of chemistry; and also on the manner in which it has been represented.

First with regard to the facts. Dr. Phipson asserts that the two young men were the assistants of Dr. Frankland, and that the poisonings occurred in Dr. Frankland's laboratory; and he does not scruple to accuse this chemist, whose character and investigations place him in the first rank, of cowardly exposing the lives of his assistants to danger for self-interested ends. But what will be thought of the conscientiousness and credibility of the reporter when we learn that Dr. Frankland, against whom this weighty accusation is made, had not the slightest connection with the affair? The two young men were not his assistants, but the assistants of Dr. Odling; and the accident happened not in Dr. Frankland's laboratory, but in that of Dr. Odling.

Dr. Phipson further represents that the misfortune which happened to the two young men was caused by the professor in whose laboratory they worked, from his ignorance of a danger he ought to have known, or, knowing, had not the courage himself to encounter. These insinuations are levelled against Dr. Frankland; but if founded apply to Dr. Odling, in whose laboratory the work was done.

As regards the reproach of ignorance, the writer, bearing in mind that he is now addressing not chemists only, but a much larger circle of readers, may be allowed to mention that Dr. Odling is one of the most distinguished chemists in England; one who by the vast extent of his knowledge and his comprehensive study of all branches of the science has materially contributed to the development of modern chemistry. To suppose that Dr. Odling was unacquainted with the poisonous nature of mercurial compounds, and with the necessity for handling them cautiously, sounds too ridiculous to deserve further notice. But what indeed was unknown to Dr. Odling at the time he worked on mercuric methide, and what was equally unknown to the writer of these lines and to chemists in general, was the altogether exceptionally poisonous nature of this particular compound of mercury. Mr. Buckton, who discovered it, and other chemists who worked with it before Dr. Odling, say not a syllable of having suffered from its influence, or even of having been annoyed by it, or of the necessity for taking special precautions to avoid danger from it.

Now that the frightfully poisonous nature of the body has been proved by these tragical events, it is not difficult to assert that its highly poisonous nature might have been inferred from its composition and physical properties. The possibility of such a conclusion cannot be denied; but it is equally certain that before this catastrophe no one was acquainted with the dangerous properties of mercuric methide.

The writer met Dr. Ulrich a few days before his illness. The conversation turned almost exclusively upon the experiments with mercuric methide, on which the young man had been for some time occupied. Dr. Ulrich spoke with the greatest interest of the results of his labours, and of the discoveries likely to be furnished by their continuation. He evidently had not the smallest suspicion of the dangerous nature of the body he was engaged in examining; nor did the slightest suspicion of it cross the mind of the writer, or he certainly would not have parted from his young friend without giving him a serious warning, or without communicating to Dr. Odling, with whom he was in frequent association, his anxiety on the subject; but he did neither the one nor the other. If, therefore, Dr. Odling is to be reproached with ignorance, the undersigned must equally share the reproach.

But in order to form a correct opinion of this affair, it is necessary to know something personally of the young man who has been so early torn from science and his friends and in so melancholy a way. Dr. Ulrich was no novice in chemistry. About 30 years old, he had been for the last ten years exclusively occupied with chemical pursuits, partly scientific, partly technical. He possessed a fund of experience which made him equal to every chemical task. He had distinguished himself by sundry researches, the first of which was published in 1859. Later he was for ten or twelve months engaged in the writer's laboratory, who, in full confidence of his knowledge, ability, and caution, would not have hesitated to confide to him the task which had such a lamentable and altogether unexpected result (*ausser aller Berechnung liegende*).

From the foregoing it will be seen that Dr. Phipson's account is partly untrue and partly distorted.

After this explanation the writer considers Dr. Phipson's warning to young chemists as hardly deserving of further notice. During his twenty years' residence in the English metropolis he had ample opportunities of forming an opinion on the position of his young countrymen in the chemical laboratories of England, and he only obeys the voice of duty when he characterises Dr. Phipson's warning as most unjust, destitute of all foundation, and undeserving of the least attention. The writer would make use of a still harsher expression if he did not believe that Dr. Phipson's pen was guided by ignorance and levity rather than by malice. It is certainly incomprehensible that Dr. Phipson, who styles himself a Fellow of the Chemical Society, and who lives in London, should omit to acquire accurate information on the matter before he brought an accusation as weighty as false against a colleague, and passed a judgment as injurious as unfounded on his fellow chemists in general. But to assume that Dr. Phipson did knowingly tell the untruth, did knowingly distort the facts, and did knowingly raise a false accusation against his fellow chemists, would be to accuse him of a slander of which the undersigned cannot believe him to be guilty.

One word more, and the object of this explanation will be accomplished. During his long residence in England, the writer became acquainted with a large number, probably a majority, of his young countrymen who had engagements in the laboratories of London and the provinces. From no one of these did he ever hear a word of complaint. On the contrary, every one acknowledged in the highest terms the friendly reception and considerate treatment he met with, as well as the conscientious fulfilment of stipulated agreements. Most of them were full of the amiable and honourable character of their employers, of their varied experience and insight into the grand forms of English life which these positions afforded them, and of the advantages which they hoped to derive therefrom in their future careers. Many of them have since made their way from these places to positions of importance in science and manufactures, some in England, some in the Colonies, and some on the Continent.

Young German chemists may therefore, if opportunity should be offered them to enter a London laboratory, proceed to the banks of the Thames without fear. In the manifold relations which link chemical science to life in England, they will find an inexhaustible store of instruction and incentive, and in the chemists of England they will become acquainted with the most honourable and reliable of men, well representing the great and splendid virtues of the English nation, among which stands uppermost the love of truth. I am, &c.,

Aug. Wilh. Hofmann, &c.

University Laboratory, Berlin, December 14, 1865.

The Removal of Bisulphide of Carbon from Coal Gas.

To the Editor of the Chemical News.

Sir,—Allow me to correct the inaccuracies of Mr. Anderson's letter on the above-named subject at page 301 of the last number of the Chemical News.

In the first place, Mr. Anderson writes as if he wished to be considered the originator of the process for purifying coal gas from sulphur compounds by washing it with ammoniacal liquor, whereas there will be found at page 6 of the first July number of your last volume, a report of a lecture by me to the Society of Gas Engineers, wherein I state that the process is somewhat old, although it has lately been put into successful operation. My remarks were as follows:—

"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 (wrongly printed for condensers). As far back as 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 a 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 (Mr. Hawksley), 'it thus

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* *Journal of Gas Lighting*, vol. xiii. (July 26, 1864), p. 542.

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 exist in coal gas after it has been passed through lime or other metallic oxides.' "[†] Now, as Mr. Anderson was present at my lecture, he must have heard all this stated by me.

Again, I would remark that gas chemists have for a long time noticed that every contrivance which kept the raw gas in contact with ammoniacal liquor, or even with other alkaline sulphides, as the sulphide and oxysulphide formed in wet lime, had the effect of diminishing the amount of sulphur in the gas; and this I referred to in the earlier part of the lecture when I stated that "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."[‡] The same fact is expressed by Mr. Ellissen in his report on the sulphur question to Mr. Barlow in June, 1864, when he says, "It seems to me of the greatest utility to keep as long as practicable the ammonia in contact with the gas, to repeat as often as possible the washings in ammoniacal water in the scrubbers;" and he further adds that "this result, indicated by theory, has been confirmed by the experiments I have made in the gasworks of the principal towns in England."[§] Lastly, it has been ascertained in my own laboratory that the sulphides and oxysulphides of lime in soda waste accomplish the object in a similar manner. It is therefore evident, not only that the principle of this mode of purification, but also the actual practice of it has been long known to chemists; and Mr. Anderson has no claim whatever either to the discovery of it or to its application.

Secondly, I am compelled to state that Mr. Anderson is in error when he says that the Nottingham experiments have not been published, and that gas companies have been without much information on this subject; for although the experiments have not been put forward in any pretentious or pseudo-scientific form, yet they have been well described for all practical purposes. Mr. Barlow, for example, in his report to the directors of the City, the Chartered, and the Great Central Companies, on the excess of sulphur in the gas supplied to the City, states that when he was conducting his experiments at Nottingham, with the view of ascertaining the relative effects of clay and iron retorts on the amount of sulphur in the gas, "it was found, contrary to his expectation, that the gas produced in the iron retorts contained 14·86 grains of sulphur in 100 feet, while the same coal distilled in clay retorts, and yielding subatantially the same quantity of gas, contained only 7·41 grains; the only difference in the purifying process employed at the two stations being that at the station where the clay retorts are exclusively used *the gas is washed with large quantities of ammoniacal liquor, pumped over and over again*, until it attains a high degree of strength, in which state it becomes highly offensive;"[‖] and he further adds that Mr. Hawksley has kindly promised to continue the experiments, with the view of ascertaining whether the diminution of the sulphur remaining in the gas produced in the clay retorts is in any degree owing to this washing; and should this prove to be the case, he would make it the subject of an additional report. But this report has not been called for, because Mr. Hawksley has himself described the particulars of the process. In the *Journal of Gas Lighting*, for July 26, 1864, Mr. Hawksley says, "At one of the stations of the Nottingham Gas Company the gas is washed by a stream of ammoniacal liquor, the volume of which amounts to about one-sixteenth of the volume of the gas. This stream descends through a vertical scrubber of about twenty feet in height, and containing four pebble-filled trays, in opposition to the current of gas, which ascends at the very slow rate of two inches per second. The result is, that one-half of the bisulphide of carbon is removed, together with much ammonia and condensible tarry vapour." This description was written expressly for the gas companies, in order that extensive experiments might be made; for he adds that "the companies have very much to gain and nothing to lose by these investigations."

Thirdly, Mr. Anderson is again in error when he says that the Corporation of the City of London have appointed a Commission to investigate this matter. That which has really been done is fully described in a leading article of the *Journal of Gas Lighting* for October 18, 1864, wherein it is stated that in consequence of the periodical complaint by me of the excess of sulphur in the gas supplied to the City, the gas companies had consulted Mr. Barlow on the subject; and on receiving his report the City authorities were advised by me to take the opinion of Mr. Hawksley, and to request him to continue his experiments at Nottingham and to advise them on the results. Those experiments have been continued from that time to the present, and Mr. Hawksley has already furnished a preliminary report on the subject. I may state, further, that the products of his experiments have always been examined by me, and they show that the process is capable of removing a large percentage of sulphur from the gas. It thus appears that for the last eighteen months, and long before Mr. Anderson had any thought of the subject, the particulars of the Nottingham experiments have been fully described. They were first mentioned by Mr. Barlow at the beginning of July, 1864; they were then described by Mr. Hawksley in the *Journal of Gas Lighting* for the same month; and finally they were discussed by me in Mr. Anderson's presence, at my lecture in May last.

I am unwilling to prolong this letter, but I am bound to say that all the other allegations and statements in Mr. Anderson's communication are likewise erroneous; and I am really puzzled to know why the letter was written, for it neither explains nor amends any part of your notice, although he complains that "it is not quite correct." I thought, indeed, you had done the matter ample justice when you quoted his general conclusions; for to my mind the details of his experiments are not merely unimportant—they are perplexing, and in many respects absolutely incomprehensible.

I am, &c. Hy. Letheby.

College Laboratory, London Hospital, December 25, 1865.

Associate of the Royal School of Mines.

To the Editor of the Chemical News.

Sir,—As an Associate of the Royal School of Mines, I awaited with some interest Mr. Reeks' reply to Mr. Denham Smith's expression of "languid curiosity"—rather curiously obtruded on the attention of the readers of the Chemical News two or three weeks ago.

It was asked, "What does this Associate of the Royal School of Mines signify?" Having passed through the extensive course of the school, and taken first-class places in all the examinations (such success being necessary to obtain the title), Associates could doubtless have wished the reply to have gone beyond the mere notice of the authority on which the title is granted in a sketch, however slight, of the curriculum and the necessary qualifications. Should Mr. Smith's curiosity attain, however, a moderate degree of energy, it may undoubtedly be fully satisfied on inquiry in the proper quarter, and he may then learn also that, to obtain the degree, earnest work during a lengthened period is required.

The school being comparatively new, even the earlier holders of the Associateship are young men, but curiosity need not be exerted very severely to discover among them men distinguished highly for their years.

I am, &c., Thomas Gibb.

Glasgow, December 21, 1865.

[†] Chemical News, vol. xii., p. 7.

[‡] Ibid, p. 6.

[§] *Journal of Gas Lighting*, vol. xiii. (Oct. 18, 1864), p. 716.

[‖] Ibid, p. 714.

Extract of Cod Liver.

To the Editor of the Chemical News.

Sir,—Will you kindly grant me space in your columns for a few observations in reference to your necessarily brief report of the Pharmaceutical Society of the 6th inst., at which the claims of the new extract of cod livers were discussed? My apology for again intruding on you must be the general interest of the discovery that the watery constituents of cod liver, which have been hitherto deemed of no value, and thrown away, are really richer in medicinal substances than cod liver oil.

The 28 lbs. of cod liver from which Mr. Squire was only able to produce 1 lb. of aqueous matter must have lost much of their water before coming into his hands. The 15 lbs. of liver which remained after the withdrawal of the 12 lbs. of oil and 1 lb. of water evidently still contained much aqueous liquid.

The waters of cod liver, when skilfully obtained, constantly yield 15 per cent. of extract. Mr. Squire seemed to have got no more than 12 per cent.

The extract, when properly prepared, contains fully 78 per cent. of organic and inorganic matters (exclusive of oil); while cod liver oil, according to the best known analyses, contains only 1·024 per cent. Hence, in one tablespoonful of the latter, which comprises 240 grains, there are present scarcely 2½ grains of the organic and inorganic matters of which the extract is almost entirely composed.

What is the chemical and medicinal nature of this extract? On the authority of the French analysis and official report, I assert that it is composed of the very substances —namely, fish-bile constituents and inorganic elements which distinguish cod liver oil from all other animal oils and fats; and I challenge the Pharmaceutical Society to determine by analysis the value of that assertion. To this the Society reply, that although they consider it their duty to undertake the analysis of such preparations as would appear to come short of the pretensions of their authors, it is no concern of theirs to analyse those that seem likely to prove genuine; in other words, their province is to condemn, but never to approve! It was meritorious in them to proclaim to the world by Dr. Attfield that Le Thière's "cod liver oil powder" was an imposture, because it contained no traces of chlorine, iodine, bromine, sulphur, and phosphorus; but it would be contrary to their policy to undertake an analysis which might result in showing that Guffroy's cod liver extract was a product peculiarly rich in those and other important bodies.

With regard to that part of the subject which was admitted to be wholly beyond the province of the Pharmaceutical Society—namely, the remedial properties of the extract, I must protest against the unfairness of the proposal made by the Chairman, Mr. Hills, that an individual member of the Pharmaceutical Society (Mr. Squire) who, as well as Mr. Hills, is a manufacturer and vendor of cod liver oil, should "induce a medical friend to make some experiments with the extract, and report to the Society."

Mr. Squire's medical friend to experiment in private with cod liver extract privately prepared by that gentleman, who has only recently heard of the substance, and is evidently not master of the process of making it, in order that the Pharmaceutical Society might arrive at a knowledge of the medicinal value of the extract prepared by M. Guffroy, who has devoted six years to the practical study of the subject!!!

But the medical experiments suggested by Mr. Hills have already been made. Not to mention those that have been going on for five years on the Continent, extensive trials of Guffroy's dragées of cod-liver extract have, during the last six months, been made in London. At St. Mark's Hospital, where my request for experiments with the extract was received in a liberal spirit by Mr. Gowlland, one of the surgeons of that institution, the new preparation has been distinctly proved by him to be so superior in remedial effects to cod-liver oil, that for some considerable time back it has almost entirely superseded the oil in his practice in that hospital. This statement is open to verification by any one who chooses to make inquiries in the proper quarter.

If Messrs. Hills and Squire, who must have many friends among the hospital physicians and surgeons of London, will consent to procure further serious trials of Guffroy's extract in one or more of the large metropolitan institutions, I shall be much pleased; and I beg here to inform those gentlemen that I shall be ready to supply gratuitously sufficient prepared cod-liver extract for the treatment of a large number of patients, provided the medical attendants will undertake to permit a medical gentleman on my behalf to take part in the experiments, duly to record the cases, and to publish them in the medical journals. I am, &c. John Barr.

83, Fleet Street, December 27, 1865.

Table Exhibiting the Comparative Composition of Cod-liver Oil and Cod-liver Extract.

	Cod-liver oil.	Cod-liver extr.
Oily acids and glycerine . .	95·967	none
Fish-bile constituents . .	0·318	60·620
Propylamine . . .	occasional trace	2·545
Acetic, lactic, and butyric acids .	0·120	6·000
Phosphorus and phosphoric acid.	0·113	2·090
Sulphur and sulphuric acid .	0·071	·200
Iodine	0·037	154
Chlorine, with trace of bromine.	0·149	1·525
Soda	0·055	1·170
Magnesia	0·009	366
Lime	0·152	510
Potash	none	211
Ammonia	none	2·862
Water and loss	3·009	21·847
	100·000	100·000

The extract is thus shown to contain 135 times as much of bile-constituents and other organic substances (exclusive of oily matter) as the oil, and 15 times as much of inorganic elements. Those two classes of bodies together form 78·153 per cent. of the extract, but only 1·024 of the oil. In a tablespoonful of the oil, which comprises 240 grains, there are therefore present hardly 2½ grains of the above matters, while the extract is almost wholly composed of them.

New Cornish Minerals.

To the Editor of the Chemical News.

Sir,—The chief object of my letter to your journal last month was to correct statements of your reporter. As regards any other points arising out of it, I would say that, foremost in recording my pleasure at the discovery of a cerium mineral from Cornwall, I shall be not less happy in recognising its crystalline system and forms, whether oblique or otherwise, so soon as ever Mr. Church or any one else shall have investigated and made them out. Until then the case stands as it stood when I wrote my letter to you. I have only to add that I did not "promise" a "crystallographic determination" of Churchite.

It was solely to secure justice for Mr. Talling that I alluded to part of what I know regarding his share in contributing to the discovery of that mineral.

I did so after hearing Mr. Church state—or my ears strangely deceived me—that he, Mr. Church, had at first taken the mineral for Wavellite.

Mr. Talling, when he sold the mineral, considered it would prove to be new, although he had his misgivings still that it might prove to be Wavellite.

As regards myself, the specimens he sent me were very poor and uncertain in their characters. I had no idea that better, or that other ones existed. He kept the well-characterised and fine specimens, it appears, for future sale; and of these Mr. Church got the benefit. I assuredly have not the meanness to grudge it him. Nay, as I would rather do sound work on an old and known, than uncertain work on a new mineral, notwithstanding the *éclat* of a novelty, so would I far rather that another man should discover a new thing and thoroughly work it out, than that I, working (as in this case I should have done) with inferior means and an inferior material, should take the freshness and the bloom off the results of his analytical skill.

I am, &c.
Nevil Story Maskelyne.

British Museum, January 2, 1866.

New Minerals.

To the Editor of the Chemical News.

Sir,—Will you oblige a few of your subscribers here by giving a list of the minerals that have been discovered during the last ten years, and their composition too, if you can afford it?

The most recent works on mineralogy are very antique.

I am, &c., T. R. A.

Manchester.

MISCELLANEOUS.

Composition and Quality of the Metropolitan Waters in December, 1865.—The following are the Returns of the Metropolitan Association of Medical Officers of Health:—

Names of Water Companies.	Total solid matter per gallon.	Loss by ignition.*	Oxydisable organic matter.†	Hardness.	
				Before boiling.	After boiling.
Thames Water Companies.	Grains.	Grns.	Grains.	Degs.	Degs.
Grand Junction . . .	21·35	1·28	0·56	12·08	6·10
West Middlesex . . .	21·14	1·02	0·69	11·00	4·99
Southwark & Vauxhall .	22·20	1·38	1·10	13·48	5·08
Chelsea	20·19	1·01	1·08	12·00	5·00
Lambeth	20·74	0·98	0·84	12·00	5·89
Other Companies.					
Kent	26·21	0·48	0·19	18·90	6·81
New River . . .	20·60	0·51	0·48	15·00	5·00
East London . . .	24·21	0·92	0·86	15·94	5·86

* The loss by ignition represents a variety of volatile matters, as well as organic matter, as ammoniacal salts, moisture, and the volatile constituents of nitrates and nitrites.

† The oxydisable organic matter is determined by a standard solution of permanganate of potash—the available oxygen of which is to the organic matter as 1 : 8; and the results are controlled by the examination of the colour of the water when seen through a glass tube two feet in length and two inches in diameter.

H. Letheby, M.B., &c.

Fire at St. Katherine's Docks.—On Monday last an alarming fire broke out at the above docks, and destroyed an immense amount of property. It appears to have commenced in a warehouse in which jute was stored, and its origin is said to have been mysterious. It is just about this time last year that proceedings were taken against a "jute drier" at the Southwark Police Court, in the course of which Dr. Odling showed the danger arising from storing large quantities of jute, the liability of which to spontaneous combustion appears to be very great. The jute on the premises which Dr. Odling examined appeared at the time to be almost on the point of ignition.

American Manufacture of Soda from Cryolite.—An American friend writes as follows:—"I have just been informed that the company having the contract for cryolite in this country have received notice that they will be expected to take 11,000 (eleven thousand) tons in 1866. Their contract, I believe, is for one-half or two-thirds of all the cryolite mined, and an increase has been made in the force of men at the mines. I have seen very nice soap, that lathers well, made by boiling the caustic soda and aluminate of soda (produced from the cryolite) with fat. I do not know what its detergent qualities are. This is being done on quite a large scale here."

Provincial Science.—We extract the following from the *Birmingham Daily Post* for Dec. 26, 1865:—

"*Preventive for Colliery Explosions.*

"To the Editor of the *Daily Post.*

"Sir,—It is with deep regret I have read of the recent heavy loss of life by explosions in a coal mine near Merthyr Tydvil.

"These dreadful accidents are easily prevented by muriatic acid gas, assisted by an oxygenising process, as steam, which precipitates the sulphur, and the gas cannot then explode.

"It only needs to be maintained in one place.

"Joseph Jones,
"Hutchinson's No. 2, Chemical Works.
"Widnes, near Warrington, Dec. 22, 1865."

Cheap Manufacture of Phosphate of Soda, and its Use in Manure.—We read in *Les Mondes* a statement by M. Dumas that coprolites are now made into phosphide of iron containing from 14 to 15 (?) per cent. of phosphorus. This is done by heating the coprolites with iron ores in a reverberatory furnace. The phosphides so obtained are sent to Paris and treated with sulphate of soda, by which sulphide of iron and phosphate of soda are formed. The phosphate of soda and some magnesian salts are mixed with the contents of cesspools, whereby an ammoniaco-magnesian phosphate is produced, and all the ammonia and phosphates in the urine and fœcal matters are fixed. This plan of treatment is the invention of M. Boblique.

Petroleum from America.—The quantity shipped to England this (1865) year has been but 5790 tuns, against 15,455 in 1864, and 29,272 in 1863.

Methylated Spirit in "Brandee" and "Whiskee."—Mr. J. A. Bell, chemist and druggist, of Preston, and well known throughout the North of England as the maker of two curious mixtures, called "Indian brandee" and "Indian whiskee," was charged with having sold a certain liquid containing methylated spirit, whereby he had rendered himself liable to a penalty of 50*l.*, and also for having sold such liquid as and for a beverage, whereby he had rendered himself liable to a penalty of 100*l.* Mr. Lane, supervisor of Excise at Preston, said that on the 3rd of August last he went to Mr. Bell's shop and purchased a pint of his "Celebrated Indian Brandee" and a pint of his "Original and only genuine Old Whiskee, combined with the Grand Stomachic Essence of Hops," for which he paid 12s. Afterwards he sealed up the bottles containing the two mixtures and sent them to Somerset House. In June, 1864, he cautioned Mr. Bell, through his son, against selling methylated spirits, and he had previously been informed that he could not retail them without a licence. Mr. William Harkness, analytical chemist from the laboratory of Somerset House, deposed that he received the two bottles sent by Mr. Lane, and analysed their contents. He first examined the "brandee," and found that it contained 76 per cent. of methylated spirit, the rest of it being treacle and water. The "whiskee" had in it 72 per cent. of methylated spirit, and the rest of it was sugar and water. Both the "brandee" and the "whiskee" were, as he examined them, equal in quality to strong gin highly sweetened, and they were evidently prepared as beverages. In some places "brandee" and "whiskee" were drunk, and they were called the "Teetotallers' nightcap." They were liquids which would both "cheer and inebriate," and they were injurious to health. The "brandee" and the "whiskee" which Mr. Lane gave 12s. for were not worth more than 2s. In his defence Mr. Bell said that he had not had any methylated spirit on his premises for several years; that in making his "brandee" and "whiskee" he used spirits of nitre; that he was allowed by the Inland Revenue authorities to make use of that spirit, and that for anything he knew spirit of nitre might contain methylated spirit. He afterwards applied for the case to be remanded, in order that he might produce his invoices and bring witnesses to show that he did not use methylated spirit in the preparation of his celebrated "brandee" and "whiskee." Mr. Harkness, on being recalled, said that there was not a particle of nitre in the "brandee" and "whiskee" which he analysed. The Bench refused to grant a remand, as Mr. Bell had had his summons ten days, and had plenty of time to produce whatever evidence he wanted. The mitigated penality of 37*l.* 10s. was then imposed upon him.

The Corporation Gas Bill.—The following is a summary of the Bill to be introduced into Parliament by the Corporation, empowering them to supply the City with better and cheaper gas so far as concerns quality and price of the gas. The Corporation are to provide a testing-place in the City, where proper apparatus will be kept for testing the quality of the gas supplied, and a chemical examiner shall be appointed, who, for a fee of 1s. shall at any time, when called upon by a consumer, examine and report to him on the quality of the gas. The following provisions are made as to the brilliancy and purity of the gas to be supplied:—All gas shall be, at the testing-place, of such an illuminating power as to produce from an Argand burner of the description and measurements described, consuming not more than five feet of gas per hour, a light equal to that produced by not less than eighteen sperm candles of six to the pound, each burning at the rate of 120 grains per hour. The Argand burner shall be of the description now known as Sugg's steatite burner, with fifteen holes, and the measurements of the several parts of the burner shall be as follows,—namely, the external diameter of the burner shall be one inch and one-tenth of an inch; the internal diameter thereof shall be half an inch; each of fifteen holes shall be one-twentieth part of an inch in diameter, the chimney shall be seven inches high, and the rest for the gallery which holds the chimney shall be one inch below the top of the burner. A specimen of the burner shall be deposited with the Town Clerk of the City, and shall be open to examination by all persons interested, at all reasonable times, on payment of a fee of 1s. All gas supplied by the Corporation shall be, at the testing-place provided under this Act, of such purity that the gas will not discolour turmeric paper, or paper imbued with acetate of lead, when such paper is exposed to a current of gas issuing for one minute from an orifice one-fourth of an inch in diameter, at a pressure of not less than half an inch of water. Gas supplied by the Corporation shall not at the testing place provided under this Act, contain more than sixteen grains of sulphur in any form in 100 cubic feet of gas; the amount of sulphur therein contained to be estimated by the process known as Dr. Letheby's sulphur test. It is provided that any consumer may complain to two justices of the illuminating power or purity of the gas, and the justices may order the removal of the cause of complaint within a reasonable time specified; a fine not exceeding 5*l.* per day to be inflicted so long as the order is not complied with. The price of the gas consumed by meter shall not exceed 3s. per 1000 cubic feet.

To Clean Tarnished Silver.—Wash the silver over with a strong solution of cyanide of potassium. Simultaneously with the development of a very disagreeable smelling gas, the metal becomes bright, and must be immediately washed with water and dried.—*Erdmann's Journal.*

A Boiler Composition.—Friedrich recommends a mixture of crude pyroacetic acid and aluminous matter as a means of preventing boiler incrustations. He puts so much of the mixture into the boiler as just to redden litmus paper.—*Chem. Centralblatt*, No. 61, 1865, p. 976.

Window for the Illumination of a Photographer's Dark Room.—Obernetter mixes an acid solution of sulphate of quinine with some gum or dextrine, and paints the mixture over a thin sheet of white paper. With this he covers the window panes, and he states that on the brightest day a window so prepared will allow no actinic light to pass.—*Berlin Photograph. Mittheil*, No. 16, 1865.

Alloys of Manganese.[*]—In Germany M. E. Prieger has commercially prepared alloys of manganese with iron or copper possessing valuable properties, and the applications of which are constantly improving in number and utility. To prepare the alloys of iron and manganese (ferro manganese), he made a mixture of pulverised oxide of manganese, charcoal dust (corresponding in quantity to the oxygen of the oxide) and of metallic iron sufficiently broken up, such as minute grains of cast-iron filings or turnings of iron or steel, &c.; the mixture was put into a graphite crucible, which would hold from 15 to 25 kilogr., and covered with a coating of charcoal dust, sea salt, &c., then heated for a few hours at a white heat. After cooling there was at the bottom of the crucible a metallic homogenous mass, containing but very insignificant quantities of foreign bodies. Of these alloys the most important are those containing 2 equivalents of manganese to 1 of iron, and 4 equivalents of manganese to 1 of iron, and corresponding to 66·3 per cent., and 79·7 per cent. of manganese. Both are harder than tempered steel; they are capable of receiving a very high polish, they melt at red heat, and can be easily poured; they do not oxidise in the air, and even in water only superficially; their white colour is of a shade between steel and silver. Alloys of copper and manganese are similarly obtained; they resemble bronze, but are much harder and more durable. Alloys of tin are very fusible, durable, and easy to work; in colour and brilliancy they may be compared to silver. The iron and manganese alloy furnishes a very simple means of adding to iron or steel a given amount of manganese; by the addition of from 1·10 to 5 per cent. very satisfactory results are obtained.

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. XII. 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. XIII. commenced on January 5, 1866, and will be complete in 26 numbers.

A. B.—Sugg, gas engineer, Marsh-gate, Westminster, gives every explanation.

Titanium.—From reports which have reached us, we do not believe that titanium receives any technical application at Birmingham.

Clericus has not furnished us with the correct reference to the experiment he wishes explained.

R. Campbell, jun., Canada.—Received with thanks.

Received.—"Report on Water for Locomotives and Boiler Incrustations," by Chas. F. Chandler, Ph.D., New York.

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[*] *Deutsche Industrie-Zeitung*, clxxxv., 184.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

*Researches on the Volatile Hydrocarbons,** by C. M. WARREN.

(Continued from Vol. xii., page 292.)

Hydrocarbons from Oil of Cumin and Cuminic Acid.—The oil of cumin employed in this research was obtained from Büthrer, of Leipsic, and answered in all physical properties, odour, colour, &c., the description of the oil given by Gerhardt and Cahours. Its behaviour in distillation left no doubt of its being a genuine article; and this was afterwards confirmed by treatment of the cuminole with fused potash, for the production of cuminic acid, its comportment with this reagent being in all respects identical with that described by Gerhardt and Cahours. Subjected to repeated series of fractionings by the process described before (*ante* pp. 98 and 99, vol. xii.), it gave, in addition to cymole and the residue of cuminole, a body boiling at about 155°, which so closely resembles oil of turpentine in odour, &c., as to be hardly distinguishable from the latter substance. The presence of this body may account for the very low boiling-point which Gerhardt and Cahours assigned to cymole, viz., 165°. The boiling-point of cymole was subsequently found by Gerhardt to be 175°, but my own determination places it still lower by about 5°. It is evident, therefore, from a comparison of their own determinations, that the oil of cumin which they originally operated upon contained an oil boiling below cymole; and hence the finding of such an oil in that which I employed need not raise a doubt as to its being genuine. This lighter body is present in so small a quantity as hardly to admit of its being detected, or at least identified, by the old process of fractioning; and its detection and isolation by the new process is but another illustration of the superior excellence of this method.

I. Of the Oil Resembling Oil of Turpentine.—Sp. gr., 0·8772 at 0°, and 0·8657 at 15°. The quantity of material at command was too small to admit of attaining so high a degree of purity for this body as was desirable. The product obtained, however, distilled to dryness between 153·4° and 155·5°. Taking the average of these observations and applying the usual corrections we obtain 155·8° for the boiling point of this body.

Analysis.—0·2575 gramme of the substance gave, by combustion with oxide of copper, 0·8283 of carbonic acid, and 0·2766 of water.

		Calculated.		Found.
Carbon	C_{20}	120	88·24	87·73
Hydrogen	H_{16}	16	11·76	11·94
		136	100·00	100·00

Density of vapour found . . 4·7281
Theory $C_{20}H_{16}$=4 volumes . 4·7028

Excess found . . . . 0·0253

The calculated density on the formula $C_{20}H_{14}$ is 4·635, which, compared with the density found, would increase the excess to 0·093. Although the determination agrees almost exactly with the calculated density on the formula $C_{20}H_{16}$, the calculation on the formula $C_{20}H_{14}$ does not show a greater variation from the density found than we have observed to be quite frequent with hydrocarbons of so high boiling-point; so that it may be questionable which of these formulæ is the true one. I cannot regard the determination of a vapour density as reliable for fixing the formula nearer than within two equivalents of hydrogen. In the absence of opposing evidence, it will be wiser, however, to take the formula which agrees best with the results of experiment; at least until it shall be shown that the discrepancy between the calculated and observed vapour densities of bodies of high boiling point, which appears to be so frequent, is nearly constant, or variable by some fixed law, by which the amount of the error, in any given case, may be pretty nearly estimated. I shall therefore regard the body as having the formula $C_{20}H_{16}$, which is also better supported by the results of analysis. On account of its source and close resemblance to oil of turpentine, I can think of no better appellation for this body than *cumo-oil of turpentine:* thus adding another to the long list of isomers of the former substance, the chemical relations of which stand in so much need of being further studied.

Cumole.—This body was first obtained by Gerhardt and Cahours, by the dry distillation of six parts of crystallised cuminic acid and twenty-four parts of caustic baryta. Abel obtained the same by substituting lime for baryta. His product, however, was found to boil 4° above that of Gerhardt and Cahours. My preparation was made by the use of lime. Although the results of my experiments confirm those of Gerhardt and Cahours as to the composition of the body, the numerical results differ considerably. I have also observed some new facts regarding the formation of this body. They have described the reactions between baryta and cuminic acid as much more simple than my experiments seem to indicate. They remark—"The formation of cumene is easily explained. The cuminic acid being represented by $C_{40}H_{20}O_4$, it appears that C_2O_4, or two equivalents of carbonic acid are retained, by the baryta, while $C_{34}H_{24}$ are set free."† In another place (p. 88) they say, "that by suitably managing the heat, and employing no more than 6 grm. of cuminic acid, no other products are ever obtained than those we mention." My experiments show that the reaction is by no means so simple. The crude product from the lime and cuminic acid, when submitted to a simple distillation, was found to distil between 125° and 250°, leaving a residue, at the latter temperature, which became semi-fluid on cooling. The distillate thus obtained gave by my process of fractioning an oil boiling at 151·1°, and a residue at 170°. It is not improbable that the latter may prove to be mostly cymole, $C_{20}H_{14}$; but the quantity was too small to admit of deciding the question. There is evidence, however, that the product obtained by Gerhardt and Cahours was not simply pure cumole, but a mixture of different bodies. Gerhardt and Cahours found the boiling point of their cumole to be constant at 144°. Four years later Gerhardt made a more accurate determination, and found its boiling point to be 9° higher—viz., 153°, which is but 2° higher than my own determination. The disagreement between their determinations may be accounted for by supposing that in the first instance they operated on a mixture of different bodies, and yet I cannot see how they could have obtained the product boiling below 150°. Additional evidence on this point will be found in the discrepancy between their determination of the vapour-density and that calculated on my theory.

The specific gravity of my preparation of cumole was 0·8792 at 0° and 0·8675 at 15°.

The preparation had not a constant boiling point, the distillation ranging from 148·4° to 151·6°. Applying the proper corrections to the mean of these observations, we

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* Abridged from the Memoirs of the American Academy.

† *Annales de Physiq. et de Chimie*, 1841, p. 89.

have 151·1° for the boiling point of cumole, which is doubtless a little too high. If the boiling point difference between cumole and cymole, for the difference C_2H_2 in their elementary formulæ is 30°, as there is every reason to believe, then the boiling point of cumole should be 150°, as I have found the boiling point of cymole to be a fraction under 180°.

Analysis.—0·11700 grm. of cumole gave, by combustion with oxide of copper, 0·563 of carbonic acid, and 0·1557 of water.

		Calculated.		Found.
Carbon . .	C_{18}	108	90·00	90·35
Hydrogen .	H_{12}	12	10·00	10·18
		120	100·00	100·53

Density of vapour found . .	4·2003
Theory, $C_{18}H_{12} = 4$ vols. .	4·151

This determination, and the results of the analysis confirm the formula of Gerhardt and Cahours. I had anticipated a different result, inasmuch as the hydrocarbon from coal tar naphtha which I have called *iso-cumole*, boiling at 170°, or nearly 20° higher than the cumole from cuminic acid—had been found to have the formula $C_{18}H_{12}$. I am forced, therefore, to the conclusion that these two bodies are isomeric, and belong to different series. A preliminary examination of their behaviour with reagents indicates that their chemical properties are also different. This will be treated of on a future occasion.

Cymole.—Notwithstanding that this body is so much more volatile than the cuminole with which it is associated in oil of cumin—there being a difference of 40° between their boiling-points—Gerhardt and Cahours found it necessary to resort to chemical means—viz., treatment with fused potash, in order to isolate it. Being desirous of testing the efficiency of my process of fractional condensation, the preparation employed in this investigation was obtained by that process which was found as effective in this as in other cases. This will appear by a comparison obtained in the study of this body before and after treatment with concentrated sulphuric acid, which is also effective to remove cuminole.

Specific gravity at 0°	before treatment with	$HOSO_3$		0·8697
„	after	„	„	0·8724
„	14° before	„	„	0·8592

The preparation before treatment with sulphuric acid distilled to dryness between 175·8° and 177°. The temperature was absolutely constant at 176° for ten minutes, and occupied fifteen minutes in rising from 176° to 176·5°. Taking the mean, and applying the corrections, we obtain 179·5° for the boiling point of cymole.

No essential change in the boiling-point was produced by the treatment with sulphuric acid; nevertheless, some impurities were removed as the first portions of the acid became dark coloured.

Analysis before Treatment with $HOSO_3$.—0·1589 grm. of cymole gave by combustion in a stream of oxygen 0·52 of carbonic acid and 0·1532 of water.

		Calculated.		Found.
Carbon . .	C_{20}	120	89·55	89·25
Hydrogen. .	H_{14}	14	10·45	10·71
		134	100·00	99·96

After treatment with HO,SO_3, and distillation in vacuo 0·1623 grm. gave by combustion in a stream of oxygen 0·5324 of carbonic acid and 0·1561 of water.

Carbon	C_{20}	89·46
Hydrogen . . .	H_{14}	10·68
		100·14

The removal of impurity by sulphuric acid had, therefore, hardly a sensible effect on the results of analysis.

Density of vapour found before treatment with $HOSO_3$. . . .	4·742
Density of vapour found after treatment with $HOSO_3$	4·7536
Difference	0·0116
Theory $C_{20}H_{14} = 4$ vols. . . .	4·6351

A comparison of the above results with those obtained in the study of isocumole, the body from coal-tar naphtha boiling at 170°, will show that the two bodies are far from being the same substance as Mansfield assumed, and that they have a constitutional difference of C_2H_2, and, therefore, doubtless belong to different series.

(To be continued.)

Note on the Danger Attendant on the Preparation of Potassium-ethyl and Potassium-methyl. By J. ALFRED WANKLYN.

IN the preparation of the compounds of sodium with ethyl or methyl there is comparatively little to fear—at any rate, if moderate quantities only be prepared at one operation.

But there is the greatest danger in preparing the potassium compounds. When the replacement of the zinc by the alkali metal proceeds briskly, there is a considerable rise of temperature both in the case of sodium and potassium. From the low temperature at which potassium fuses, it very easily happens that the potassium fuses, and when once this occurs a most tremendous explosion is the immediate result.

London Institution.

Organic Chemistry, by Professor A. W. WILLIAMSON, *F.R.S.*

(*Extracted from "Chemistry for Students."*)

MANY acids, bases, and neutral compounds are usually obtained from plants or animals, to whose organism they belong. Thus citric acid is prepared from lemons; tartaric acid, from grapes; formic acid, from ants; albumen, or gelatin, from animals; sugar, starch, gum, resin, and essential oils, &c., from plants; quinine, morphine, &c., also from plants. These substances were called "organic" to denote their origin in living organisms.

Other substances are made from materials derived from animals or plants, and not from mineral materials, such as those which are employed for the formation of inorganic compounds. Thus oxalic acid is usually made from starch or from woody fibre, and formic acid from oxalic; alcohol is made from sugar, and olefiant gas is made from alcohol; acetic acid is also made from sugar, and acetone or marsh gas are made from acetic acid; lactic acid or butyric acids are made from sugar; glycerine is made from fats, and propylene is made from glycerine. The term "organic" has been extended to these bodies, inasmuch as they come from animals or plants, although not directly like the first-named class, but indirectly.

All of these bodies, whether themselves extracted from vital organisms, or derived from others so extracted, are found to contain carbon, and most of them contain hydrogen and oxygen also. Not a few contain nitrogen, in addition to carbon, hydrogen, and oxygen. All of them are destroyed by the action of a high temperature, for they pass over into other compounds usually termed products of destructive distillation, which do not, on cooling, return to the state of combination in which they occurred in the organic compounds.

Thus wood, when distilled, yields a mixture of various gaseous compounds, accompanied by tarry matter and acetic acid, acetone, methylic alcohol, benzole, &c.; while carbon is left behind in the retort in which the wood was heated; and it is impossible to re-unite these various products so as to recover the woody fibre from which they were made.

Some mineral substances are, no doubt, also decomposed by heat, forming products of decomposition which are unable to re-unite on cooling so as to re-produce the compound whose decomposition gave rise to them. Thus pyrites gives off, when heated, some of the sulphur contained in it, and the lower sulphide which is left does not combine with the free sulphur to re-produce pyrites. Silver oxide is decomposed by heat into metallic silver and oxygen, and these products do not re-combine on cooling.

Ammonia is decomposed by a strong heat into a mixture of free nitrogen and hydrogen, which does not re-combine on cooling.

On the other hand, the greater number of decompositions, and other changes of mineral bodies, effected by the action of rise of temperature are reversed by mere cooling. Thus, common phosphoric acid (trihydric phosphate) decomposes when heated, forming water and hydric phosphate; but the two bodies re-combine if put together in the cold. Calcic hydrate is decomposed by heat into lime and water; but the products unite again to form the original hydrate as soon as they are brought together. Hydrosodic sulphate is decomposed by heat into sodic sulphate and hydric sulphate, but if the products be left together in the cold, they re-unite to form the original double salt. Hydric sulphate itself is believed to decompose, on evaporation, into water and anhydrous acid; but these bodies combine again to form the original sulphate during the process of cooling. Mineral compounds are expanded by heat, and many are transformed by rise of temperature into liquids, and these in their turn, by still further heating, into vapours; but, on cooling, the vapour contracts and condenses to the original liquid. This, in its turn, returns, on sufficient cooling, to the original solid state.

The difference between organic and inorganic compounds with respect to heat may be thus summed up:—That, whereas all organic bodies are decomposed by heat, the great majority of mineral bodies are not permanently decomposed by it.

Organic molecules are more complicated in their structure than mineral compounds, and this characteristic distinction between the two great divisions of chemistry has been admirably embodied in Liebig's dictum —"Organic chemistry is the chemistry of compound radicals." Nothing, indeed, is more remarkable than the extension which the theory of radicals has undergone of late years, side by side with the extension of our knowledge of organic bodies, and organic bodies are only explained by showing what radicals they contain. If compound radicals belonged only to organic bodies, this circumstance would afford us a very simple distinction between organic and mineral chemistry, but the distinction, although quite real, is not absolute.

In organic chemistry we have mainly to do with compound radicals which act like elements; whereas in mineral chemistry we meet with elementary bodies uniting in their individual capacity, as well as groups of elements which act like elementary atoms. Thus metallic oxides, sulphides, bromides, iodides, nitrides, phosphides, find no parallel in organic chemistry, while metallic nitrates, sulphates, phosphates, &c., may be compared to the metallic acetates, tartrates, citrates. In the formula $AgNO_3$ for argentic nitrate we may consider that NO_3 is a radical just as much as in argentic acetate the group $C_2H_3O_2$; for when a molecule of the nitrate is decomposed by potassic chloride the silver takes up an atom of chlorine in lieu of its atom the radical NO_3, and when acetate is decomposed by potassic chloride, the radical $C_2H_3O_2$ changes places with chlorine.

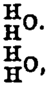
So also a sulphate H_2SO_4 undergoes double decompositions analogous to those of a succinate $H_2C_4H_4O_4$, and SO_4 is the diatomic radical of the sulphate just as much as $C_4H_4O_4$ is that of the succinate. H_2SO_4 may be compared to hydrochloric acid, or, in other words, represented in the type of hydrochloric acid, by considering it as formed from two molecules of hydrochloric acid (H_2Cl_2) by removing the two chlorine monads and replacing them by the dyad SO_4; and in like manner succinic acid may be represented on the hydrochloric type by calling it two molecules of hydrochloric acid, in which the dyad $C_4H_4C_4$ replaces two chlorine monads.

For many purposes it is more convenient to represent the arrangement of the elements of these molecules on the type of water—

$$\begin{array}{l}H\\H\end{array}O,$$

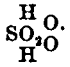
and they must then be considered as containing radicals differing from these by having two atoms less of oxygen in their composition. Thus the sulphates viewed on the water type contain the dyad SO_2, which replace two atoms of hydrogen in two molecules of water, half of it being in the place of an atom of hydrogen which has left one molecule of water, the other half of it being in the place of an atom of hydrogen which has gone out from the second molecule of water.

Thus the two molecules may for convenience be written thus—



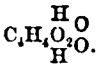
$$\begin{array}{l}H\\H\end{array}O.\quad\begin{array}{l}H\\H\end{array}O,$$

and hydric sulphate has got the dyad SO_2 in the place of the two middle atoms of hydrogen, thus—



$$\begin{array}{c}H\\SO_2\\H\end{array}\begin{array}{l}O.\\O\end{array}$$

In like manner the two succinates contain the dyad $C_4H_4O_2$ in the place of two atoms of hydrogen; one from one molecule of water, one from another; thus—



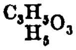
$$\begin{array}{r}H\\C_4H_4O_2\\H\end{array}\begin{array}{l}O\\O.\end{array}$$

In salts consisting of organic acids combined with metallic bases, these latter are really the inorganic part of the compound; and in like manner organic bases combine with mineral acids, such as hydrochloric, sulphuric, &c., but in these salts the really organic part is the radical which acts the part of basic metal.

Thus the radicals methyle (CH_3), ethyle (C_2H_5), propyl (C_3H_7), and others of this series, are really the hydrogens of organic chemistry; and their salts, such as methylic chloride (CH_3Cl), vinic chloride (C_2H_5Cl), &c., correspond to the mineral chlorides containing monatomic metals.

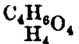
Other radicals, such as ethylene (C_2H_4), propylene

(C_3H_6), &c., are dyads, like zinc, barinm, &c., and form chlorides, bromides, nitrates, &c., of which each molecule contains two atoms of chlorine, bromine (NO_3), &c., (such as $C_2H_4Br_2$,$C_3H_6Br_2$, like $ZnBr_2$ or $BaBr_2$). Nor does the analogy stop here, for there are also triatomic and tetratomic radicals, and others of still higher atomicity in organic chemistry corresponding to triatomic antimony, tetratomic tin, &c. Glycerine affords an illustration of organic compound containing a triatomic radical, replacing three atoms of hydrogen in three atoms of water. Its empirical formula is $C_3H_8O_3$, and its reactions and decompositions prove it to contain the triad glycerile C_3H_5, thus,—



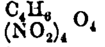
$$\begin{matrix}C_3H_5\\H_5\end{matrix}O_3$$

Erithrite is a compound of a tetratomic-radical of the composition C_4H_6. This radical replaces four atoms of hydrogen in four molecules of water, forming

Erithrite 

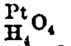
$$\begin{matrix}C_4H_6\\H_4\end{matrix}O_4$$

The nitrate of this basic body is formed by replacing the hydrogen, not belonging to the radical but to the water, by the radical NO_2. Its formula is



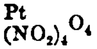
$$\begin{matrix}C_4H_6\\(NO_2)_4\end{matrix}O_4$$

just as platinic nitrate corresponds to the platinic hydrate



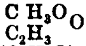
$$\begin{matrix}Pt\\H_4\end{matrix}O_4$$

the hydrogen being replaced atom for atom by NO_2, forming

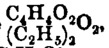


$$\begin{matrix}Pt\\(NO_2)_4\end{matrix}O_4$$

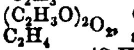
On the other hand, organic chemistry abounds in compounds of basic radicals with chlorous radicals, such as

Methylic acetate 

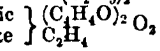
$$\begin{matrix}C\,H_3O\\C_2H_3\end{matrix}O,$$

Vinic succinate 

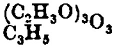
$$\begin{matrix}C_4H_4O_2\\(C_2H_5)_2\end{matrix}O_2,$$

Glycollic acetate 

$$\begin{matrix}(C_2H_3O)_2\\C_2H_4\end{matrix}O_2,$$

Glycollic succinate 

$$\left.\right\}\begin{matrix}(C_4H_4O)_2\\C_2H_4\end{matrix}O_2$$

Acetine 

$$\begin{matrix}(C_2H_3O)_3\\C_3H_5\end{matrix}O_3,$$

&c.; and these bodies, built up entirely of compound radicals, are most characteristic of organic chemistry, and entitle that branch of the science to the definition which Liebig gave it.

It will be understood from these few examples that the constitution of organic compounds is more complicated than that of mineral compounds, and that organic compounds present greater varieties of property than mineral bodies. Thus alcohol is in organic chemistry the representative of water in mineral chemistry; but, instead of being the only body of its kind, alcohol is one term of a numerous series, varying in composition from CH_4O to $C_{30}H_{62}O$, and presenting properties as different as their compositions. Some alcohols are volatile fluids, which have not been frozen by the greatest artificial cold to which they have been subjected; whereas, others are solid wax-like bodies, fusible only at temperatures approaching the boiling-point of water, $C_{30}H_{62}O$ melts at 85°.

The formation of most organic compounds such as sugar, woody fibre, quinine, albumen, &c., is effected in the organism of growing plants under the influence of sunshine, and chemists for some time did nothing more than extract these products from vital organisms, and break them up into the simple products, carbonic acid, ammonia, and water, from the elements of which they were built up, or break them up less completely into products of simpler constitution than themselves, yet more complex than the ultimate products of combustion. Thus by the action of nitric acid on sugar $(C_6H_{10}O_5)$ carbonic acid and water are obtained by a process of combustion at the expense of the oxygen of the acid,—

$$C_6H_{10}O_5 + (HNO_3)_{12} = (CO_2)_6 + (HNO_2)_{12} + (H_2O)_5.$$

But by moderating the action of the acid, and using less of it, oxalic acid was prepared,—

$$C_6H_{10}O_5 + (HNO_3)_9 = (C_2O_4H_2)_3 + (HNO_2)_9 + (H_2O)_2.$$

By using still less of the oxidising agent, tartaric acid is obtained, together with a smaller quantity of oxalic acid,—

$$C_6H_{10}O_5 + (HNO_3)_6 = C_4H_6O_6 + C_2O_4H_2 + H_2O + (HNO_2)_6.$$

and by moderating still further the oxidising action, a substance, called saccharic acid is obtained—

$$C_6H_{10}O_5 + (HNO)_3 = C_6H_{10}O_8 + (HNO_2)_3.$$

This saccharic acid is easily oxidised to tartaric acid, and thence to oxalic acid; and oxalic acid in its turn is easily oxidised still further to form carbonic acid—

$$C_6H_{10}O_8 + (HNO_3)_6 = (C_2O_4H_2)_3 + (HNO_2)_6 + (H_2O)_2\,;$$
$$(C_2O_4H_2)_3 + (HNO_3)_3 = (CO_2)_6 + (HNO_2)_3 + (H_2O)_3.$$

Saccharic, tartaric, and oxalic acids were classed among organic compounds because we had only made them by such processes as the partial decomposition of sugar; and oxalic acid was not considered the less entitled to rank among organic compounds, from the fact that it was often made from the acid juice of the sorrel.

Later researches, however, showed that oxalic acid can be built up artificially without the presence of any plants, and from inorganic materials. Thus nitrogen gas passed over a hot mixture of carbon and sodic carbonate forms sodic cyanide (NaCN), while carbonic oxide escapes. From this sodic salt, it is easy to prepare mercuric cyanide; and this, when heated, gives off cyanogen gas. Cyanogen dissolves readily in water, and the two compounds gradually decompose one another, forming, amongst other products, ammonia oxalate—

$$(CN)_2 + (H_2O)_4 = C_2O_4(NH_4)_2\,;$$

from which hydric oxalate is liberated by a mineral acid.

By the action of sodium on oxalic ether, Löwig has obtained an acid, which he calls desoxalic acid; and desoxalic acid breaks up into one kind of tartaric acid and carbonic acid.

Alcohol is another product classed among organic bodies from the fact of its being obtained by a partial breaking up of sugar. For under the influence of growing yeast grape sugar breaks up partly into carbonic acid and alcohol—

$$C_6H_{12}O_6 = (C_2H_6O)_2 + (CO_2)_2.$$

But Berthelot has shown that alcohol can be built up artificially from its elements. He first makes acetylene (C_2H_2) by discharging a galvanic battery in an atmosphere of hydrogen by carbon points. This acetylene he combines with copper, and he then brings it in contact with nascent hydrogen, thereby forming ethylene (C_2H_4); and ethylene he combines with oil of vitriol, forming the compound $C_2H_6SO_4$, from which alcohol is liberated by dilution with water and distillation.

Urea is another compound first obtained only from an organic source, but subsequently prepared from mineral materials. The number of organic compounds which we have learnt how to build up by inorganic processes is already very great, and additions are constantly being made to it; so that it is no longer customary to apply the term "organic" only to those compounds which are derived directly or indirectly from plants or animals. Some compounds which were originally considered as organic are now usually studied among mineral compounds, and there seems a tendency in organic chemistry to continue this encroachment on the domain of organic chemistry; but the general distinction between the two parts of the science is not the less real nor the less marked.

The formation of complex molecules, such as sugar, albumen, &c., together with free oxygen, from carbonic acid, ammonia, and water, are, however, not the only results of the vital processes of plants; for there are processes of partial breaking up of complex organic molecules into less complex molecules by the agency of growing plants, analogous to the cases of partial breaking up which are effected by artificial means. Thus the fermentation of sugar is a transformation of its complex molecules into a variety of simple molecules, of which the best known are alcohol, carbonic acid, glycerine, succinic acid; and this process has been shown by the admirable investigations of Pasteur to be due to the growth of the so-called yeast or ferment, a plant which lives upon sugar, and gives off this variety of simpler molecules by decomposition of the sugar. In like manner the formation of acetic acid from alcohol or from sugar in contact with the air, is effected by another plant called mycoderma aceti.

Another ferment, called penicillium glaucum, transforms sugar into lactic acid, if a base be present with which the acid can combine; and the lactate thus formed is in its turn decomposed by another process of fermentation, giving rise to butyric acid, carbonic acid, hydrogen gas, &c. Under certain conditions sugar is broken up by a process of fermentation into mannite and a kind of gum. As far as researches have gone as yet into this most important class of phenomena, it would appear as if a great variety of elementary plants and infusoriæ were capable of effecting transformations of organic bodies by processes of fermentation or putrefaction, and that each little organism has a sphere of action peculiar to itself, being capable of decomposing particular organic compounds only. Thus calcic tartrate in presence of atmospheric oxygen serves as food for monads, bacteriums, &c., which evolve carbonic acid. If, however, oxygen be excluded from the mixture these infusoriæ die off, and vibrios are developed from germs in the liquid, and grow during the decomposition of the tartrate, and no doubt at its expense.

Water containing sugar, ammonia salts, and the ashes of yeast soon becomes inhabited by various lower forms of living beings if merely exposed to the atmosphere. In like manner other mixtures capable of undergoing fermentation are found to contain infusoriæ and fungi, &c., after exposure to the air for some time.

On the other hand, Pasteur has shown that all germs of organic life in such a mixture are destroyed at a temperature of about 130°, and that the liquid may then be kept for any length of time without undergoing fermentation or putrefaction of any kind.

Moreover, no fermentation or putrefaction is started in such a liquid by air which has been passed through a red-hot tube, or which has been strained by passing through a tube filled by a porous plug of cotton wool or of gun-cotton. In both of the cases the air is freed from all germs or seeds, &c., and it is found incapable in setting up the process of fermentation or of putrefaction in any liquid previously deprived of all germs of organic beings.

On the other hand, it has been shown by Pasteur that the dust strained off from the air by the cotton is sufficient to set up a process of decomposition of any suitable liquid, and that infusoriæ and fungi, &c., are found to be in active growth in the liquid during the whole continuance of its fermentation. By examination under the microscope the dust was, moreover, found to contain, besides the various earthy and woody particles, &c., little cellular masses precisely similar in appearance to the spores of fungi, &c.

In course of these investigations it was found that the germs of animal life contained in milk (an alkaline liquid) are not destroyed by boiling at the ordinary atmospheric pressure. They were, however, completely destroyed by boiling the milk at a pressure of about 1140 millimetres (1·5 atmospheres), and the milk could then be kept for an indefinite time in a closed vessel without undergoing any decomposition.

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 4.

Tuesday, April 25, 1865.

On some of the Discoveries in Agricultural Chemistry.

I SHALL in this lecture follow the same plan as I observed in my last (No. 3), taking a general view of the subject under consideration, and introducing as I proceed some of the most important discoveries which have been published of late on each particular subject. By adopting this plan, I shall, on the one hand, avoid publishing a mere review of the results obtained, and, on the other, I shall be enabled to give a general outline of the views entertained by most chemists of the present day on the subject of Agricultural Chemistry. You will also be better prepared to appreciate the value of the important discoveries made by our own countrymen, who, I am happy to say, are not surpassed in that branch of applied chemistry by any other class of chemists existing on the Continent.

The largest number of organic substances are composed of only three elements or simple bodies—viz., carbon, hydrogen, and oxygen—and even in many the latter substance is absent; for example, in many essential oils and the products resulting from the destructive distillation of organic substances, whilst those which contain oxygen are chiefly represented by starches, gums, resins, organic acids, and fixed oils. Another class, such as morphine, quinine, and indigo, contain nitrogen, in addition to the substances mentioned. There is another class of substances, limited in number, which contain sulphur and phosphorus besides the four elements above cited. These are represented by albumen (corresponding to the white of an egg or the serum of blood in animals), fibrine (represented in animals by the clot of blood), caseine (characterised in animals by the curd of milk). Therefore the whole of the organic matter of the vegetable kingdom is represented by the uniting together in various portions (influenced by particular molecular arrangements) of six elements—viz., carbon, hydrogen, oxygen, nitrogen, sulphur, and phosphorus.

Although organic matters are composed of two or more of these elementary substances, they are never found in vegetable matters in their pure and isolated condition. They are always combined with a certain quantity of mineral matters which appear essential to the healthy condition of plants, and are, so far as we know, essential to the formation of the organic bodies themselves. Thus chemists have ascertained that plants generally contain lime, potash, soda, magnesia, oxide of iron, sulphuric acid, phosphoric acid, &c.

Let us examine the principal sources from which plants derive the elements essential to their formation, growth, or healthy progress. The most important element of all vegetable substances, and which, in fact, characterises all organic matter, is carbon, or what is commonly called charcoal. This element is derived entirely in vegetables from a colourless, invisible, and slightly acid gas, having a specific gravity of 1·52, and also sparingly soluble in water—I mean carbonic acid. You will easily conceive, on reflection, what an enormous proportion of carbonic acid must be produced annually, when you consider the vast amount of vegetation which surrounds us, produced either by the hand of man, under the influence of the plough, and other instruments, or by the rapid growth of trees and other vegetation which covers our hills and mountains. In truth, the Divine Being has provided for an abundant supply, for there exist many sources of production of this gas so necessary to vegetation. It is useless to record here the well-known modes of producing this gas by respiration and combustion, but I wish to call your attention to some more special sources of its production with which you may not be so perfectly acquainted. M. F. Kulhmann, a well-known chemist, published in 1861 and 1862 a most interesting series of papers on the production of carbonic acid through the oxidation and reduction of the oxides of iron by their contact with organic matter. Thus, he found that, if he took a clod of earth, the bulk of the iron existing on its surface was in a state of peroxide, mixed with a small quantity of protoxide, whilst towards the interior of the soil the reverse was observed. M. Kulhmann thus found that the oxygen of the oxide of iron was conveyed to the organic matter to convert it into carbonic acid. He further made the remark that sulphate of lime was, as M. Chevreul had already observed, a powerful oxidising agent, or served as a conveyor of the oxygen of the atmosphere to the organic matter existing in soils, the sulphate of lime becoming converted into sulphuret of calcium. These results explain certain facts observed by two learned chemists, MM. Boussingault and Loewig, who found that there existed large quantities of carbonic acid in cultivated soils, and especially in those that were highly manured, and that the production of this gas was continuous and most abundant. The following table, taken from their researches, will satisfy you, I hope, of the correctness of the above assertion :—

Carbonic Acid.

Air	0·4
Recently manured soil	54·6
,, ,, ,,	235·3
Vineyard	282·4
Forest loam.	70·6
Forest land	88·2
Soil rich in manure	420·6
Meadow	161·8

Another source of the production of carbonic acid gas is one lately pointed out by a gentleman whom I cited last year with great, but not exaggerated praise, as a successful demonstrator of the untruth of the theory of spontaneous generation. M. Pasteur has demonstrated that wherever there is decay there is life—that, in fact, the rapid decay of organic matter depends in a great measure on the existence and maintenance of microscopic beings, and, as I stated in my last year's lecture, death is life. For M. Pasteur has shown that in all decaying matter exposed to the atmosphere there exist mycoderms which carry the oxygen of the atmosphere to the organic matter, converting its carbon into carbonic acid, its hydrogen into water, its sulphur into sulphuric acid, its phosphorus into phosphoric acid. As to its nitrogen, other chemical actions come into play. There is still another source of production of carbonic acid which I cannot pass by in silence; for though at the present day its activity is decreased by the better cultivation of land, its influence must have been very great when men were less numerous on the surface of our planet, and no doubt, even now, that source of production of carbonic acid plays a great part in the vegetation of wild forests, such as those of Northern and Southern America. Dr. Lyon Playfair, Mr. J. A. Ransome, and M. Morin, proved some years since that certain small vegetable substances, known under the names of confervæ and algæ, had the property, under the influence of light, of decomposing carbonic acid; while, on the contrary, in diffused light or darkness they yield carbonic acid. Strange it is to think that often some of the trees of these wild forests carry on their surface or their bark the vegetables which are to destroy them by absorbing their sap, and to feed them by liberating the carbonic acid essential to their growth. As to the confervæ, which exist in marshy lands, pools, and other stagnant waters, they disappear by the hand of man as he drains the land and improves it for agricultural purposes. Notwithstanding the abundant sources of the production of carbonic acid, the atmosphere appears to contain but a minute quantity, viz., four parts in 10,000. This fact may be regarded as owing, first, to a law discovered by Dalton of the extraordinary property which gases have of being diffused and mingling together; secondly to the immensity of the atmosphere as compared even with the abundant sources of carbonic acid; thirdly, to its removal by constant vegetation, either on land or in the ocean; fourthly, that a great portion of the carbonic acid which is produced in the interior of soils is absorbed by the spongelets of plants. Liebig calculated, some years since, that if our sources of production of carbonic acid were to cease, and the present state of vegetation on the surface of our planet still continued, there was a sufficient amount of carbonic acid in the atmosphere to maintain it in full activity for a great number of years. As to the decomposition of carbonic acid by the leaves of plants under the influence of the chemical rays of light—scientific points which have engaged the attention of many chemists, among whom I may cite Boussingault, Dr. Gladstone, Grinwenden, and others, it is unnecessary that I should do more than state that the carbon of the carbonic acid is retained by the plant, and contributes to produce the organic matters which form the frame of it, whilst the oxygen is liberated in a pure state to contribute again to the reproduction of carbonic acid by fixing itself on the carbon of decaying matter, or that which is produced by combustion or animal respiration.

Nitrogen.—The absorption and fixation of nitrogen in plants are of the highest importance to vegetation, and no subject has more engaged the attention of chemists and agriculturists than the ascertaining how nitrogen was supplied to plants; for if the quantity of nitrogen is found but in small quantities in plants, still its supply to vegetation is essential to the growth and health of those plants. The quantity of nitrogen that a plant requires is but small; but still, as it is an essential element in the formation of nitrogenated substances, and as these are always found most abundant in all newly-formed vegetable matters, such as the germ from the seed or the sprout of the plant, nitrogen must be freely supplied by the agriculturist if he wishes to obtain an abundant crop.

Liebig's publications of 1841, proving the identity of the nitrogenated substances of plants, such as albumen, fibrine, caseine (legumine), with those existing in animals, and the exaggerated views entertained by Boussingault and Payen on the value of manures in accordance with the quantity of nitrogen they contain, led many chemists to investigate whether the nitrogen which plants require for the production of these nitrogenated substances was derived either from the atmosphere in its gaseous form, or from ammonia or nitric acid existing also in the atmosphere or in the soils in which the plants grew. An animated discussion, based upon a long series of researches, ensued between Boussingault and Ville, the latter contending that plants could absorb nitrogen from the atmosphere and fix it as a part of their organism; the former contending that the nitrogen contained in plants was derived either from ammonia or nitric acid. This discussion was still proceeding when Mr. Lawes and Drs. Gilbert and Pugh published, in the "Memoirs of the Chemical Society of London," 1863, such a complete and elaborate series of researches that chemists came to the conclusion that the nitrogen existing in plants was not derived from the atmosphere as nitrogen. There can be no doubt that the general tendency of scientific as well as practical investigation, as above stated, proves that it is most probably under the form of nitric acid, or more so in a state of nitrates, that nitrogen penetrates into plants, and becomes one of the essential elements of the formation of albumen, fibrine, legumine, or other nitrogenated substances which are found existing in vegetables. We shall as we proceed go more deeply into these interesting data, connected not only in a scientific point of view with agriculture, but having a most important bearing on its practical progress; and to give you here only one example of the importance of the subject under consideration, I may be allowed to cite the thousands of tons of guano which have been imported into this country with a view of supplying to plants the nitrogen they require for active vegetation. In fact, so much importance was attached some twenty years ago to the presence, and more so to the amount, of nitrogen in a manure, that the whole of its commercial value was based upon the real amount of nitrogen it contained; and though in the present day these views have been greatly modified by the publications of Liebig, which have shown that for the healthy growth of plants certain mineral matters are essential, and if not so essential as nitrogen, are as important, still the commercial value of a manure at the present day depends, in a great measure, on the amount of nitrogenated matter which it contains; and there can be no doubt that the ardent discussions which have taken place between the chemists who were in favour of attributing the whole of the value of a manure to nitrogen, and Liebig, who denied these views, and supported, with his usual indomitable spirit, his all-exclusive mineral theory, led to the conclusion that if plants can live without the addition of manures, still that the use of them stimulates vegetation in a marked degree.

These views of Liebig were based on the fact that after he had noticed trees growing on a barren rock, he asked, whence did these trees derive the elements necessary to the formation of the organic tissues which entered into their composition. The reply was obvious—from the atmosphere. Therefore, if we give to plants the mineral elements, they can derive their organic construction from the elements existing in the atmosphere, and to substantiate those views, he discovered in rain-water, collected in the open country, away from all sources of pollution, nitrate of ammonia, results which were confirmed by Dr. Lyon Playfair, and by the researches of Barrall, which are shown in the following table:—

Rain-water, Paris.

Nitrogen	7·939
Ammonia	2·769
Nitric acid	21·800
Chlorine	1·946
Lime	5·397
Magnesia	2·300

No doubt the views of Liebig are correct in theory, and will suffice for a slow and feeble vegetation, but will not answer the requirements of active husbandry, especially with heavy rents, and this has been demonstrated beyond all doubt by the elaborate researches pursued for years and at a great expense by Mr. Lawes and Dr. Gilbert, who proved that if, on the one hand, an addition of a certain proportion of nitrogen is essential to vegetation, on the other a due regard must be paid to the nature and the amount of the mineral matters supplied to crops according to their peculiar requirements, as shown by the following tables:—

Quantity of Wheat on same Land Twelve to Twenty Years.

	Bushels per acre.
Farmyard manure	35
Unmanured	15
Superphosphate of lime	18
Salts of ammonia	22
Salts of ammonia Mixed mineral manure	38
Nitrate of soda	25
Nitrate of soda Mixed mineral manure	34

Table Showing the Effect of Ammonia Salts and Mixed Mineral Manure.

Dressed Corn per Acre in Bushels and Pecks.

Plot.	1852.		1853.		1855.		1856.		1857.		1858.		1859.		1860.		1861.		1862.		1863.		1864.		Annual average.				
	B.	P.	B.	P.	B.	P.	B.	P.	B.	P.	B.	P.	B.	P.	B.	P.	B.	P.	B.	P.	B.	P.	B.	P.	B.	P.			
3	13	3	5	3	21	0	17	0	14	2	19	3	18	0	18	1	12	3	11	1	16	0	17	1	15	2	...		Unmanured.
5	16	3	10	0	24	0	18	1	19	2	23	3	19	0	20	2	13	3	15	1	17	3	19	2	18	1	2	3	Mineral manure.
17	24	3	8	2	44	0	18	0	31	0	26	1	33	2	20	2	25	1	18	2	27	3	21	1	18	3	3	1	Mineral manure and ammonia salts.
18	14	1	19	1	23	3	33	0	16	3	40	2	21	3	32	2	15	3	32	3	18	2	46	1	32	2	17	0	
10 A	21	3	9	3	34	1	19	3	24	0	29	0	22	3	18	3	15	0	12	3	23	0	39	0	22	2	7	0	Ammonia salts alone.
10 B	22	0	15	2	39	0	28	0	27	2	34	2	27	3	25	2	18	2	15	3	24	3	43	2	26	3	11	1	
7	26	3	23	2	45	1	33	0	36	3	44	3	39	0	34	2	27	2	34	3	35	3	53	2	36	1	20	3	Ammonia salts & mineral manure.

From these practical results, and many others which will be found in the papers published by Mr. Lawes, F.R.S., and Dr. Gilbert, F.R.S., in the *Journal of the Agricultural Society of England*, 1863-4, it is evident that in this case, as in many others I could cite, extreme views always bring a medium result which time generally confirms as the correct one.

I shall have to refer more minutely to these theories as I proceed with my lecture. Let me, meanwhile, call your attention to several chemical reactions which tend to modify organic matter, and render it fit to penetrate into plants, so as to enable them to yield the nitrogen so essential to vegetation. If the conversion of nitrogen into nitric acid, under the influence of certain mineral substances, has been known by its results for a long period in what is called the nitrification in the walls of our dwellings, still the demonstration of the conversion of ammonia into nitric acid is the result of comparatively recent researches. Even at the present day on the Continent it is believed (except by scientific men) that the moon has a great influence on the production of nitre in the walls of dwellings. Now, it is not the moon which has that power, but the sun, and as both move in the same direction, the influence of one must be affected by the other, for as we know from the researches of Bunsen and others, as stated in my first lecture, that the intensity of chemical rays is in ratio with the intensity of light, it follows that it is the chemical rays of the sun which affect the conversion, and not the rays of the moon. At all events, it is easy to conceive how ammonia can be converted into nitric acid in the walls of our dwellings, for sulphate of lime has the power of condensing ammonia, and no doubt, as demonstrated by Kuhlmann, of yielding its oxygen, thus converting its hydrogen into water, and its nitrogen into nitric acid, which in its turn destroys the sulphuret of calcium, giving birth to nitrate of lime. We all know that formerly, not only the rubbish from our dwellings was used as a means of obtaining the nitre which was required to manufacture the gunpowder used at that period, but that artificial nitre beds were prepared so as to yield the nitrate of potash required for war purposes. Even until recently, in Switzerland and Norway, the peasantry were subjected to a tax of supplying the Government every year with a certain weight of nitre, which those Governments required for the preparation of gunpowder. Many researches have been undertaken to try and throw light on the chemical changes which take place in the conversion of the nitrogenated organic matter existing in such bodies into nitrates. The most interesting series of researches published on this subject are those due to M. Millon, which you will find in the *Comptes Rendus de l'Academie de Sciences*, 1864, in which he has shown that the production of nitre is in ratio with the quantity of vegetable matter, especially humic acid, that a soil contains, and that the most favourable land for the production of nitre is that which is called mould by gardeners. He further ascertained that if he made a mixture composed of ordinary earth twenty parts, ashes four, mould three, the production of nitre was most active, and also that the oxygen of the air had a great influence on its production, converting the ammonia resulting from the decay of the organic matter into nitric acid.

These facts are well illustrated in the following table, quoted from his researches:—

Nitrification.

		Parts.
Soil	Earth	20
	Ashes	4
	Decayed manure	3

	Quantity of Nitre.
Upper layer	·440
Middle do.	·441
Bottom do.	·009

(To be continued.)

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

December 26, 1865.

R. Angus Smith, *Ph.D.*, *F.R.S.*, *&c.*, *President, in the Chair.*

Mr. Henry Simpson, M.D., was elected an ordinary member of the Society.

Mr. Binney, F.R.S., F.G.S., exhibited some singular calcareous nodules found in the lower coal seams of Lancashire and Yorkshire, full of beautiful specimens of fossil wood, showing structure even to the smallest striæ of the tubes. These nodules were found in several seams of coal, but were always associated, so far as yet known, with beds of fossil shells lying immediately above them. In one instance the beds occurred in the following descending order, namely:—

	Ft.	In.
1. Black shale full of shells of the genera *Aviculopecten*, *Goniatites*, *Posidonia*, &c., and containing calcareous concretions enclosing similar shells.	1	6
2. Seam of caking coal with the nodules containing the fossil plants	2	0
3. Floor of fire-clay and gannister, full of *Stigmaria ficoides*	2	

The fossil wood is found in nodules dispersed throughout the coal, some being spherical, and others elongated and flattened ovals, varying in size from the bulk of a common pea to eight and ten inches in diameter. In some portions of the seam of coal the nodules are so numerous as to render it utterly useless, and they will occur over a space of several acres, and then for the most part disappear and again occur as numerous as ever. For a distance of twenty-five to thirty miles the nodules occur in this seam of coal in more or less abundance, but always, so far as yet known, containing the same plants. Fossil shells are rarely met with in the nodules found in the coal, but they occur abundantly in the large calcareous concretions found in the roof of the mine, and are there associated with *Dadoxylon* containing *Sternbergia* piths, which plant had not been noticed in the coal, and *Lepidostrobus*. So far as his experience extended, the nodules in the coal were always found associated with the occurrence of fossil shells in the roof, and were probably owing to the presence of mineral matter held in solution in water and precipitated upon or aggregated around certain centres in the mass of the vegetable matter now forming coal before the bituminisation of such vegetables took place. No doubt such nodules contain a fair sample of the plants of which the seams of coal in which they are found were formed, and their calcification was most probably, in a great measure due to the abundance of shells afterwards accumulated in the soft mud now forming the shale overlying the coal. These shells, on their decomposition, would yield most of the minerals now found in the fossil wood, whilst the surrounding salt water and vegetables would supply the remainder.

The specimen of *Sigillaria vascularis* exhibited was of an irregular oval shape, one foot three inches in circumference, had the ribs and furrows well shown on the outside of the decorticated stem, and afforded evidence of the structure of the original plant from the centre to the circumference. In the middle was a light coloured cylinder of about an inch in diameter, which appeared to be composed of carbonate of lime and carbonate of magnesia. The remainder of the specimen was of a much darker colour. By the kindness of our President an analysis was made in his laboratory, by Mr. Browning, of a fair sample of the bulk of the dark part of the specimen. This gave

Sulphates of potash and soda	1·62
Carbonate of lime	45·61
Carbonate of magnesia	26·91
Bisulphide of iron	11·65
Oxides of iron	13·578
Silica	0·23
Moisture	0.402

The minutest vessels of the central axis and the internal radiating cylinder of the plant, with their finely striated sides, were preserved nearly as perfectly as in the living plant, without affording evidence of disarrangement from pressure or chemical change.

From the position where the calcareous nodules occur, namely in the middle of the seam of coal, they must have been formed when the coal was in a soft and pulpy state, and in the same shape and condition in which they are now found, something similar to such nodules in a peat bog of the present day. Instances have been known of hazel nuts placed in a damp calcareous deposit having had all their kernels removed and replaced by carbonate of lime, while the woody portion of the nutshell remained little altered, but in this case the form of the starchy granules and original cellular tissue had not been preserved.

From the analysis previously given it is evident that the waters in which the nodules were formed contained a considerable amount of sulphuric acid, probably as much as would act on the cellular tissue and woody fibre of the vegetables so as to convert them into colloids. If this be assumed to be the case, then we might, by the laws of liquid diffusion given by Mr. Thomas Graham, F.R.S., Master of the Mint, in his valuable paper printed in the *Philosophical Transactions* for 1861, suppose that the crystalloids now forming the light coloured cylinder in the middle of the specimen could have a free passage from the circumference to the centre, and replace molecule by molecule the particles of the original vegetable, and all its beautiful and delicate structure just as we now see it preserved in the stone. However, before dialysis could be held to account satisfactorily for the phenomena above stated, a good many experiments on recent woods would have to be made, and more attention devoted to the subject than he (Mr. Binney) would be able to give.

The specimens exhibited were a portion of those described in a paper in the *Philosophical Transactions* of this year.

MICROSCOPICAL AND NATURAL HISTORY SECTIONS.

December 18th, 1865.

J. B. Dancer, *F.R.A.S., in the Chair.*

Mr. Parry exhibited some sections of fossil wood and Echinus spines, most beautifully cut by Mr. John Butterworth, of Oldham, and presented some of the slides to the Section.

Mr. Parry also presented to the meeting, for distribution among the members, mounted slides of the contents of a shark's stomach, from the Madras coast, consisting almost entirely of Diatomaceæ.

Mr. Hurst then made a few remarks on late improvements in illuminating opaque objects under the higher powers of the microscope. He said they consisted of three different methods. Firstly, that of H. E. Smith, of Kenyon College, America, described in the "English" *Mechanics' Magazine* of the 20th October, 1865, in an extract from the American *Journal of Science and Arts.* This gentleman employed a box, or adaptor, between the object glass and the Wenham's prism of the binocular, with a side perforation opposite to which was a small silver reflector or a common thin glass cover, acting as a mirror and capable of adjustment to any angle, thus enabling it to throw the rays of light admitted by the side aperture through the object glass down on to the object itself. The disadvantage of this method is that all adaptors cause unsteadiness, and however skilfully constructed, injure the accurate centering of the object glass, and while on the one hand the thin glass cover appears to produce some distortion of the image, the reflector so near the object necessarily casts off a number of the rays proceeding from it. This plan also seems to require lamp light and the use of a condenser. Messrs. Smith and Beck appear to have patented the use of the thin glass cover. Secondly, a modification of the foregoing by Mr. Dancer, of this Section, who places the thin glass or reflector between the eyepiece and the Wenham prism, cutting an aperture in the body of the microscope to admit the light. This dispenses with the objection inherent to adaptors, and theoretically seems the most perfect of these new methods; but Mr. Hurst's experience in its use was as yet too limited to form an opinion. He hoped, however, to report on the subject at the next meeting. Thirdly, that invented by Mr. Dancer, who places a circular mirror over the oblique tube of the microscope, previously removing the eyepiece: the light is thrown down to the Wenham's prism, and thence through the objective on to the object. The only disadvantage of this method was that of not admitting of binocular vision; otherwise its simplicity, cheapness, and great facility of adjustment render it far preferable to the others, while its effects are fully equal to theirs. It answers, moreover equally well by day or lamplight, and does not require a condenser to be used. Mr. Hurst thought every binocular microscope would be fitted with it when their owners had seen its working. Mr. Hurst wished meanwhile to draw the particular attention of the members to the extraordinary beauty and clearness with which opaque objects—hitherto the despair of microscopists—were displayed by these methods of illumination, some being shown as clearly as if enlarged into a relatively gigantic model and viewed by the naked eye. Another peculiarity connected with them is, that as the object glass itself acts as a condenser, the amount of light is increased with the magnifying power of the object glass, contrary to the effect of other modes of illumination. Mr. Hurst thought the subject was in its infancy and that great improvements would yet be made, but that the idea of Mr. H. E. Smith of making the object glass its own illuminator, would prove to be one of the greatest steps in modern microscopic science, and, as improved upon by Mr. Dancer, it was one so costless in price and rapid in its adjustment, that every microscopist, however economical either of time or money, could readily avail of its assistance.

Mr. Coward then exhibited some interesting plants from India, illustrating abnormal forms of different natural families, especially of Leguminoseæ.

ACADEMY OF SCIENCES.

January 2, 1866.

Sir David Brewster sent a note "*On Spectrum Analysis.*" The importance which this subject has acquired justifies Sir David in the anxiety that his own early discoveries and those of his friend Mr. Fox Talbot should not be overlooked when the history of spectrum analysis is written. The author therefore reminds the Academy that Mr. Fox Talbot observed the orange line of strontia in 1826, and that he himself published an account of several important observations between 1833 and 1842. We shall publish this short note at length in an early number. In the early volumes of the Chemical News we reprinted as many of these original papers as we could then meet with, including those by Mr. Fox Talbot and Dr. W. Allen Miller, which latter Sir David appears to have overlooked.

M. J. Jeannel contributed some "*New Researches on Supersaturated Saline Solutions,*" in answer to M. Gernez, who, it will be remembered, contends that the contact of a solid particle of the salt in solution is necessary to provoke crystallisation. The author shows that if this were the case a multitude of salts must always be present in the atmosphere, some of which could hardly exist there without decomposing, and some which could not possibly be in the solid state. Some salts, he shows, also crystallise from boiling solutions as they cool, protected from the air. We need not multiply the illustrations, as the matter is of very little interest.

MM. Salleron and Urbain presented "*A New Method of Testing Mineral Oils.*" Their plan is to determine the tension of the vapour of the oils, for which they have contrived a special apparatus, of which a description has not reached us. From their experiments they have come to the conclusion that the tension of 64 millimetres (at 35°?) of water may be adopted as the limit which an oil safe to use in a lamp should possess.

M. Hempel contributed a note "*On the Electric Conductibility of Hyponitric Acid.*" He states that with a powerful machine in full activity and giving strong sparks, the sparks cease and the machine loses all its tension if a vessel containing nitric acid and some copper turnings be placed so that the red vapours of hyponitric acid may escape into the space traversed by the spark. The tension of the machine reappears as soon as the vessel is removed and the red cloud has been dissipated. To succeed well with this experiment it must be made in a dry atmosphere, or nitric acid will be produced.

Dr. Phipson sent a note "*On the Medicinal Muds of the Island of Ischia,*" which will be found in the Chemical News for October 15, 1864.

M. Anathase Dupré presented a note "*On the Number Molecules contained in a Unit of Volume.*" The paper is mathematical, and we must refer the reader interested in the reasoning to the original. But supposing a liquid—water—and the volume unit a cube having a millionth of a millimetre for a side—such a cube being visible only with the aid of a first-rate microscope, will, nevertheless, says the author, contain more than a hundred and twenty-five thousand times a million of molecules.

Some readers may thank us for a note on natural history. M. Duchemin has discovered that bees have a terrible enemy, against which its sting is of no avail, in the shape of an acarus. This parasite, he affirms, is developed upon the Helianthus annuus; so every one who wishes to preserve his bees had better keep sunflowers out of his garden.

NOTICES OF BOOKS.

Zeitschrift für Chemie, &c. New Series. · Vol. I. Parts 21 and 22.

This number contains little which has not already received some notice from us. Among the papers we see for the first time is one on "Cantharidin," by Bluhm, who gives the following process for extracting the whole of it in the flies. The powdered flies are to be rubbed with one-third the weight of calcined magnesia, and a little water, and this mixture is to be dried on a water-bath. The dried mass is then to be saturated with dilute sulphuric acid, and now repeatedly shaken with ether. The etherial extract is now washed with water, and then the ether is distilled off. The residue is cantharidin, contaminated with fat and a yellow substance. The former is removed by washing with bisulphide of carbon, and the latter by alcohol. Oxide of zinc may be used instead of calcined magnesia. According to the author, cantharidin combines with earthy and alkaline bases. He gives a table of solubilities, and some other particulars, which we transfer to another place.

The journal also contains an abstract of Mr. Warren's paper on the "Volatile Hydrocarbons," to which is appended some remarks by one of the editors (Beilstein), who again severely handles Professor Church, going to the extent of putting a note of interrogation after the words "this chemist."

Il Movimento Scientifico, &c. A Monthly Review of the Progress of the Sciences, and of their Principal Applications. Modena: Carlo Vincenzi. Vol. I. No. 1.

Whatever may be the political future of the Italian peninsula, there can be no doubt that the events of the last few years have completely emancipated the Italian mind; and now we may hope that the land which was, so to speak, the cradle of science, will be a home for the giant it nourished when an infant. How far the progress of emancipation has gone will be seen in this—that in Modena, not many years ago one of the most priest-ridden provinces in Italy, a journal is established which proposes to discuss with all freedom such questions as the "Origin of Species," "Spontaneous Generation," and "The Antiquity of Man," &c., &c. Every lover of freedom of thought will welcome the appearance of this journal, and wish it all success. A good part of this first number is occupied with a translation of Professor Phillips' Address to the British Association; Dr. Richardson's paper on ozone also finds a place here. No chemical paper appears in this number; but we notice an account of the discovery of petroleum in the ex-Duchy, which, it is be hoped, may be worked to advantage.

Chemical Society.—The next meeting of this Society will take place on Thursday evening next, at 8 o'clock, when the following papers will be read:—On "Pyrophosphotriamic Acid," by Dr. Gladstone, and "Reactions of Sodium-ethyl," by Prof. Wanklyn.

CORRESPONDENCE.

Mural Standards of Length.

To the Editor of the Chemical News.

Sir,—There appears to be one objection to the employment of ruby and blue coloured glass, in apposition for mural standards of length, which has not struck your correspondent "F.C.S.," and that is, that when such glasses are viewed, as these standards would necessarily be, by reflected light, they appear uniformly black, or so nearly so as to do away with any advantage which the contrast of colours might afford.

Polished porcelain or opal glass would probably be the best material; and to obviate the great objection of burning in after engraving, the divisional marks might be etched in with hydrofluoric acid, or scratched with a diamond, and then have black lead rubbed in. This is a plan in common use amongst scientific instrument makers, and is found to answer very well. The graduations on Mr. Casella's admirable thermometers are, I believe, rendered distinct in this manner; so that the suggestion, which I understand he approves of, will be sure to meet with a fair trial in his hands,

I am, &c. F.R.S.

London, January 9, 1866.

Mural Standards of Coloured Glass.

To the Editor of the Chemical News.

Sir,—In reference to the proposal of "F.C.S." in your number for December 29, that the mural standard should exhibit the yard and the metre in glass of different colours, I beg to observe that the process of grinding would be too coarse, and that the method recommended by Dr. Frankland and Mr. Casella, viz., covering the instrument with a thin layer of wax, and treating it, when engraved, with hydrofluoric acid, seems preferable. I see no reason why this should not be done with coloured glass. The yard in ruby glass might then be placed in immediate apposition with the metre in cobalt blue. Possibly the expense might be an objection, and the modesty of science might require that an instrument of so much beauty and splendour should be covered with a veil, as the lady Professor of Mathematics in the Italian University shrouded her charms so as not to distract the attention of her audience. Otherwise I do not see why artists should not be encouraged to display their taste and skill upon such a production, which, if it were not adapted for public buildings out-of-doors, might be well suited for the walls of elegantly-furnished mansions. It appears desirable that these instruments should be made with some variety in appearance and material, due regard being always paid to accuracy, distinctness, and clearness. Mr. Casella is making the instrument of white glazed porcelain. If any other artist will make it in coloured glass, or any other eligible material, it may be laid before the Committee of the British Association for approbation, if the intention of producing it be communicated either to myself or to Professor Levi, at his chambers in the Inner Temple.

I am, &c. James Yates.

Lauderdale House, Highgate, London, January 8.

Use of Soda Waste for Removal of Sulphur from Gas.

To the Editor of the Chemical News.

Sir,—In the letter from Dr. Letheby which appears in your last issue I find the following passage:—"Lastly, it has been ascertained in my own laboratory, that the sulphides and oxysulphides of lime in soda waste accomplish the object in a similar manner."

As Mr. Barret and myself have already claimed the use of soda waste in the purification of coal gas as our own invention, we should be glad to learn from Dr. Letheby when the experiments he refers to were made.

I should not trouble you with this letter were it not that the use of this material has been already announced as a discovery of Dr. Letheby's, a statement the truth of which I wish to test.

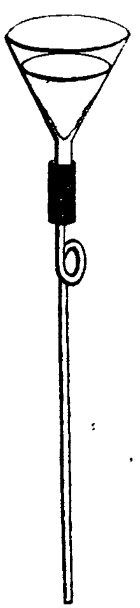
I am, &c.
C. H. Wood, F.C.S.

January 10, 1866.

Method of Hastening Filtrations.

To the Editor of the Chemical News.

Sir,—In your number 306 (vol. xii., p. 180) you mention Dr. Picard's "Way of Hastening Filtrations" as rather an injurious* one, and, therefore, few of your readers will have felt inclined to consult the description given in the original paper. I happened to come across the latter, and found that the author himself does not attribute much value to the method you described with a few words, on account of the complication of apparatus, and of the danger of breaking the filter. But he proceeds to propose another arrangement, which obviates both these drawbacks; and since I have found on trial every one of his statements to be correct, I venture to draw your attention to it once more, and to subjoin a sketch of the arrangement proposed by him, selecting the obviously best modification.



The funnel is elongated, by means of an elastic joint, into a long glass tube, having a kind of loop in its upper part, which serves to keep a constant column of liquid in the tube, and causes it to act as an aspirator.

Having used this contrivance constantly for many weeks, I can but fully confirm Dr. Picard's final statements, of which, therefore, I beg to subjoin a translation:

1. The column of water not exceeding one foot in length, there is never any danger of a filter breaking.
2. The funnels should not have a bulge, but they should be exactly conical, so that the paper filter lies everywhere close on the glass, without any creases or other irregularities; it must then be wetted, and all air-bubbles between the glass and paper must be pressed out with the finger. This preparation is indispensable.
3. If the last-mentioned condition is fulfilled, the rate of filtration is ten or twelve times quicker than without the bent tube. If that condition is not completely fulfilled, but if some air is sucked between glass and paper, so that a row of beads is generated in the aspirating tube, instead of a continuous column of liquor, then the rate sinks to four or five times the ordinary one; but even with filters badly made on purpose it only comes down to three times.

I may be allowed to add that hot liquids are found to work far better than cold ones, in spite of the counter pressure of their vapours, and that in no instance I have noticed any increase in the tendency of some precipitates to pass through the filter,—a disadvantage which can easily be avoided by using the denser Swedish filtering paper, since in the new arrangement the latter is no more objectionable on account of the slowness of its working.

I am, &c. Geo. Lunge, Ph.D.

South Shields, January 3.

Reply to a Letter by Dr. Hofmann.

To the Editor of the Chemical News.

Sir,—In the last number of the Chemical News appears a long letter, written by Dr. Hofmann, and communicated to you by a person signing himself "Chemicus," but whose real name it is not difficult to imagine.

The accusations and insinuations launched against me in this epistle by Dr. Hofmann are entirely unfounded and untrue. I beg to give them the most emphatic denial. Dr. Hofmann has evidently been misinformed.

1st. I did *not* accuse Professor William Odling of *ignorance*, but of *negligence* (*Cosmos*, November 29). How could I imagine him ignorant of the toxic properties of a substance containing 87 *per cent.* of mercury?

2nd. In no passage of my papers in the whole twenty-six volumes of *Cosmos* have I ever "passed judgment upon," or in any way alluded to, my "fellow chemists in general."

3rd. If Dr. Hofmann has not read my letter in *Cosmos*, November 29, it was his duty to do so before endeavouring to screen a friend from blame at my expense.

4th. My *rôle* in the *Cosmos* is simply that of an historian; and although the facts I mention may not be agreeable to all parties concerned, they are *historical*, and present an impartial and truthful view of the subject, taken from authentic sources, which are quoted in my articles.

I am, &c. T. L. Phipson.

London, January 6, 1866.

MISCELLANEOUS.

Royal Institution of Great Britain.—The following are the lectures for the ensuing week:—Friday, January 19, at 8 o'clock, Professor Tyndall, "On Radiation and Absorption with reference to the Colour of Bodies and their State of Aggregation;" Saturday, January 20, 3 o'clock, Professor Westmacott, "On the Way to Observe in Fine Arts."

Amount of Permanent Gas obtained in the Distillation of Coal for Oils.—A correspondent writes to the *Journal of Gas Lighting* as follows:—"It may perhaps not be generally known that at however low a heat coal or cannel is distilled, there is nevertheless a certain quantity of *permanent* illuminating gas which refuses to be turned into oil. My own experiments in distillation for oil give from 1000 to 2000 cubic feet per ton as the yield of permanent gas, depending upon the heat and the quality of the cannel distilled."

New Metropolitan Gas Bill.—A bill is to be brought before the new Parliament, in the name of the Metropolitan Board of Works, which, among many other things, provides that "the maximum price at which gas shall be sold by the said gas companies, or any or either of them, or by the said Metropolitan Board of Works, or district lighting board, under the powers by this Act vested in them, and each of them, shall not exceed the sum of *four* shillings and *three* pence per thousand cubic feet, for cannel gas, and the sum of *three* shillings and *six* pence per thousand feet for common gas, provided that when the profits derived from the "works" or "undertakings" of any or either of the said gas companies shall in any years exceed the sum of *five* pounds per centum per annum on the capital invested therein, exclusive of the reserve fund, then the price to be charged for gas shall be reduced in proportion to such excess of profits beyond *five* pounds per centum per annum."

Royal Institution.—Probable arrangements for the Friday evening meetings before Easter, 1866, to which members and their friends only are admitted:—January 19, Professor Tyndall, F.R.S., M.R.I., "On Radiation and Absorption, with reference to the Colour of Bodies, and their State of Aggregation." January 26: S. W. Baker, Esq., "On the Sources of the Nile." February 2: The Earl Stanhope, F.R.S., Pres. Soc. Ant. M.R.I., "On the Influence of Arabic Philosophy in Mediæval Europe." February 9: Archibald Smith, Esq., F.R.S., "On the Deviation of the Compass in Iron Ships." February 16: Colonel Sir H. James, F.R.S., "On the Ordnance Survey of Jerusalem." February 23: William Pengelly, Esq., F.R.S., "On Kent's Cavern, Torquay." March 2: G. Scharf, Esq., "On Portraiture: its Fallacies and

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* The word *injurious*, we must state, was a misprint for ingenious.—Ed. C. N.

Curiosities as connected with English History." March 9: Sir John Lubbock, Bart., F.R.S., M.R.I., "On Transformation of Insects." March 16: Balfour Stewart, Esq., F.R.S. March 23: Dr. Bence Jones, F.R.S., "On the Existence in the Texture of Animals of a Fluorescent Substance closely resembling Quinine."

The Arsenious and Sulphurous Ore Reduction Company.—The Company has been formed to carry on and extend the Perran Arsenic Works at Perran-ar-Worthal, near Falmouth. These works have produced 500 tons of white arsenic yearly, and it is now proposed to extend them, and utilise the mineral residuum of the arsenic process. The late proprietors of the works are to act as Managing Directors of the Company, and have agreed to accept no remuneration for their services, except their proportion of profit on shares, until the rate of dividend shall exceed 12½ per cent. upon the paid-up capital. The capital is 20,000*l*., in 10*l*. shares, only half of which is to be called up.

New Scientific Baronets.—Professor Fergusson, of King's College, and Dr. Simpson, of Edinburgh, have had the honour of a baronetcy conferred upon them, and Sir Roderick Murchison has been raised to the same dignity. We wonder whether those who select the recipients of these honours ever heard of the scientific researches of Mr. Thomas Graham, doubtless well known to them as Master of Her Majesty's Mint. It is long since a chemical baronet was created,—a distinguished one has inherited the title—and Dr. Faraday, we believe, declined it; but certainly if any scientific Englishman of the day merits the honour, Mr. Graham does. The discoveries which have made him famous in the scientific world were not skimmed from the surface of the ground in the course of more or less agreeable travels, and productive of little good when made. They represent years of patient labour and research, and are pregnant with most important consequences.

Analysis of the Metropolitan Waters in December, 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	28·00	1·52	·1942	7·0	9·1	16·1
West Middlesex . . .	28·91	1·49	·1045	6·8	11·9	18·7
Southwark and Vauxhall .	31·32	1·98	·1972	7·4	11·5	18·9
Grand Junction . . .	29·51	1·91	·1712	7·4	11·0	18·4
Lambeth	29·06	1·08	·0842	8·8	7·6	16·4
Other Companies.						
Kent	37·45	0·61	·0070	8·8	17·4	26·2
New River	30·02	0·54	·0396	7·0	14·1	21·1
East London . . .	31·90	1·36	·1274	7·2	15·0	22·2
South Essex . . .	38·10	0·30	·0112	5·8	19·0	24·8

* 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.

The table may be read thus: 100,000 lbs. of the Chelsea water contained 28·00 lbs. of solid matter, of which 1·52 lbs. of organic and other matters were driven off by incineration. ·1942 lbs of oxygen were required to destroy organic matter in the said quantity of Chelsea water. Of the solid matter, 16·1 lbs. are carbonate of lime or its equivalent; of which 9·1 lbs. are got rid of by boiling, and 7·0 lbs. remain. With the exception of the water supplied by the Kent and South Essex Companies, the waters again exhibit this month a marked increase in the total amount of solid impurity as compared with last month; this applies also to the water supplied by the Lambeth Company, which was the only one which in October showed no increase of residue over the preceding month. On the other hand, the organic and other volatile matter has (with the exception of the water supplied by the Grand Junction Company) decreased; while the amount of oxygen required for oxidation of the organic matter is in most cases less than in November. The waters of the Chelsea, Lambeth, Southwark, Grand Junction, and East London Companies were turbid when drawn from the companies' mains. The second column of this table contains the amount of solid matter left on evaporation and desiccation at 120° C.—130° C. (248° F.—266° F.) The results are recorded in 100.000 parts. By moving the decimal point one place to the right, the above figures express in milligrams the quantities contained in one kilogram of the several waters.

Thin Sheet Iron.—Protection of Iron from Rust.—We have on previous occasions reported the successive efforts of British and foreign ironmasters in the direction of producing sheets of iron of extreme tenuity. On the occasion of the meeting of the British Association, in September last, some large and very perfect sheets of iron foil were shown at the works of Messrs. Lloyds, Fosters, and Co., of Wednesbury, which weighed two grains per square inch; and we have already described the laminated metal produced by Mr. Parry, of Ebbw Vale, weighing only 1·5 grains per square inch. Since then great progress has been made by several manufacturers, and sheets of iron have been prepared of the marvellous degree of tenuity indicated by the measurement of 4800 thicknesses being equivalent to one inch. They were produced in the mills of Messrs. W. Hallam and Co., Upper Forest Tinworks, near Swansea, and are in the form of perfect sheets, measuring 10 inches by 5½ inches, or 55 square inches, and weighing no more than 20 grains, or 0·36 grain per square inch. A noteworthy circumstance in connexion with these thin sheets of iron is their remarkable degree of permanence, or power of resisting the oxidising action of the air. This protection is undoubtedly due to the continuity of the black fused layer of magnetic oxide with which these specimens are invariably coated,—a fact which Mr. McHaffie, of Glasgow, has turned to useful account in a special furnace treatment, to which plates and other articles of wrought iron are subjected for the purpose of securing increased protection against air and water. The operation consists merely in imbedding the iron plates in powdered hæmatite, or other native oxide of iron, and heating to full redness for several hours, when a perfect layer of the protective oxide is formed; the plates are then allowed to cool gradually, and are found to be especially well adapted to ship-building purposes. Mr. McHaffie, in his paper, also claims the use of oxide of zinc for producing an adherent black film, which in this case doubtless consists of a true combination of the oxides of iron and zinc, possessing an equal, if not superior, degree of permanence to that which has been already mentioned.

ANSWERS TO CORRESPONDENTS.

Professor Beilstein's request shall be attended to.

J. H. B. should consult Ure's "Dictionary of Arts and Manufactures."

R.H.—Italics, "fat letters," and barred letters,

C H O N, **C H O N**, ~~C H O N~~,

have been used by different authors to signify double atoms. The dashes after a symbol, C'''' O'' N''' are used to indicate the atomicity of the element.

United States.—The writer of a letter bearing the U.S. stamp, and addressed to "Mr. Wm. Crookes, 1, Wine Office Court, Fleet Street," sent by mail delivered in London on the 2nd inst., is respectfully requested to write again, in consequence of the letter having been accidentally lost.

Books Received.—Braithwaite's "Retrospect," 1865; "Outline Facts of Chemistry," by T. Ward.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

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

PART II.

THEORY OF TYPES AND ATOMICITY.

SECTION I.—*Theory of Types.*

(Continued from Vol. xi., page 135.)

THE idea of types arises from the fact of substitutions. After having discovered trichloracetic acid (1840) M. Dumas first expressed the opinion that when chlorine is substituted atom for atom for hydrogen in an organic compound, the new chlorinated body and the hydrogenated body from whence it is derived belong to the same type. He has applied the same view to those bodies in which bromine, oxygen, &c., have replaced hydrogen.

The primitive hydrogenated substance, and also the bodies formed by substitution, belong to the same *chemical type*, when the fundamental properties are preserved after the change undergone in the composition. It is the same with acetic acid and with trichloracetic acid, which are both powerful monobasic acids, and which split up in a similar manner under the influence of alkalies, one giving off marsh gas, and the other chloroform.

The primitive substance and the bodies derived from it by substitution belong to the same *mechanical type* when the fundamental properties are modified by the effect of the substitution, the number of elementary atoms having nevertheless remained the same.

Such are the fundamental principles of the theory of types of M. Dumas. We must add that the idea of mechanical types belongs to M. Regnault.

In its first form this theory united in the same group a given organic compound and the bodies derived from it by direct substitution of one element by another. Later M. Dumas added to the groups thus formed the nitrogenated compounds resulting from the substitution of nitrous vapour ($NO_4 = N\text{Ɵ}_2$) for hydrogen. And this is a most important development; for it has led the way to the existing ideas concerning the substitution of compound radicals, mineral or organic, for elements.

But another and perhaps more striking point sprang from the new doctrine. It is the way in which M. Dumas considered the chemical combinations. Dualism represented them as formed from two elements, themselves simple or compound. M. Dumas conceived them as forming a whole, the different parts of which are connected together. Comparing them to a planetary system, he admitted that the atoms are maintained there by affinity. Let one atom be removed, if it is replaced by a different atom to the first, the system remains intact. This replacement can even be effected by a compound atom without the general constitution being modified.

Who does not see that these ideas are the basis of our present theories, and particularly that they form the starting-point of what Gerhardt afterwards called the *unitary system?*

But to return to the chemical types. It is the peculiarity of true ideas to prove themselves fruitful. This latter bore in it the germs of an immense development. In its early form it was not capable of any great generalisation. It admitted as many types as primitive combinations, and between these types it established no common connexion.

But it has now taken a new form; it has referred all organic and inorganic compounds to a small number of types, chosen so as to represent different forms of combination; a profound idea which is in harmony with one of the fundamental properties of matter; the combining capacity of the elements, or atomicity. Such is the work of the followers of M. Dumas. We will give the part established by each of them.

Laurent, first, compared certain oxides to water. Hydrate of potassa, said he, is water in which an atom of hydrogen is replaced by potassium. The same view has been applied to the anhydrous oxides. The following formulæ express these ideas:—

$$H_2O \quad K_2O \quad (KH)O \quad (NaH)O \quad Ag_2O.$$

There the new types begin.

In 1849 I discovered the compound ammonias. In the first communication made on this subject,[*] I remarked that these bodies may be looked upon as simple ethers in which the equivalent of oxygen would be replaced by an equivalent of amidogen, or *as ammonia in which an equivalent of hydrogen is replaced by methylium* C_2H_3, *or by ethylium* C_4H_5.

I expressed the relations existing between these bodies and ammonia by the following formulæ:—

NH_3 Ammonia.	NH_2,H Hydramide.
NH_5C_2 Methyl-ammonia.	NH_2,C_2H_3. Methyl-amide.
NH_7C_4 Ethyl-ammonia.	NH_2,C_4H_5. Ethyl-amide.

This last view represents the idea of types. Some months later Dr. Hofmann gave it the preference in the interpretation of his fine discovery of diethylamine and triethylamine.[†] These bodies, said he, are ammonia in which two or three equivalents of hydrogen have been replaced by two or three ethylic groups—

$$N\left\{\begin{matrix}H\\H\\H\end{matrix}\right. \qquad N\left\{\begin{matrix}\text{Ȼ}_2H_5\\H\\H\end{matrix}\right. \qquad N\left\{\begin{matrix}\text{Ȼ}_2H_5\\\text{Ȼ}_2H_5\\H\end{matrix}\right. \qquad N\left\{\begin{matrix}\text{Ȼ}_2H_5\\\text{Ȼ}_2H_5\\\text{Ȼ}_2H_5\end{matrix}\right.$$

Ammonia. Ethylamine. Diethylamine. Triethylamine.

Besides, the idea of regarding ammonia as the combination type of the ammoniacal compounds was introduced of itself by a comparison of their properties. Whatever it might be, the ammoniacal type was established; but it was then only an isolated idea, it was not yet a doctrine. This latter began with the experiments of Dr. Williamson on etherification, and his brilliant discovery of mixed ethers.[‡]

This eminent chemist has given a satisfactory demonstration of this point; if the molecule of alcohol contains one ethylic group, that of ether contains two; if we represent the first by the formula—

$$\text{Ȼ}_2H_5.H.\text{Ɵ},$$

the second contains

$$(\text{Ȼ}_2H_5)_2\text{Ɵ}.$$

He has compared both compounds not only with water but with the hydrates and oxides of inorganic chemistry. Water has become the type of all these bodies differing from each other so much by their properties, but ana-

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[*] *Comptes Rendus*, xxviii., p. 224, February, 1849.

[†] *Ibid.*, xxx., p. 147.

[‡] Among the first promoters of the idea of types I must also mention Mr. Sterry Hunt.

logous in their molecular structure. He has made these analogies apparent by the following notation :—

Type.	Hydrates.	Oxides.
$\left.\begin{matrix}H\\H\end{matrix}\right\}\Theta$	$\left.\begin{matrix}K\\H\end{matrix}\right\}\Theta$ Hydrate of potassium.	$\left.\begin{matrix}K\\K\end{matrix}\right\}\Theta$ Oxide of potassium.
	$\left.\begin{matrix}Na\\H\end{matrix}\right\}\Theta$ Hydrate of sodium.	$\left.\begin{matrix}Ag\\Ag\end{matrix}\right\}\Theta$ Oxide of silver.
	$\left.\begin{matrix}\text{Ꞓ}H_3\\H\end{matrix}\right\}\Theta$ Hydrate of methyle.	$\left.\begin{matrix}\text{Ꞓ}H_3\\\text{Ꞓ}H_3\end{matrix}\right\}\Theta$ Oxide of methyle.
	$\left.\begin{matrix}\text{Ꞓ}_2H_5\\H\end{matrix}\right\}\Theta$ Hydrate of ethyle.	$\left.\begin{matrix}\text{Ꞓ}_2H_5\\\text{Ꞓ}_2H_5\end{matrix}\right\}\Theta$ Oxide of ethyle.
		$\left.\begin{matrix}\text{Ꞓ}_2H_5\\\text{Ꞓ}H_3\end{matrix}\right\}\Theta$ Oxide of methyle and ethyle.

(To be continued.)

Discovery of a New Chalybeate at Harrogate, by Dr. SHERIDAN MUSPRATT, *M.D., F.R.S., Ed., &c., Founder and Principal of the College of Chemistry, Liverpool.*

SOME months ago there appeared in this journal a letter from me, stating I had discovered in a water (situated in the Cheltenham Gardens, of Harrogate) a very large quantity of *protochloride of iron*. The presence of this salt at all in a potable water is an anomaly, but when occurring to a considerable amount it renders the spring in which it exists *unique*. At first some of the medical men of the place were dubious as to the results, but when Dr. Miller, of King's College, London, and Dr. Herapath, of Bristol, ratified them, attention was at once turned to the spring, which is *without a prototype;* and which is likely, from all that has since been written and said on the matter, to give to Harrogate a particular celebrity in cases that such a singular ferruginous water might benefit. The editor of the *Harrogate Advertiser* wrote :—"This discovery should tend to make this spot more celebrated than it ever has been for its historical reputation as the 'place of healing waters;' and we trust it may be the means of restoring thousands to vigorous health who have despaired of finding a remedy in any other means." It is strange there is no mention of the ferrous chloride in the Pharmacopœia, and that not anything, up to September last, was elicited regarding its therapeutic effects.

I now append the analysis of the water, *i.e.*, the gases and solid contents in an imperial gallon :—

Gases.	Cubic inches.
Carbonic acid	25·40
Nitrogen	7·55
	32·95

Saline constituents.	Grains per gallon.
Chloride of iron ($FeCl$)	16·011 !
Chloride of sodium ($NaCl$) . . .	208·468
Chloride of magnesium ($MgCl$) . .	84·716
Chloride of calcium ($CaCl$) . . .	133·642
Chloride of potassium (KCl) . . .	4·013
Chloride of barium ($BaCl$) . . .	7·717 !
Chloride of lithium ($LiCl$) . . .	trace.
Carbonate of iron ($FeOCO_2$) . . .	10·842
Silicic acid, manganese, &c. . . .	trace.
Total per gallon	465·049
Temperature of water . . .	41·50

The quantity of chloride of iron I find varies in this water; for a sample, freshly drawn, yielded me more than 20 grains of the salt per gallon. My friend Dr. Miller found 14·50 grains. In 1854 my esteemed friend and former colleague, Dr. Hofmann, published analyses and reports on the Harrogate waters, and he gave the subjoined results on this "Cheltenham saline chalybeate":—

Gases.	Cubic inches.
Carbonic acid	19·50
Carbonetted hydrogen	5·00
Oxygen	1·02
Nitrogen	
	25·52

Saline contents.	Grains per gallon.
Carbonate of lime ($CaOCO_2$) . . .	6·604
Carbonate of iron ($FeOCO_2$) . . .	4·629
Chloride of sodium ($NaCl$) . . .	158·840
Chloride of magnesium ($MgCl$) . .	34·027
Chloride of calcium ($CaCl$) . . .	51·629
Chloride of potassium (KCl) . . .	27·410
Silica	1·450
Organic matter	·282
	285·869
Temperature of water . .	40°

The above composition, tabulated by one of the first chemists of the day, is a convincing proof that some time during the last ten years a most extraordinary metamorphosis has taken place in the region of this truly remarkable spa. Dr. Bennett, of Harrogate, informs me "that *sulphates* (?) were found in this spring in 1819, but that the same chemist detected none in 1829." He also writes:—"The protochloride of iron is, as you state, contained in large quantity, and it must rest with us medical men to find out, in time, the good effects to be derived, and this can only be done after a few seasons' experience."

I intend from time to time taking or getting samples of the water, to ascertain if it alters, and in what form or way—an inquiry of the utmost importance and concern.

Dr. Herapath remarks:—"This new water may be used with great benefit in anæmia of all kinds—whether the result of general cachexia, excessive hæmorrhage, chlorosis, anorexia, incipient phthisis, or from that produced by chronic disease, as gout, or rheumatism, or albuminaria. It will also give tone to the system generally, at the same time that it helps to repair the want of the red globules of the blood. In the diseases attendant upon the gentler sex, this chalybeate will be a great boon to medical men, and no doubt the practitioners of Harrogate will soon learn to appreciate its true medicinal worth. The existence of the ferrous compounds will make the water a most valuable one in the treatment of numerous diseases, but it must almost be taken at the spring-head to insure none of its virtues being lost. Allow me to congratulate you on the felicity of such a happy discovery, and by it pointing the attention of the profession *to the most extraordinary chalybeate water in existence.*"

Dr. Whitehead, of Manchester, is, I understand, greatly interested as regards *the form* in which the iron is contained in the water.

Sir Robert Kane, of Dublin, remarks:—"There is no doubt but that the results you describe are of the greatest possible importance, and I am glad to find you coming forward in such an original point of view."

Dr. George Kennion, the eminent physician of Harrogate, writes:—"Your name in all histories of the spring will of course be identified with a discovery for which the place will ever have reason to thank you. We are all here greatly indebted to you."[*]

The presence of chloride of barium (which Dr. Miller detected) is also very wonderful; but as soon as the water is swallowed this salt will become sulphate of baryta, which is insoluble and inert. The great value of this spa will be due to its ferruginous compounds, more especially as regards the state in which one (the chloride of iron) exists; and I feel no little pride in being the first chemist who has discovered this salt in a potable water.

TECHNICAL CHEMISTRY.

Memoir on the Utilisation of Chlorine Residues and Soda Waste, by M. E. Kopp.[†]

We commenced with the chlorine residues, the most dangerous and annoying of the waste we have to deal with, and our object is so to act on them with other valueless residues as to obtain the utilisable products which will pay the expenses of the operation and yield a profit.

In chloride of lime manufactories the chlorine is usually prepared by means of strong hydrochloric acid and peroxide of manganese in earthenware retorts or stone cisterns which are heated by steam. When the disengagement of chlorine has ceased, the hot liquid from the retorts or cisterns is carried away by gutters or trenches which run about the factory. These gutters may be made of stone not acted on by hydrochloric acid, or wooden shoots may be used. They lead in the first place to reservoirs, which must also be constructed of siliceous stones, or, which is more economical, to an old tun or wooden vat of from five to ten hectolitres capacity.

The vat or tun may be fixed in the following way:—Having excavated a hole sufficiently large and deep, and covered the bottom with a layer of fat clay ten or fifteen centimetres thick, set the bottom of the tun or vat carefully upon the bed of clay, and fill in the sides with the same material, strongly compressing it so as to give firm support to all parts of the vessel. All the vats required must be set in the same way. A notch must be made in the upper part of the reservoir to receive the wooden shoot, which must be set on a very gentle incline. To prevent leakage from the shoot it may be set in a bed of clay like the vats.

The vats are to be set at intervals of about twenty metres, so that the liquors as they flow from one to the other may deposit the solid matters carried along mechanically. In the first, unattacked peroxide of manganese will be principally deposited, then sulphite of baryta, sand, clay, and some chloride of barium, &c. A box with a double bottom perforated with small holes is set close to each vat or tun to receive the solid matters taken out of the reservoir. It must be set in such a way that the liquors draining from the deposit may flow back into the canal. When a sufficient quantity of deposit has been collected in this box it may be washed with water and removed.

At the lower end of the canal two or three large reservoirs of stone are constructed, and contrivances arranged for directing the stream into one or the other, as may be necessary. They must be of such a size as that each may contain one and a-half or twice the quantity of liquor produced in one day. For reasons to be mentioned presently, they should be as deep as possible, two or three metres at least. These reservoirs may be filled to four-fifths or five-sixths of their height.

The limpid, yellowish-brown liquor which is carried into these reservoirs is composed essentially of a certain amount of free chlorine, a large proportion of free hydrochloric acid and solutions of perchloride of iron, sesqui- and protochloride of manganese, some chlorides of barium, calcium, magnesium, and aluminium, and traces of the chlorides of cobalt and nickel.

The first treatment this liquor is subjected to has for its object the removal of the excess of chlorine, and the reduction of the perchloride of iron and sesquichloride of manganese to the state of protochlorides. To effect this soda waste is gradually added to the liquor in small quantities at a time. The author suggests that the waste may be thrown into a wooden spout which is carried a little distance over the side of the reservoir, and from which, by means of a long pole, the workman can push the waste into the liquor.

Soda waste is principally composed of sulphide of calcium, chalk, and a certain amount of hydrate of lime. On falling into the liquor it is attacked by the hydrochloric acid, carbonic acid and sulphuretted hydrogen being set at liberty. But as the waste falls immediately to the bottom of the reservoir, the sulphuretted hydrogen in traversing the liquor gets decomposed by the free chlorine, and metallic chlorides, the hydrogen combining with the chlorine to form hydrochloric acid while the sulphur is set free. The effervescence observed is due to the escape of carbonic acid, which may, however, carry with it a small amount of sulphuretted hydrogen. A little chloride of sulphur may be formed at first, but this is quickly decomposed. It may be, also, that a small quantity of bisulphide of hydrogen is produced.

The addition of soda waste is continued until the liquor loses its yellowish tint and becomes colourless; from this moment the sulphuretted hydrogen is no longer decomposed, and will escape. If by accident a little too much of the waste has been added, and the liquor has a strong odour of rotten eggs, it may be remedied by running in fresh liquor until the smell has disappeared.

The author next suggests how the liquor may be completely dechlorinated without the escape of any sulphuretted hydrogen by building a sort of small house with a very light roof over the reservoir, and properly disposing hydrated peroxide of iron just as for the purification of coal gas. We need not stay over the details of this arrangement, since they will readily suggest themselves to every practical reader.

To collect the sulphur which is deposited in the reservoir, the bottom of these should have a gentle inclination, and at the lowest point a well should be placed. The opening to this may be outside the reservoir, taking care that it has a well-fitting cover, or is closed by a water trap.

As the sulphur is separated in a very finely divided state, it takes some time to deposit, but in about six hours the precipitation is complete; and the liquor, now colourless, but slightly opaline from a little sulphur still in suspension, may be syphoned off into a cistern placed near, but a little below the level of the reservoir.

The sulphur will be found in the walls in a sort of paste, but sufficiently liquid to be removed by means of ladles, or even with properly constructed pumps. It is removed to filtering backs, where it is drained and well washed. It is needless to say that these backs and the filters must be made of the cheapest materials. M. Kopp

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[*] Dr. Kennion has since proposed that the spring shall be called the "Muspratt Chalybeate," a name which we consider appropriate.—Ed. *C. N.*

[†] Abridged translation from the *Bulletin de la Société Chemique*, p. 335, 1865.

suggests old nitrate of soda bags, or the remains of woollen carpets for the filtering medium.

After well washing on the filters, he then removes the sulphur to a sort of filter-bed in the open air, where it remains exposed to the rain for several months, or in default of rain is well watered occasionally. After this it will be found fit for use in the manufacture of sulphuric acid. If the sulphur be wanted quickly, the washing may of course be completed on the filters, or by decantation in special vats.

With regard to the amount of sulphur to be obtained the author states, on the authority of Mr. W. Hofmann, that 10,000 litres of chlorine liquor of 34° B. will yield 36 kilogrammes of pure sulphur.

(To be continued.)

PHYSICAL SCIENCE.

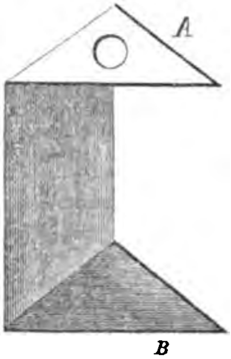
Bisulphide of Carbon Prism, by G. MARLOW.

SEVERAL years ago, having a desire to become practically acquainted with the nature of the prismatic or solar spectrum, I soon found that it was impossible to conduct experiments with any degree of accuracy in the absence of a first-class prism. Being acquainted with the great refractive and dispersive powers of bisulphide of carbon, I determined to see what could be done with it in the way of making a prism by enclosing it between plates of patent plate glass; at that time I was not aware that it had already been used for that purpose, and was ignorant of the method employed for cementing together the glasses. For this purpose I tried many substances, and at length found that gelatine possessed qualities in many respects highly desirable, being unaffected by the bisulphide after being immersed in it for a considerable period. The next point was to ascertain the best mode of applying it to the edges of the glass; this I conceived would be best accomplished by saturating bibulous paper with it, and so covering the joints with a film of gelatine supported by the fibres of the paper. This plan answered pretty well, but the gelatine contracted so in drying as sometimes to cause the paper to turn up from the glass; this was especially the case when a strong solution had been used. To remedy this defect I added to the gelatine a little glycerine to give it elasticity. When, in addition, proper precautions were taken to free the glass from every trace of greasy matter (which is apt to get on during the putting together of the various parts) this combination was found to answer admirably. I found the glass most readily freed from oleaginous matter by a weak solution of carbonate of soda carefully wiped off with a wet cloth and finished with a dry one.

At first I constructed the entire case of glass: the top, bottom, and one of the sides being composed of strong brass. The annexed figure exhibits the brass portion of the instrument.

It may be readily be made out of one piece of rolled metal by turning down the ends to form the top and bottom. In one of the ends a hole is drilled in which a cork is inserted.

The gelatine will adhere equally to the metal as to the glass, providing the same care be taken to remove grease. In practice I have found it necessary to give the inside a coat of the same gelatine which is used to cement on the glasses. This prevents the bisulphide from acting upon the metal, an effect which takes place in the course of a few months, and which is rendered evident by a yellowish deposit on the glass.



After having made the brass frame of the size and shape desired, and for accuracy having arranged the sides A and B parallel, the glasses being already ground to the right size and shape may be cemented to the frame with a little of the gelatine solution, which should be allowed to dry with the object of keeping the glasses in their place. This makes the last operation—viz., that of applying the strips of bibulous paper saturated with the gelatine solution, comparatively easy. The strips of paper should turn over on to the surface of the glass from one-eighth to three-sixteenths of an inch. The following is the best formula for the gelatine solution:—Gelatine 100 gr., glycerine 26 drops, water one ounce. The gelatine used by me cost 1s. 4d. per pound, but probably commoner kinds would answer equally well.

I may remark that I have found bisulphide of carbon prisms sent out with spectroscopes which were cemented with shell-lac. In prisms thus constructed I have observed the formation in the liquid of numerous small bits which float about in the liquid, and must be more or less detrimental to its perfect working.

Those who are not aware of the fact will be pleased to learn that a bisulphide of carbon prism will enable them to see some of the celebrated Fraunhofer lines with considerable distinctness by simply looking through the prism at a fine rectangular slit made of two knife edges. I do not claim this as a new discovery, but I am satisfied that it is a fact that many persons well versed in physics are unacquainted with.

The lines are best seen by using diffused solar or direct lunar light.

To those interested in spectral researches the bisulphide of carbon prism is both a cheap and most valuable instrument when properly made, and will enable any one to make himself practically acquainted with the solar or prismatic spectrum who otherwise might be debarred the pleasure, as a really good glass prism is quite beyond the means of all but the few; besides which several are required to do the work which one bisulphide of carbon prism will perform.

Birmingham.

Royal Institution of Great Britain.—The following are the lecture arrangements for the ensuing week:—Tuesday, January 23, and Thursday, January 25, 3 o'clock, Prof. Tyndall, "On Heat." Friday, January 26, 8 o'clock, S. W. Baker, Esq., "On the Sources of the Nile." Saturday, January 27, 3 o'clock, Professor Westmacott, "Art Education, and how Works of Art should be Viewed."

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 4.

Tuesday, April 25, 1865.

(Continued from page 10.)

From the foregoing you will gather that in the upper part of a bed (one metre in depth, and composed as above shown) there is far more nitre than in the lower portions of it. These researches of M. Millon threw much light on those published some years since by M. Boussingault, who ascertained the rate of proportions of nitre that existed in various qualities of soils, and also the influence of manured land on the production of nitre in soils. Thus M. Boussingault found that the quantity of nitre in non-manured land was a mere trace; in uncultivated land there were from 1 to 0·5 in 1000 parts of soil, whilst in cultivated land and in highly manured ground, 18 parts in 1000. He further observed that if he manured a piece of land, after 7 days there were 12 parts of nitre per 1000; in 17 days, 81 parts; in 15 days more 233; in 15 days more 280; and in 15 days further 260; and then the quantity decreased rapidly. M. Millon has clearly demonstrated that the substance which first absorbs and then helps the conversion of the ammonia into nitric acid is the one known by chemists under the name of humine, or humic acid. The presence of a small quantity of nitrates and traces of nitre in uncultivated land may be due to two different sources.

First, Liebig, as we have already stated, demonstrated some years since—and his results have been confirmed by other chemists—that there always exist in the atmosphere small quantities of nitric acid, which are brought down to the soil by rainfalls.

Secondly, M. Cloez has recently demonstrated that the mere passage of purified air over porous substances is sufficient to force a small amount of air and oxygen to combine together so as to produce a small quantity of nitric acid. Further, all soils, so far as we are aware, contain organic matter, with which the soil comes into contact from time to time. The tenacity with which soils retain organic matter is very remarkable; for Ubaldini has lately proved that if you treat a soil several times with strong muriatic acid, and wash the residue with water so as to remove all traces of acid, still, in that residue you will find the presence of organic matter. The following researches prove that the nature of this organic matter may be either considered as being similar to humine, as shown by M. Millon, or similar to cellulose, as shown by Verdeuil, or of a nitrogenated nature, as demonstrated by Baron Paul Thenard. The elaborate researches of this gentleman are most interesting in many points of view, and, without entering into details, allow me to state that he has extracted from decayed dung, as well as from soils, an acid which he has called fumic acid. This nitrogenated acid is insoluble in water, but freely soluble in weak ammoniacal liquors, thus facilitating its absorption by soils when rotten dung is laid on land as a manure. But this solubility of the fumate of ammonia soon disappears, for immediately that fumic acid comes in contact with peroxide of iron or oxide of aluminium (alumina) it forms an insoluble compound, which presents great stability, explaining at once how land manured one year can retain with tenacity the essential nitrogenated elements of the manure which it had one, two, or three years previously. What enhances the value of these recent researches is, that Baron Thenard has succeeded in producing artificially the acid which he has discovered in rotten dung, and that by simply heating starch, sugar, gum, or substances existing in straw and other vegetable matters, with ammoniacal salts or nitrates, it being employed by him as a substitute for what we may conceive takes place under the slow action employed by nature to accomplish her general purposes. If Baron Liebig's views respecting the importance of adding mineral matters to exhausted soils were too exclusive, as tending to establish that it was necessary to use other vegetable and animal manures for a farmer to produce remunerative crops, still, there cannot be a doubt that he has rendered great service to the progress of agricultural chemistry by drawing the attention of scientific men to the general composition of soils, and enabling them to point out the essential mineral substances that a soil should contain for it to claim the title of being fertile.

The most complete and elaborate researches which we possess on this intricate subject are due to one of our leading agricultural chemists, Dr. A. Voelcker, who has published in this year's *Journal* of the Royal Agricultural Society of England (p. 128), of which Society he is the appointed chemist, a paper on some of the causes of the unproductiveness in soils, and the following table will give you not only an idea of the extent of his labours, but also point out the difference there is in the composition of soils, and that if in a soil there exists a great excess of one substance, as compared with others that compose it, that soil becomes unproductive:—

Composition of Unproductive Peat Land, Clay, Calcareous, and Sandy Soil.

	Calcareous soil.	Sandy soil.	Clay soil.	Peaty soil
Moisture	—	2·65	—	—
Organic matter and water .	—	4·56	7·94	49·07
Oxides of iron and alumina	·780	5·93	10·95	10·88
Carbonate of lime . .	73·807	·39	·86	2·29
Magnesia	·825	—	·26	·75
Potash and soda . .	traces	·28	·39	·90
Phosphoric acid . . .	·242	—	·10	·06
Sulphuric acid . . .	1·546	—	·30	1·04
Silica	16·710	86·19	—	—
Insoluble silicious matter .	6·090	—	79·20	35·01
	100·000	100·00	100·00	100·00

Dr. Voelcker summed up his researches on the unproductiveness of soils in the following words:—

"Having spoken at some length of a variety of conditions which appear to me to affect the fertility of the land, my subject perhaps may be usefully brought to a close by a brief statement of what, in my opinion, the chemical analysis of soils can determine, and what it necessarily must leave undecided.

"In the first place I would remark that the chemical analysis of soils can give very decided answers to the following questions:—

"1. Whether or not barrenness is caused by the presence of an injurious substance, such as sulphate of iron or sulphide of iron?

"2. Whether soils contain common salt, nitrates, or other soluble salts, that are useful when highly diluted, but injurious when they occur too abundantly?

"3. Whether or not barrenness is caused by the preponderance of—Organic matter, or lime, or sand, or pure clay?

"4. Whether sterility is caused by the absence or deficiency of—

- "*a.* Lime.
- "*b.* Phosphoric acid.
- "*c.* Alkalies, especially potash.
- "*d.* Or available mineral (ash-constituents) matters generally.

"5. Whether clays are fertile or barren?

"6. Whether or not clays are usefully burnt and used in that state as manure?

"7. Whether or not land will be improved by liming?

"8. Whether it is better to apply lime, or marl, or clay on a particular soil?

"9. Whether special manures, such as superphosphate or ammoniacal salts, can be used (of course, discreetly) without permanently injuring the land, or whether the farmer should rather depend upon the liberal application of farmyard-manure that he may restore to the land all the elements of fertility removed in the crops?

"10. What kinds of artificial manures are best suited to soils of various compositions?

"11 Whether deep ploughing or steam cultivation is likely to be useful as a means of developing the natural stores of plant-food in the soil?

"12. Whether the food of plants in the soil exists in an available or inert condition?"

(To be continued.)

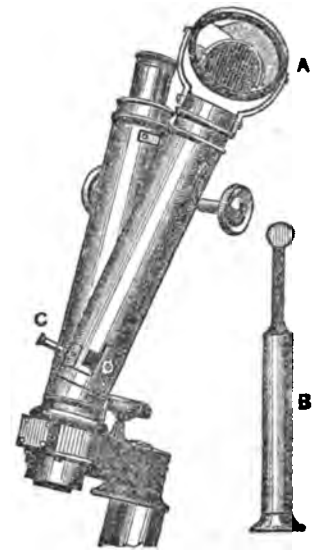
MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

November 28, 1865.

R. Angus Smith, *Ph.D., F.R.S., &c., President, in the Chair.*

Mr. Dancer, F.R.A.S., said that in a paper "*On the Illumination of Opaque Objects under the High Powers of the Microscope,*" read before the Microscopical Section of this Society, November 20, he had described a method of employing the oblique body of the binocular microscope with Wenham's prism, for illumination of opaque objects, and he had also exhibited an instrument fitted up for this purpose, giving the members present a practical demonstration of the advantages which this mode of illumination afforded under other circumstances. He wished now to describe another method of illuminating opaque objects, and as it is equally applicable to monocular and binocular microscopes, it appears worthy of some consideration. In the method of Mr. H. L. Smith, of Kenyon College (which was briefly described in the paper before mentioned), and also in the use of the Wenham's prism, there is a considerable loss of angular aperture (which is a very important consideration): it occurred to the author that by modifying Mr. Smith's contrivance this loss might be diminished in some degree; this has been attempted in the following manner:—Instead of placing the mirror immediately over the opening at the back of the object glass, a small speculum ⅛th of an inch in diameter is introduced into the front of the body of the microscope, 2½ inches above the top of the objective. A lateral opening is made in the body at right angles to the speculum, for the admission of light to be reflected down through the objective to the object below. The interposition of the small speculum does not produce any disagreeable effect in the field of view, and in the examination of objects it is easy to use that portion of the field which is between the centre and the edge. With proper manipulation very good definition can be obtained by this method, when the speculum is of the proper curvature. This contrivance can always remain attached to the microscope without interfering with the general appearance of the instrument, and when the use of the speculum is not required, it can be withdrawn or turned aside out of the field of view, and the aperture at the side of the body may be closed by a small shutter.' It is obvious that the use of the binocular body is not interfered with by this arrangement. A binocular and a monocular microscope with this arrangement were exhibited to the members at the close of the meeting.

Engraving of Mr. J. B. Dancer's Method of Illuminating Opaque Objects under the high powers of the microscope.



At A is shown a concave mirror, having a vertical and horizontal movement, mounted over the oblique body of a binocular microscope. By this mirror the light is reflected down to the Wenham's prism, and thence through the objective to the object.

Another Method.

B is a representation of a small speculum fixed at the end of a brass wire. This is inserted into the vertical body just over the fine motion tube at C. The speculum receives light at the side of the microscope at D, and reflects it down through the objective to the object. If there is any obstacle in the way of attaching the small speculum in the vertical body as shown at C, it could be fitted to an adapting ring between the body and the objective.

ACADEMY OF SCIENCES.

January 8, 1866.

M. Galy-Cazalat presented a note describing "*A New Process for Quickly and Economically Converting any Mass of Cast Iron into Steel.*" The author passes superheated steam into the fused iron. In traversing the mass, the steam is, of course, decomposed; the oxygen burns progressively the carbon and oxide of iron; while the hydrogen combines with and removes the sulphur, phosphorus, and other metalloids, which render the steel brittle. When the colour of flame at the top of the mass indicates a proper amount of decarburation, the steel is run out. The author operates either in a cupola or a reverberatory furnace of his own construction, in which the waste heat from the furnace is utilised to produce the steam. There has always been a difficulty in knowing when to stop the decarburating current, the process often being carried too far; but to-day, says the author, common steel can always be regularly produced by completely decarburating the cast iron, and then adding 10 per cent. of spathic cast iron, which restores to the iron the amount of carbon necessary to effect the conversion into steel. By a peculiar contrivance, the author shuts off the current of superheated steam from the metal, and passes it into the chimney, where it serves to increase the draught in the furnace, and thus leaves the steel in a state of tranquil fusion for about fifteen minutes, by which he gets a perfectly homogeneous masss. To remove bubbles in his castings, he has a very ingenious device. A cannon, for example, being cast, while the metal is still hot and soft, he covers the mould hermetically with a sort of hat, from the top of which rises a pipe, in which is placed 6 or 10 grammes of a mixture, 80 parts of saltpetre and 20 parts of charcoal. By opening a stopcock, the powder is allowed to fall on the metal, where it gets ignited, producing a large quantity of gas, which exerts pressure on all parts of the casting, removing the bubbles and increasing the tenacity of the metal.

M. J. Nicklès contributed a note "*On the Effects of Colouration, and the Extinction of Colours Produced by Artificial Lights.*" The author has made the discovery that some colours look very different in daylight to what they do by candle light, and also that the magnesium light has the same properties as solar light. We need hardly give his illustrations. One thing stated, however, we may quote, as it will suggest a good lecture experiment. The author paints a spectrum, which shows all the colours either by gas or candle light, but shows only black and white with a soda flame (alcohol and salt).

Colour by daylight.	Pigment.	Colour by soda flame.
Red	Ochre	Black
Orange	Biniodide of mercury	White
Yellow	Chromate of lead	
Green	Manganate of baryta	Black
Blue	Aniline blue	

After this note was read, M. Chevreul made some remarks, in which he stated that the electric light shows all colours and shades quite as well as daylight.

M. Berthelot communicated a note "*On the Formation of Acetylene in incomplete Combustions.*" We shall publish this note *in extenso*, and now only mention an experiment or two. Fill a test tube of 300 c.c. capacity with a gas, such as ethylene, propylene, or marsh gas; or pour in a few drops of a volatile liquid, common ether or hydride of amylene, and then place in the tube a few cubic centimetres of ammoniacal cuprous chloride; then light the combustible vapour, and incline the tube almost horizontally, moving it about, so as to distribute the copper solution over the sides of the tube. The characteristic red precipitate of acetylide of copper will be seen to form immediately. Another way of showing the production of acetylene in the combustion of benzole, ether, turpentine, &c., is to place the mouth of a long tube a little above the flame, so as not to interfere with the combustion, and by means of a gentle aspirator draw the products of combustion into a clean, dry bottle of about a litre capacity. After a few minutes a few drops of the copper reagent dropped into the bottle will show the characteristic precipitate. M. Berthelot states that acetylene is formed whenever organic matter is burnt in the air so as to produce smoke, and he notices its production especially in the incomplete combustion of gas. According, however, to M. Moreau and the author, acetylene has no special physiological action; and they ascribe the bad effects of half burnt gas to the carbonic oxide which must be formed at the same time. The author then shows how the discovery must modify our notions of the theory of combustion. In reality, he says, the combustion of hydrocarbon compounds is not effected at a single stroke, but by a succession of decompositions. The first of these decompositions give rise to special products, which depend on the particular nature of the combustible bodies. We know, for example, that the first product of the incomplete combustion of alcohol is aldehyde. Then come the general products formed in all combustions, and which precede the water and carbonic acid. Until now carbon and carbonic oxide were the only general products which had been recognised. It is now shown that acetylene must be added to them.

M. Pisani sent an account of the granite sand of Pesaro, of thulite, a Piedmontese mineral, and of bustamite (from Monte Civillina). The first is used for cutting and polishing marble, and is mainly finely divided granite. The second is also a granite. Bustamite is principally silicate of manganese.

NOTICES OF BOOKS.

Watts's Dictionary of Chemistry. Vols. I., II., and III. and *passim.* Longman and Co.

The chemical student of the present age is a truly privileged individual, for he has been a spectator of one of the most interesting and extraordinary revolutions that ever took place in any branch of physical science. He may take his stand by the side of those who were alive when Galileo, Newton, Copernicus, and Lavoisier delighted and astonished the thinking world with their marvellous discoveries and daring generalisations. He has been present at the gradual unfolding of facts and theories which, when fully established and matured, will give chemistry a position at any rate on the verge if not on the inner side the barrier dividing the exact sciences from those which are purely experimental. When John Dalton first expounded his theories on the atomic constitution of compound bodies, every one felt that under the veil which he essayed so bravely to tear aside, there must be facts as certain and demonstrable as any proposition in the twelve books of Euclid.

From the time when—to borrow a metaphor so happily used by Dr. Hofmann in his last and greatest work—Lavoisier and his noble little army of thinkers slew the four Titans of the ancient world, Air, Earth, Fire, and Water, and showed that tricksy and malevolent will-o'-the-wisp, Phlogiston, in his true light, to the end of the first half of the present century chemical theory was almost at a standstill. It is true that Sir Humphry Davy laid the foundation-stone of the unitary theory by stating that sulphate of potash ought to be formulated as KSO_4, and not as $KOSO_3$; but the chemists of the day were so wedded to the Lavoisierian system that they were slow to acknowledge that the great Frenchman was wrong. The stone lay neglected for years, Dr. Clarke, of Aberdeen, Griffin, Daniel, and a few more daring innovators, now and then clearing the grass and weeds away from it, and combatting the views that for a whole generation had been received as incontrovertible. In fact, chemical science seemed to be serving an apprenticeship to truth, and simply hoarding up fact after fact to be one day brought out and put to good use in building up the wonderful edifice we now look upon with so much admiration and delight.

During the last years of the half-century whose history we are considering, it was noticed by several chemists that certain organic compounds, whose composition appeared to be anomalous and inexplicable, and which had hitherto baffled all attempts at classification, were falling into apparently natural groups. The investigations of numerous philosophers, with Liebig at their head, into the composition and properties of the hydrocarbons resulted in the arrangement of these bodies into confessedly imperfect homologous series. One by one the gaps in these groups began to be filled up, and certain philosophers dared to reason inductively about the missing links in the chain; but when at last they were discovered, their behaviour, both chemical and physical, bore out all the prophecies that had been made by those who were once looked upon as wild theorists.

Two young chemists, Laurent and Gerhardt, consolidated a system of nomenclature founded on theories first propounded by our own Sir Humphry Davy, and worked upon by Daniel, Graham, Clarke, and others, but it was years before it was even partially adopted, and then only to be speedily abandoned for another still more perfect. Hofmann, Wurtz, and a host of others did invaluable service to the cause of truth by their classical researches on the polyammonias. Bunsen set the example to Frankland, Odling, and another large body of workers, by his discovery of cacodyl and its compounds. We need hardly allude to the unexpected results gained from the late investigations into the properties of the organo-metallic bodies, such as zinc ethyl.

Church and Northcote and Conington published manuals of analysis in the Gerhardtian tongue, which were adopted in several chemical schools in this country. The College of Chemistry gave in its adherence to the views of Gerhardt, and we began to see crossed symbols in our scientific journals, and hear our more advanced friends talk about sulphuric anhydride and sulphate of potassium.

Dr. Odling followed with the first part of his "Manual of Chemistry," which, with his ever-to-be-remembered lecture on the "Molecule of Water" delivered at the Royal Institution, took the wavering portion of the community by storm, and largely increased the small crop of unitary formulæ then to be found in our magazines, and set at rest the doubts of many who were waiting timidly to accept the new system. Dr. Hofmann's lecture at the last-named Institution gave the deathblow to the old faith in this country, and prepared us for still wider and clearer views with regard to the constitution of bodies.

All this time Cannizzaro, Kopp, Kekulé, Berthelot, Wurtz, and others were hard at work sapping and mining below the edifice so lately built by the Gerhardtian School. Towards the end of the International Exhibition of 1862, when the most celebrated chemical philosophers of the world were present in London, Wurtz delivered his memorable discourse on "Oxide of Ethylene," in which he enunciated the more advanced views of himself and Cannizzaro with respect to the atomicity of certain of the metals. Many of the chemists who were present on that occasion—at least the majority of the Fellows of the Chemical Society—left the rooms that night, shaking their heads, and almost grumbling at the somewhat too daring views of their French colleague. Was it not enough that they had given in their adhesion to a theory which held the molecule of water to be H_2O, but that they must now redouble the atomic weights of a score of metals? They little thought as they murmured against the truth that in a few months the leaders they respected, one of whom had already given way, would join the ranks of the advanced party.

Dr. Williamson's lectures at the Chemical Society and the Royal Institution were amongst the first signs of the rapid way the Cannizzarian system was making in this country, and the appearance of the third edition of Miller's "Elements of Chemistry" showed that philosopher, who had held back so long, to be more Cannizzarian than the great Italian himself. Then came Wurtz's lectures at the College of France, and the little pamphlet of tables issued by Dr. Odling, which gave the finishing blow to the Gerhardtian theory, and practically reduced his intended *magnum opus* to what Dr. Hofmann would call an "*incomplete molecule.*"

Such was the state of matters towards the commencement of last year, and the latest papers of other philosophers were anxiously searched by impatient students for crossed Pb's and Ca's, to see who had come over to the new faith, and who were hanging back.

The appearance of Dr. Hofmann's last work, containing a table in which the diatomicity of calcium, lead, and their congeners was clearly indicated, following as it did his celebrated croquet-ball lecture at the Royal Institution, has consolidated the theories of the last twenty years into one harmonious whole.

The progress of chemistry during the time whose history we have briefly attempted to sketch has been so rapid that many, especially those who have been engaged in manufactures, have been so dazzled and confused as to be unable to follow its footsteps. To use a phrase from the greatest of our modern historians, in speaking of the progress of science under the Baconian method, "the point which was invisible yesterday will be our goal to-day and our starting-point to-morrow." It is, therefore, with no common pleasure that the appearance of a work like Watts's Dictionary has been hailed by every student in science wherever the English language is spoken or understood.

Hitherto we have confined ourselves to a simple announcement of the contents of the different parts as they appeared, but the work has now advanced sufficiently far for us to begin the pleasing task of reviewing the theoretical articles contained in the parts that have already been published.

Taking them in alphabetical order, the first article that merits our attention is that on "Acids," by Professor Foster. He sets out by giving a list of the common properties of the more important acids; following it up by a succinct history of the theories broached with respect to these bodies from the time of the Arabians to the present day. The views of Becker, Stahl, Lavoisier, Davy, Dulong, and Gerhardt are given at length, and will convey to the student an excellent notion of the growth of ideas respecting those important substances. The different classes of acids are then described, and the differences between mono-, di-, and tribasic acids clearly shown by their leading properties being given side by side in three parallel columns. The homology of certain groups of acids is finally treated of, their relations to the corresponding alcohols, glycols, and glycerins being shown in a table.

Closely following, we have a long and interesting account of the properties of the "Alcohols," from the pen of the Editor, showing the progress made from the year 1835, when Dumas and Peligot discovered that wood-spirit was an analogous body, in composition and properties, to spirits of wine, to the present time, when there are legions of alcohols; and we find ourselves obliged to include under this head such substances as glycerin, stearin, mannite, glucose, and phycite. These remarks will apply with about equal force to the article on "Aldehydes," the number of which is daily increasing.

The three articles, "Amic Acids," "Amides," and "Amines," written by the late F. T. Conington, are exhaustive treatises on these subjects; the latter especially will be read with great delight by all those who are beginning the study of those fascinating compounds, the polyammonias.

"Atomic Volume" is an admirable exposition of one of the great stumbling-blocks that the chemical student meets with at the commencement of his studies. The peculiar relations between the atomic volumes of different bodies is explained and discussed in a very lucid manner; the views of Kopp and Berthelot, the *facile principes* of this difficult subject, being given, as well as tables of the atomic volumes of a large number of elements and compounds, gaseous, liquid, and solid.

Immediately following it is a monograph on "Atomic Weights," by Dr. Odling, in which, for the first time in the book, an exposition of the views of the Gerhardtian school is given. In this article Dr. Odling seems to be quite in his element, and brings all his great logical power to bear on the subject. Commencing with an account of John Dalton's atomic theory, he shows how that great man established the general principles of combination in definite proportions, although from the imperfection of his modes of analysis and synthesis he fixed the atomic weights of oxygen at 7 and of carbon at 5. He pays a just tribute to the labours of Berzelius, whose figures we can rarely find reason for materially altering, although our instruments and processes have been so much improved since his day. The learned Doctor then takes up the purely theoretical part of his subject, and shows in the most conclusive manner why the atomic weights of oxygen, nitrogen, and carbon must be taken as 16, 14, and 12, and not as 8, 4·66, and 3. As a specimen of close reasoning we commend this portion of the article to any wavering souls who are hesitating to join the new faith. If it does not succeed in convincing them of the error of their ways, we can only say that they must be in a state of what theologians call "invincible ignorance." An excellent table (which, by the way, might be reprinted in accordance with the latest views) is given, in which we find not only the latest determined atomic weight of each element, but the name of the chemist whose figures are taken, and the formula of the compound analysed.

The phenomenon of disassociation is then described, its influence in causing apparent anomalies in the vapour densities of certain bodies being very clearly explained.

Regnault's researches on the specific heat of bodies are next touched upon, and Cannizzaro's proposition to double certain atomic weights spoken of as having too many objections to it to be adopted in the then state of knowledge. This remark is instructive as showing the rapid march of chemical philosophy. The article we are reviewing was published in May, 1863, and for more than a year Cannizzaro's speculation has been received as a truth for other reasons besides those advanced by him. The influence of isomorphism in determining the atomic weight of a body is discussed in the last paragraphs of this brilliant article, but we are sure that if it had appeared under the heading of "Weights, Atomic," the views advanced would have been greatly modified. Without wishing to refer to this delicate subject again, we cannot help admiring the noble honesty of the chemical philosophers of the present day, who, without a qualm, knock down their own pet theories and adopt views which effectually stultify their own writings and expressions of perhaps only a few months before. When we find our leaders so straightforward and just, what may we not hope for in the great search after truth in which all of us, professor and student, are heartily and humbly engaged? Never in the whole history of science have individual views undergone such radical changes, never has there been so little personality or acrimonious controversy.

The article on "Chemical Affinity," by the Editor, is a careful *resumé* of the subject, an account of the experiments of Bunsen, Debus, Gladstone, Margueritte, Malaguti, and others being given. The author very properly concludes by giving a sketch of the different theories of chemical action, as expounded by Berthelot, Berzelius and his school, Gmelin, and lastly the ingenious and beautiful ideas of Dr. Williamson on this interesting subject.

The last article we shall notice at length in the first volume is that on "Classification," by Professor Foster, which is remarkable not merely as a piece of profound philosophical reasoning, but as being the first article in the book in which the Cannizzarian system of atomic weights is adopted—not, perhaps, in its entirety, for Professor Foster classes lead amongst the tetratomic elements, and hesitates before allowing calcium, barium, and strontium places amongst the diatomic group. We need hardly say that the Professor's classification of the elements is founded on their atomicities. In classifying compounds he uses as a foundation a series of eleven types, which may be represented by the following formulæ:—

1. $H'Cl'$

2. *a* $O''H'H'$
b $O''Hg''$

3. *a* $N'''H'H'H'$
b $N'''O''Cl'$
c $N'''B'''$

4. *a* $C^{iv.}H'H'H'H'$
b $C^{iv.}S''S''$
c $C^{iv}O''Cl'Cl'$
d $C^{iv.}N'''H'$
e $C^{iv.}Si^{iv.}$

It will be seen that, as far as it goes, this basis is theoretical—that which Gerhardt arrived at by empiric methods; all the bodies indicated by the above formulæ being capable of being classed under the types HCl, H_2O, H_3N, and H_4C. By carrying out this system to the utmost, Professor Foster is able to classify bodies having the most complicated and stubborn formulæ. At the end of the article is a long and most useful list of memoirs bearing on the subject from the time of Lavoisier to the present day.

We shall conclude our notice of the more important monographs contained in the first volume with a brief account of the article on "Combustion," by the Editor. He commences with a brief notice of the theory of combustion which has obtained up to the present day. He then goes on to consider the conditions of inflammability, the nature and composition of flames, and the causes which modify and extinguish combustion.

Braithwaite's Retrospect of Medicine. Vol. LII. July to December, 1865. London: Simpkin, Marshall, and Co. 1866.

We need only as usual announce the punctual appearance of this very useful periodical, and add that this volume contains a paper on the pathology and treatment of cholera, in which the opinions of several writers are brought together and compared. In expectation of an outbreak of this formidable disease, a paper of this kind becomes extremely valuable, and we are glad to see that it is issued separately.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

2630. A. A. Lerenard, Rue Pali Kao, Paris, Belleville, "A new composition of india-rubber, mastic, or cement, made in a more or less fluid state, according to the use to be made of it, and the process or contrivance for applying the same."—Petition recorded October 12, 1865.

2993. A. C. St. Paul de Sincay, Boulevart St. Martin, Paris, "Improvements in the manufacture of sulphur by the reduction of the sulphurous acid accruing from the roasting of sulphuretted ores, and in apparatus for the same."—November 21, 1865.

3112. J. Steart, St. James's Road, Bermondsey, "An improved method in the production of fibre from various fibrous plants and animal products."—December 4, 1865.

3172. A. V. Newton, Chancery Lane, "An improved mode of preserving animal and vegetable substances." A communication from F. Stabler, Baltimore, Maryland, U.S.A.—December 9, 1865.

3190. V. M. Griswold, Peckskill, Westchester, N.Y., U.S.A., "Improvements in photographic surfaces and the compositions and process for preparing the same."

3195. T. King, Park Road, Holloway, "An improved pyrotechnic toy."—December 11, 1865.

3206. A. Budenberg, Manchester, "An improved blasting powder." A communication from B. A. Schäffer and C. F. Budenberg, Buckau, Magdeburg, Prussia.

3208. F. K. Tomlinson and C. J. Hayward, High Street, Lincoln, "Improvements in the preparation of sheep ointment."—December 12, 1865.

3253. R. Ransford, Huron Lodge, West Brompton, Middlesex, "Improvements in the manufacture of bichloride of carbon and chloride of sulphur."—December 15, 1865.

3261. S. Whitehouse, sen., S. Whitehouse, jun., J. Whitehouse, and W. Whitehouse, Dudley, Worcestershire, "Certain improvements in the means of collecting waste gases arising from blast furnaces."—December 18, 1865.

3280. L. Durand, Lyons, France, "Improvements in dyeing and printing."—December 19, 1865.

3285. J. Gibbon, Tryddyn, Flintshire, "An improved retort for distilling or extracting products from cannel coal, shale, or schist, and more especially from the small coal or dust technically known as 'slack.'"

3288. J. Birch, Newton Heath, Lancashire, "Certain improvements in the manufacture of steel."

3296. J. Watson, Kildale, Cleveland, Yorkshire, and J. Player, Norton, Stockton-on-Tees, "Improvements in obtaining oil and other products from bituminous shale."—December 20, 1865.

3317. G. Davies, Serle Street, Lincoln's Inn, Middlesex, "Improved apparatus for burning combustible vapour (such as that from naphtha or coal oil) for heating, cooking, and lighting purposes."—A communication from J. Stratton, Philadelphia, Pennsylvania, U.S.A. — December 22, 1865.

3325. W. E. Newton, Chancery Lane, "Improvements in the preparation of glue or gelatine, so as to render it insoluble in water and applicable by the admixture of other substances to various purposes, for which common glue or gelatine cannot now be used."—A communication from H. Wurtz, New York, U.S.A.—December 23, 1865.

3339. W. F. Deane, Fanworth, near Bolton, Lancashire, "Improvements in the means of applying copper, or alloys of copper, to the bottoms and sides of navigable vessels built of iron, steel, or homogeneous metal."—December 26, 1865.

Inventions Protected by the Deposit of Complete Specification.

3300. H. A. Bonneville, Rue du Mont Thabor, Paris, "Improvements in the manufacture of steel and purified iron, and in the apparatus employed therein."—A communication from A. G. Cazalat, Belleville, France.—Recorded December 21, 1865.

3351. N. W. Wheeler, Brooklyn, King's County, New York, U.S.A., "Improvements in distilling, and in relieving distilled and other liquids from gases mechanically mixed therewith."—December 27, 1865,

Notices to Proceed.

2123. O. Lawrence, Euston Road, Middlesex, "A new medicine for the cure of the diseases of the stomach (dyspepsy), cardialgy, indigestion, and the hæmorrhoids."—Petition recorded August 17, 1865.

2140. A. Watt, Ash Cottage, Putney, "Certain improvements in soap."—August 18, 1865.

2166. J. H. Scott, Nutsford Vale, West Gorton, near Manchester, "An improved furnace for annealing iron and steel wire or rods."—August 23, 1865.

2191. J. Moule, Hackney Road, Middlesex, "An improvement in the treatment of tar and other substances suitable to be used in the manufacture of paint, and for other purposes."—August 25, 1865.

2194. J. A. Wanklyn, London, "Improvements in the manufacture of violet dye stuffs."—August 26, 1865.

2216. A. Gwilt, Birmingham, "Improvements in condensing and utilising sulphurous smokes and vapours, and in apparatus to be used for that purpose."—August 29, 1865.

2231. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in tanning, and in the preparation of extracts to be used therein."—A communication from E. D. Coëz, Paris.—August 30, 1865.

2247. W. E. Newton, Chancery Lane, "Improvements in obtaining spirits of turpentine, resin, pitch, tar, pyroligneous acid, and other products from wood."—A communication from A. H. Emery, New York, U.S.A.

2248. W. E. Newton, Chancery Lane, "An improvement in the manufacture of paper pulp."—A communication from J. B. Brown, Peekskill, New York, U.S.A.—August 31, 1865.

2385. J. Fletcher, Betts Street, St. George's-in-the-East, Middlesex, "Machinery or apparatus and in the processes for the treatment and manufacture of sugar."—September 19, 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.—September 26, 1865.

2674. C. G. Lenk, Dresden, Saxony, "An improved process for purifying and preserving water."—October 17, 1865.

3136. T. L. Nicklin, Tipton, Staffordshire, "Improvements in puddling, heating, and other reverberatory furnaces used in the manufacture of iron and steel, and for other purposes."—December 6, 1865.

3172. A. V. Newton, Chancery Lane, "An improved mode of preserving animal and vegetable substances."—A communication from F. Stabler, Baltimore, Maryland, U.S.A.—December 9, 1865.

3253. R. Ransford, Huron Lodge, West Brompton, Middlesex, "Improvements in the manufacture of bichloride of carbon and chloride of sulphur."—Dec. 15, 1865.

3300. H. A. Bonneville, Rue du Mont Thabor, Paris, "Improvements in the manufacture of steel and purified iron, and in the apparatus employed therein."—A communication from A. G. Cazalat, Belleville, France."—December 21, 1865.

CORRESPONDENCE.

Use of Soda Waste for the Removal of Sulphur from Gas.

To the Editor of the Chemical News.

Sir,—I am glad to have the opportunity afforded by Mr. Wood's letter in the last number of the Chemical News of speaking of the use of soda waste for the purification of coal gas; for although I am very unwilling to say anything about Mr. Wood's conduct in the matter, yet I am anxious that the facts concerning the proposed use of this substance should be known.

Mr. Wood had been for about two years (until Christmas last) an assistant in my laboratories, and during that time he had frequent opportunities of learning my views respecting the forms in which sulphur exists in coal gas, and the probably best means of extracting it. He has heard me again and again discuss the question of the use of alkaline sulphides as the most hopeful of all agents. He knew that we were prosecuting experiments at the gas works at Nottingham with sulphide of ammonium (ammoniacal liquor), and that those experiments were becoming more and more successful. He examined with me the products of the combustion of the gas in all those inquiries, and he conducted for me experiments of a like nature in my City laboratory. He, therefore, knew exactly the direction in which my observations and inquiries were moving. Nay, more, although we were chiefly working with ammoniacal liquor because it is the cheapest and most accessible of all such sulphides, yet we spoke of the use of other refuse sulphides or oxysulphides—as sulphide of calcium, or blue billy, and soda waste. I had even asked Mr. Young, of the Birmingham and Staffordshire Gas Works, to get some of the soda waste from Messrs. Chance, of Birmingham, and to try it on a large scale at Saltley. To be candid, however, I did not, and even now do not, think much of the proposal; because, although there are places where soda waste is easily obtained, yet, as a rule, it will be found very difficult to convey such a noxious material to the gas works and to remove it therefrom after it is exhausted. Nevertheless, I had entertained the question, and but for the pressure of work, and the experiments at Nottingham, I should have followed it out. Soon after this, however, I saw in my City laboratory specimens of soda waste, and it occurred to me that Mr. Wood might perhaps be pursuing the matter for me, he knowing how great an interest I took in the subject.

About six weeks or two months ago Mr. Wood addressed me in these words: "About that soda waste, Sir, that we were speaking of; I find it removes the sulphur from the gas, and reduces the quantity to about seven grains in the hundred feet. I have been trying it with Mr. Harris, at the Great Central Works, and it seems to be a success." I expressed my satisfaction at this, and said I had no doubt from the principle we had in view that it would be effective. He then told me that he thought of taking out a patent for it. I was very indignant at such a proposition, and told him then, as I tell him now, that he had no right, as my assistant, working in my laboratory, on a subject which I was especially investigating, to avail himself of my knowledge, and to use it in such a manner. I said that I would not have it thought that I, who had been so loud in my complaints of the quantity of sulphur in the City gas, was in any way concerned with the taking out of a patent for the remedy; and that, as the process was dereveloped in my laboratory, from the results of my own inquiries, I should at once disclose the fact, and advise the gas companies to use the process in the freest manner.

So much was I vexed by this conduct that, after consulting a few professional friends, I gave Mr. Wood notice to leave my service, for, I must confess, I had lost all confidence in him. Indeed, I put it to any one who has charge of a laboratory, where special inquiries are going on, whether any confidence could be reposed in an assistant who used the knowledge which he had thus acquired for such a purpose.

I trust I have not expressed myself at all harshly or improperly in my account of this delicate affair.

I am, &c., H. LETHEBY.

College Laboratory, London Hospital, January 15, 1866.

The Poisonings by Mercuric Methide.

To the Editor of the CHEMICAL NEWS.

SIR,—It would, I think, end all dispute, and set many minds and questions at rest, if you published a complete narrative of the events which happened at St. Bartholomew's Hospital Laboratory. What was the mode of preparation adopted? How was it carried on? When did the symptoms of poisoning first show themselves in the two gentlemen, and were any precautions taken, or was the work stopped, as soon as they were noticed? On these points several stories are about, and it would be much more satisfactory, now that some of the circumstances have been published, if the whole history was made known. I am, &c.

AN ASSISTANT.

Reply to Dr. Phipson.

To the Editor of the CHEMICAL NEWS.

SIR,—In the CHEMICAL NEWS of January 5 you have given a translation of a letter which I published in the *Berlinische Nachrichten*, in reply to an article written by Dr. Phipson, extracted by that newspaper from the Parisian journal *Cosmos*.

In the number of the CHEMICAL NEWS dated January 12, which I received this morning, appears a letter by Dr. Phipson, in which he says: "The insinuations and accusations launched against me in that epistle by Dr. Hofmann are entirely unfounded and untrue. I beg to give them the most emphatic denial. Dr. Hofmann has evidently been misinformed."

I am not a reader of *Cosmos*, and my letter in the *Berlinische Nachrichten* is a reply to the translation of Dr. Phipson's letter in *Cosmos* of November 15, published by the German journal. I have, however, in consequence of the above remarks, considered it my duty to read the original article in *Cosmos*, and I am sorry to say that I am unable to retract a single statement which I have made.

Since you have been pleased to give a translation of my letter to your readers, I must ask you to publish the following passages from Dr. Phipson's original article, to which my letter refers. Your readers will then be able to judge for themselves. Dr. Phipson thus introduces his narrative (I send you the original and the translation):—

Original.	*Translation.*
"Depuis quelques temps, il nous arrive à Londres un certain nombre de jeunes chimistes, dont l'éducation scientifique est plus on moins complète, sortant des laboratoires de Liebig, Dumas, Woehler, Bunsen, &c., &c., ayant pour toute ressources leurs connaissances de manipulations chimiques. Ces messieurs trouvent, la plus part du temps, de misérables engagements dans les laboratoires de nos écoles de chimie et dans ceux des hôpitaux de Londres. Leurs appointments de 1000 à 1500 francs environ ne sont que juste suffisants pour 'tenir corps et âme ensemble,' et avec tout cela ils ont de la chance s'ils ne sont pas empoisonnés ou dangereusement blessés par le travail que leur donne le professeur, travail qu'il n'oserait on ne saurait faire lui-même."	"For some time past a certain number of young chemists have come to London from the laboratories of Liebig, Dumas, Woehler, Bunsen, &c., &c., whose scientific education is more or less complete, and whose only resource is their knowledge of chemical manipulation. These gentlemen for the most part find miserable engagements in the laboratories of our chemical schools and in those of the London hospitals. Their appointments of about 1000 to 1500 francs are only just sufficient 'to hold body and soul together,' and with all that it is only a chance if they are not poisoned or dangerously wounded by the work which the professor gives them—work which he dares not do or knows not how to do himself."

The following are some of the remarks with which Dr. Phipson concludes his narrative:—

Original.	*Translation.*
"Est-ce donc permis de tuer ainsi des aides?—de pauvres jeunes gens qui viennent pour *apprendre* avec l'espoir de devenir un jour professeurs à leur tour, et non pas pour mener une vie d'esclaves!	"Is one permitted thus to kill his assistants — poor young people who came to learn, with the hope of one day becoming professors in their turn, and not to lead a life of slaves!
"Est ce que Gay Lussac, Thénard, Humphry Davy ont tués leurs preparateurs pour arriver à se faire un nom?"	"Did Gay Lussac, Thénard, Humphry Davy kill their assistants in order to make a name for themselves?"

Another illustration of the spirit in which Dr. Phipson performs the "*rôle* of historian"—to quote his own expression—is to be found in the manner in which he introduces the name of Dr. Frankland in his article:—

Original.	*Translation.*
". . . M. Frankland, dont les lecteurs du *Cosmos* connaissent peut-être le nom, comme ayant publié plusieurs notes sur des composés organiques qu'il dit avoir '*découverts*.'"	". . . Dr. Frankland, whose name the readers of *Cosmos* may perhaps know, as having published several notes on organic compounds which he says he has '*discovered*.'"

The italics and inverted commas which distinguish the word "*discovered*" are Dr. Phipson's.

I again leave your readers to judge for themselves.

I am, &c., A. W. HOFMANN.

New Cornish Mineral.

To the Editor of the CHEMICAL NEWS.

SIR,—There are two points in Professor Maskelyne's letter in the CHEMICAL NEWS of the 5th inst. to which I am compelled to refer.

Professor Maskelyne says:—"It was solely to secure justice for Mr. Talling that I alluded to part of what I know regarding his share in contributing to the discovery of the mineral." It was unnecessary for Professor Maskelyne to go out of his way in order to interfere in this matter. I have long ago acknowledged Mr. Talling's share in the discovery of Churchite, and in terms the most explicit. My first note on the new cerium mineral (Chemical News, September 15, 1865) opens with the words:—"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."

With respect to Professor Maskelyne's remark on "sound work" and "uncertain work," &c., I have but one word to say. I have striven to attain the utmost accuracy in my analytical operations; and although there are difficulties in the exact estimation of the cerium metals, and the quantity of material at my disposal was very small, I feel convinced that further experiments will confirm my results.

I shall not prolong the present discussion. I did not commence it; and I am sorry that it has assumed the aspect of an unpleasant controversy. In England workers in the chemistry of minerals are scarce, and it is a pity that their labours should not always be carried on in a friendly spirit of mutual help. I am, &c.,

A. H. Church.

R. A. College, Cirencester, Jan. 15, 1866.

MISCELLANEOUS.

Deodorisation and Disinfection.—Dr. J. H. Barker, in his prize essay on "Deodorisation and Disinfection," sums up the results of several series of experiments in the following propositions:—

1. For the sick-room, free ventilation, when it can be secured together with an even temperature, is all that can be required.
2. For rapid deodorisation and disinfection, chlorine is the most effective agent known.
3. For steady and continuous effect ozone is the best agent known.
4. In the absence of ozone, iodine exposed, in the solid form, to the air is the best.
5. For the deodorisation and disinfection of fluid and semi-fluid substances undergoing decomposition, iodine is best (employed in the form of tincture).
6. For the deodorisation and disinfection of solid bodies that cannot be destroyed, a mixture of powdered chloride of zinc, or powdered sulphate of zinc, with sawdust is best. After this, a mixture of carbolic acid and sawdust ranks next in order; and, following on that, wood-ashes.
7. For the deodorisation and disinfection of infected articles of clothing, &c., exposure to heat at 212° Fahr. is the only true method.
8. For the deodorisation and disinfection of substances that may be destroyed, heat to destruction is the true method.

Sarony's Posing Apparatus.—It is the simple truth to say that the photographer is almost as often posed as the sitter, though in a different sense. How to get a sitter into a graceful and easy position and keep him or her in it sufficiently long often taxes the ingenuity and patience of the artist to the utmost. Many people will assume a good pose for themselves, but then comes the difficulty of maintaining it. Photographers have hitherto relied entirely on the head rest, but for a standing portrait this is manifestly insufficient. If the head is kept steady it is generally in an uneasy position, and the picture looks stiff and unnatural. The instrument, indeed, distorts the figure without putting the subject at his ease. To call it a "rest" is absurd, for if leant against the thing would capsize. Then, again, the head is the part which, in grown-up people at all events, least wants support. If the body be at ease, the head will in most cases be perfectly still. Mr. Sarony, as one of the first portraitists of the day, has suffered more than most from the want of some contrivance for maintaining a sitter in his position, and now he has produced one which we may say leaves nothing to be desired. First of all, we may say that it is a substantial instrument, which can be leaned upon without fear of disturbing it. Next, it gives support to the body and steadiness to the head at the same time. Then the same instrument is capable of universal application. It will do for Chang and may be adapted to Tom Thumb. Lastly, upon the same instrument the artist may arrange at pleasure all the accessories he may wish to introduce into the picture—the end of a couch or the back of a chair, rigid and firm enough to be leant upon, or carved oak cabinet to place behind a standing figure, also sufficiently firm to give support. All these various contrivances, as we have said, are with the utmost ingenuity arranged at will upon the same stand, and with scarcely an effort on the part of the photographer. It would be beyond our limits to describe the ingenious mechanical combinations by which all we have mentioned is effected, and must recommend all our photographic readers to inspect the apparatus for themselves (it is on view at Mr. How's, 2, Foster Lane, Cheapside.) They will find that it well deserves one of the names Mr. Sarony has bestowed upon it, the "Universal Rest"—rest for the sitter and rest for the photographer.

"Les Mondes" (a Weekly Review of the Sciences and their application) will resume its regular issue on January 18, published by M. Rothschild, bookseller and publisher, No. 43, Rue St. André des Arts, Paris. In receiving the numbers for the Thursdays the 4th and 11th January, 1866, the subscribers will perceive with pleasure that this review, so much esteemed, will be more than ever the devoted and faithful organ of progress as it occurs.

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. XII. 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. XIII. commenced on January 5, 1866, and will be complete in 26 numbers.

T. S. is thanked for his communication. We correct the most important.

M. P. S.—We know nothing about the origin of the "Brahee sugar." All we know about it is that it looks and tastes like milk sugar.

C. L. S.—Your plan was patented about twenty years ago by Dr. Ritterbraudt, and was at one time a good deal employed. It does not succeed with *all* water.

C. H. B.—We do not know when a new edition of Dr. Muspratt's Dictionary will be published. The other book is in preparation.

J. M.—It would answer just as well, but is difficult to obtain on the large scale.

R. S., jun.—Our correspondent asks advice which we dare not assume the responsibility of giving. Success in a career depends on so many circumstances—we had almost said accidents—that it is impossible to predict it. All we can say to a young man with a decided bent is—work! There are great prizes to be gained; but generally they must be waited for.

Errata.—P. 13, col. 2, the quotation from Gerhardt and Cahours in Mr. Warren's paper should read as follows:—"The formation of cumene is easily explained. In effect, the cuminic acid being represented by $C_{20}H_{24}O_4$, it appears that C_4O_4,—that is to say, 2 equivalents of carbonic acid—are retained by the baryta, while $C_{18}H_{24}$ are set free."

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

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

PART II.

THEORY OF TYPES AND ATOMICITY.

SECTION I.—*Theory of Types.*

(*Continued from page* 26.)

THIS theory establishes between alcohol and ether relations of the same nature as those which exist between the acids and their compound ethers. These latter were compared to salt. Thus acids, salts, and compound ethers were looked upon as combinations of the same order, and placed under the type of water.

TYPE.	ACIDS.	SALTS.	COMPOUND ETHERS.
$\left.\begin{array}{r}\mathrm{H}\\ \mathrm{H}\end{array}\right\}\text{Θ}$	$\left.\begin{array}{r}\mathrm{N}\text{Θ}_2\\ \mathrm{H}\end{array}\right\}\text{Θ}$ Nitric acid.	$\left.\begin{array}{r}\mathrm{N}\text{Θ}_2\\ \mathrm{K}\end{array}\right\}\text{Θ}$ Nitrate of potash.	$\left.\begin{array}{r}\mathrm{N}\text{Θ}_2\\ \text{Ȼ}_2\mathrm{H}_5\end{array}\right\}\text{Θ}$ Nitrate of ethyle.
	$\left.\begin{array}{r}\text{Ȼ}_2\mathrm{H}_3\text{Θ}\\ \mathrm{H}\end{array}\right\}\text{Θ}$ Acetic acid.	$\left.\begin{array}{r}\text{Ȼ}_2\mathrm{H}_5\text{Θ}\\ \mathrm{Na}\end{array}\right\}\text{Θ}$ Acetate of soda.	$\left.\begin{array}{r}\text{Ȼ}_2\mathrm{H}_3\text{Θ}\\ \text{Ȼ}_2\mathrm{H}_5\end{array}\right\}\text{Θ}$ Acetate of ethyle.

Gerhardt adopted this view and generalised it. The hydrogen and hydrochloric acid types were added to the types of water and ammonia, which were themselves enlarged.

Under the hydrogen type Gerhardt placed the metals, the organic radicals, the aldehydes, and the acetones.

TYPE.	SIMPLE BODIES.	ORGANIC RADICALS.	ALDEHYDES AND DERIVATIONS.
$\left.\begin{array}{r}\mathrm{H}\\ \mathrm{H}\end{array}\right\}$ Hydrogen.	$\left.\begin{array}{r}\mathrm{Cl}\\ \mathrm{Cl}\end{array}\right\}$ Chlorine.	$\left.\begin{array}{r}\mathrm{Cy}\\ \mathrm{Cy}\end{array}\right\}$ Cyanogen.	$\left.\begin{array}{r}\text{Ȼ}_2\mathrm{H}_3\text{Θ}\\ \mathrm{H}\end{array}\right\}$ Hydride of acetyle (aldehyde).
	$\left.\begin{array}{r}\mathrm{Br}\\ \mathrm{Br}\end{array}\right\}$ Bromine.	$\left.\begin{array}{r}\text{Ȼ}\mathrm{H}_3\\ \text{Ȼ}\mathrm{H}_3\end{array}\right\}$ Methyle.	$\left.\begin{array}{r}\text{Ȼ}_2\mathrm{H}_3\text{Θ}\\ \text{Ȼ}\mathrm{H}_3\end{array}\right\}$ Methylide of acetyle (acetone).
	$\left.\begin{array}{r}\mathrm{K}\\ \mathrm{K}\end{array}\right\}$ Potassium.	$\left.\begin{array}{r}\text{Ȼ}\mathrm{H}_3\\ \mathrm{H}\end{array}\right\}$ Hydride of methyle.	$\left.\begin{array}{r}\text{Ȼ}_7\mathrm{H}_5\text{Θ}\\ \mathrm{H}\end{array}\right\}$ Hydride of benzoyle.
	$\left.\begin{array}{r}\mathrm{Ag}\\ \mathrm{Ag}\end{array}\right\}$ Silver.	$\left.\begin{array}{r}\text{Ȼ}_2\mathrm{H}_5\\ \text{Ȼ}_2\mathrm{H}_5\end{array}\right\}$ Ethyle.	$\left.\begin{array}{r}\text{Ȼ}_7\mathrm{H}_5\text{Θ}\\ \text{Ȼ}_6\mathrm{H}_5\end{array}\right\}$ Phenylide of benzoyle.

Under the type of hydrochloric acid, which is only, in reality, a subdivision of the preceding, he united the organic and inorganic chlorides, bromides, iodides, &c.

$\left.\begin{array}{r}\mathrm{H}\\ \mathrm{Cl}\end{array}\right\}$ Hydrochloric acid.	$\left.\begin{array}{r}\mathrm{I}\\ \mathrm{Cl}\end{array}\right\}$ Protochloride of iodine,	$\left.\begin{array}{r}\text{Ȼ}\mathrm{H}_3\\ \mathrm{Cl}\end{array}\right\}$ Chloride of methyle.	$\left.\begin{array}{r}\text{Ȼ}_2\mathrm{H}_3\text{Θ}\\ \mathrm{Cl}\end{array}\right\}$ Chloride of acetyle.
	$\left.\begin{array}{r}\mathrm{K}\\ \mathrm{Cl}\end{array}\right\}$ Chloride of potassium.	$\left.\begin{array}{r}\text{Ȼ}_2\mathrm{H}_5\\ \mathrm{Cl}\end{array}\right\}$ Chloride of ethyle.	$\left.\begin{array}{r}\text{Ȼ}_4\mathrm{H}_7\text{Θ}\\ \mathrm{Cl}\end{array}\right\}$ Chlorine of butyryle.
	$\left.\begin{array}{r}\mathrm{Hg}\\ \mathrm{Cl}\end{array}\right\}$ Chloride of Mercury.	$\left.\begin{array}{r}\mathrm{Cy}\\ \mathrm{Cl}\end{array}\right\}$ Chloride of cyanogen.	$\left.\begin{array}{r}\text{Ȼ}_7\mathrm{H}_5\text{Θ}\\ \mathrm{Cl}\end{array}\right\}$ Chloride of benzoyle.

His beautiful discovery of anhydrous acids gave him an opportunity of enlarging the type of water. He had formerly maintained that anhydrous monobasic acids did not exist, and, singularly enough, he discovered them himself. And yet his first assertion was not altogether unfounded; he had said that the molecule of acetic acid did not contain the elements necessary for forming a molecule of water by simple dehydration, and in that he was right; but he had not foreseen that *two* molecules of acetic acid would unite to form a molecule of water and a molecule of anhydrous acid, and that the latter would contain the remainder of two molecules of hydrated acid.

$$2\Bigg[\underset{\text{Acetic acid.}}{\left.\begin{array}{r}\text{Ȼ}_2\mathrm{H}_3\text{Θ}\\ \mathrm{H}\end{array}\right\}\text{Θ}}\Bigg]=\underset{\text{Anhydrous acetic acid.}}{\left.\begin{array}{r}\text{Ȼ}_2\mathrm{H}_3\text{Θ}\\ \text{Ȼ}_2\mathrm{H}_3\text{Θ}\end{array}\right\}\text{Θ}}+\left.\begin{array}{r}\mathrm{H}\\ \mathrm{H}\end{array}\right\}\text{Θ}$$

This point has been established by abundant proof. Far from being an obstacle, it has become a confirmation of the theory, and the very clear reactions of chloride of acetyle have afforded a satisfactory proof of the fact that the hydrogen of water can be replaced by an organic group.

$$\underset{\text{Water.}}{\left.\begin{array}{r}\mathrm{H}\\ \mathrm{H}\end{array}\right\}\text{Θ}}+\underset{\text{Chloride of acetyle.}}{\left.\begin{array}{r}\text{Ȼ}_2\mathrm{H}_3\text{Θ}\\ \mathrm{Cl}\end{array}\right\}}=\underset{\text{Acetic acid.}}{\left.\begin{array}{r}\mathrm{C}_2\mathrm{H}_3\text{Θ}\\ \mathrm{H}\end{array}\right\}}+\underset{\text{Hydrochloric acid.}}{\left.\begin{array}{r}\mathrm{H}\\ \mathrm{Cl}\end{array}\right\}}$$

$$\underset{\text{Acetate of soda.}}{\left.\begin{array}{r}\text{Ȼ}_2\mathrm{H}_3\text{Θ}\\ \mathrm{Na}\end{array}\right\}\text{Θ}}+\underset{\text{Chloride of acetyle.}}{\left.\begin{array}{r}\text{Ȼ}_2\mathrm{H}_3\text{Θ}\\ \mathrm{Cl}\end{array}\right\}}=\underset{\text{Anhydrous acetic acid.}}{\left.\begin{array}{r}\text{Ȼ}_2\mathrm{H}_3\text{Θ}\\ \text{Ȼ}_2\mathrm{H}_3\text{Θ}\end{array}\right\}\text{Θ}}+\underset{\text{Chloride of sodium.}}{\left.\begin{array}{r}\mathrm{Na}\\ \mathrm{Cl}\end{array}\right\}}$$

In the first reaction, the chlorine of the chloride of acetyle takes an atom of hydrogen from the water and supplies the acetyle in its place. In the second, the sodium of the acetate, which represents the second atom of hydrogen of the water is similarly replaced by the acetyle. By the effect of this double substitution acetic acid is first formed, then anhydrous acetic acid, and these two bodies are thus united to water by a direct experiment.

Here the idea of a water type appears no more as a mere speculation; a cause for it is found in the most natural interpretation of facts, which may almost be said to insist upon it.

It is also obvious, by the preceding example, why Gerhardt has named his types *types of double decomposition.* He admitted that, when molecules conflict together, an exchange always takes place between the atoms. This exchange is double decomposition—in fact, a sort of reaction by far the most frequent, but not the only one, as Gerhardt would have inferred it was.

Here is another example, selected from among a thousand, which may express his thought:—

$$\underset{\text{Chloride of acetyle.}}{\left.\begin{array}{r}\text{Ȼ}_2\mathrm{H}_3\text{Θ}\\ \mathrm{Cl}\end{array}\right\}}+\underset{\text{Ammonia.}}{\left.\begin{array}{r}\mathrm{H}\\ \mathrm{H}\\ \mathrm{H}\end{array}\right\}\mathrm{N}}=\underset{\text{Acetamide.}}{\left.\begin{array}{r}\text{Ȼ}_2\mathrm{H}_3\text{Θ}\\ \mathrm{H}\\ \mathrm{H}\end{array}\right\}\mathrm{N}}+\mathrm{HCl}$$

The analogous reactions to the last have made him refer to the type of ammonia, not only the compound ammonia and the organic alkalies, but also the amides. The amides, said he, only differ from the alkaloids by the oxygenated nature of their radical: ethylamine and acetamide are combinations of the same order, and the remarkable differences of their properties are owing to the influence of the oxygen which has entered into the radical.

$$\underset{\text{Type.}}{\left.\begin{array}{r}\mathrm{H}\\ \mathrm{H}\\ \mathrm{H}\end{array}\right\}\mathrm{N}}\qquad\underset{\text{Ethylamine.}}{\left.\begin{array}{r}\text{Ȼ}_2\mathrm{H}_5\\ \mathrm{H}\\ \mathrm{H}\end{array}\right\}\mathrm{N}}\qquad\underset{\text{Acetamide.}}{\left.\begin{array}{r}\text{Ȼ}_2\mathrm{H}_3\text{Θ}\\ \mathrm{H}\\ \mathrm{H}\end{array}\right\}\mathrm{N}}$$

This influence is so great that the introduction of oxygenated radicals into the molecule of ammonia can, in certain cases, give it the character of an acid.

Thus the properties of compound bodies are in some sort a function of the nature and grouping of the elementary atoms which they contain. If, on the one hand, bodies containing the same elements can differ in molecular arrangement, on the other hand, bodies offering the same atomic grouping may differ according to the nature of the elements.

In both cases the differences of their properties must be stated, and we must not be surprised in consequence to meet in the same type with bodies very dissimilar in character and chemical qualities. Thus, starting from water, which is neutral, we can form energetic acids or powerful bases. It is only necessary in the one case to replace hydrogen by an oxygenated radical; in the other by a strongly electro-positive element—as potassium. Such a thought has determined the arrangement of the following table,[*] in which Gerhardt has given an early view of his theory of types:—

		Left, or positive extremity.	Intermediate terms.	Right, or negative extremity.
Water type . .	$\left.\begin{matrix}H\\H\end{matrix}\right\}\Theta$	$\left.\begin{matrix}\text{Ꞓ}_2H_5\\H\end{matrix}\right\}\Theta$ Alcohol	. . . . .	$\left.\begin{matrix}\text{Ꞓ}_2H_3\Theta\\H\end{matrix}\right\}\Theta$ Acetic acid
		$\left.\begin{matrix}\text{Ꞓ}_2H_5\\\text{Ꞓ}_2H_5\end{matrix}\right\}\Theta$ Ether	. . . . .	$\left.\begin{matrix}\text{Ꞓ}_2H_3\Theta\\\text{Ꞓ}_2H_3\Theta\end{matrix}\right\}\Theta$ Anhydrous acetic acid
		$\left.\begin{matrix}\text{Ꞓ}H_3\\\text{Ꞓ}_2H_5\end{matrix}\right\}\Theta$ Ethylmethylic ether	. . . . .	$\left.\begin{matrix}\text{Ꞓ}_2H_3\Theta\\\text{Ꞓ}_7H_5\Theta\end{matrix}\right\}\Theta$ Acetate of benzoyle
		. . . . .	$\left.\begin{matrix}\text{Ꞓ}_2H_3\Theta\\\text{Ꞓ}_2H_5\end{matrix}\right\}\Theta$ Acetic ether	. . . . .
Hydrogen type .	$\left.\begin{matrix}H\\H\end{matrix}\right\}$	$\left.\begin{matrix}\text{Ꞓ}_2H_5\\H\end{matrix}\right\}$ Hydride of ethyle	. . . . .	$\left.\begin{matrix}\text{Ꞓ}_2H_3\Theta\\H\end{matrix}\right\}$ Aldehyde
		$\left.\begin{matrix}\text{Ꞓ}_2H_5\\\text{Ꞓ}_2H_5\end{matrix}\right\}$ Ethyle	. . . . .	$\left.\begin{matrix}\text{Ꞓ}_2H_3\Theta\\\text{Ꞓ}_2H_3\Theta\end{matrix}\right\}$ Acetyle
		. . . . .	$\left.\begin{matrix}\text{Ꞓ}H_3\\\text{Ꞓ}_2H_3\Theta\end{matrix}\right\}$ Acetone.	. . . . .
Hydrochloric acid type . . .	$\left.\begin{matrix}H\\Cl\end{matrix}\right\}$	$\left.\begin{matrix}\text{Ꞓ}_2H_5\\Cl\end{matrix}\right\}$ Hydrochloric ether	. . . . .	$\left.\begin{matrix}\text{Ꞓ}_2H_3\Theta\\Cl\end{matrix}\right\}$ Chloride of acetyle
Ammonia type .	$\left.\begin{matrix}H\\H\\H\end{matrix}\right\}N$	$\left.\begin{matrix}\text{Ꞓ}_2H_5\\H\\H\end{matrix}\right\}N$ Ethylamine	. . . . .	$\left.\begin{matrix}\text{Ꞓ}_2H_3\Theta\\H\\H\end{matrix}\right\}N$ Acetamide
		$\left.\begin{matrix}\text{Ꞓ}_2H_5\\\text{Ꞓ}_2H_5\\H\end{matrix}\right\}N$ Diethylamine	. . . . .	. . . . .
		$\left.\begin{matrix}\text{Ꞓ}_2H_5\\\text{Ꞓ}_2H_5\\\text{Ꞓ}_2H_5\end{matrix}\right\}$ Triethylamine	. . . . .	. . . . .

(To be continued.)

Researches on the Volatile Hydrocarbons,
by C. M. Warren.

(Continued from page 14.)

On the Influence of C_2H_2 upon the Boiling points in Homologous Series of Hydrocarbons, and in some Series of their Derivatives; with Critical Observations on Methods of Taking Boiling points.—It is well known that we are indebted to H. Kopp[*] for the discovery of certain definite relations existing between the chemical constitution and some of the physical properties of homologous liquid bodies. Of these, one of the most important is that of a uniform difference between the boiling points of the contiguous members of an homologous series, corresponding to the uniform difference in their elementary constitution. Kopp has shown by numerous examples that, as a general rule, in those series which are characterised by a common elementary difference of C_2H_2 between the members, in the order of the series, the corresponding difference of boiling point is about 19° C.; hence that the difference between the boiling points of any two members of such a series is x .19° for a difference of xC_2H_2 in the elementary formulæ. In the earlier observations on this subject, this relation between the boiling points and formulæ was found so nearly constant in the different series examined, that any deviations from this apparent general law were referred, not unreasonably, to assumed inaccuracies in the determination of the boiling points of the bodies compared. But the more recent and extended generalisations of Kopp[†] have led him to point out several exceptional series, in which the boiling point difference is greater, and others in which it is less, than 19° for an elementary difference of C_2H_2. That there are such exceptional series is confirmed in a very decisive manner by my own observations, as I shall proceed to show. My determinations make the boiling point differences in some cases so much larger than those of other observers as to leave no room for doubt on this point; especially if the comparative value of these determinations be duly estimated with reference to the more reliable character to which the preparations are entitled, on account of the more efficient means which I have employed for separating the liquids. Since Kopp first called the attention of chemists to this subject, different theories have from time to time been advanced by Schröder, Löwig, Gerhardt, and others, and supported by laborious research and observation. It will be interesting to examine some of these theories in the light of the new facts which I am about to present. Schröder,[‡] not satisfied with Kopp's explanation of the discrepancies between the observed and theoretical boiling points, on the ground of errors of determination of the former, argues that the influence of C_2H_2 on boiling points is variable in different series, according to the peculiar nature of the C_2H_2 in each case. He regards organic compounds for the most part made up of radicals, which he calls "compounds," of which he

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[*] This table, which first appeared in an English journal, was reprinted by Gerhardt in his memoir on the anhydrous organic acids.—*Annales de Chimie et de Physique*, 3rd series, xxxvii., p. 339.

[*] *Ann. der Chemie und Pharmacie*, 1842, xli., 79, 169; 1845, lv., 177, &c.

[†] *Annalen der Chemie und Pharmacie*, 1855, xcvi., 2.

[‡] *Poggendorff's Annalen*, 1844, lxii., 184. 337.

makes seven. Three of these are composed of carbon and hydrogen, viz. :—

Formyl = (C_4H_2)—" (C_4H_4) "—which is supposed to raise the boiling point of a substance 52° C.

Methylen = $(C_2H_2)^m$—" $(C_2H_4)^m$ "—which is supposed to raise the boiling point of a body 21°.

Elayl = $(C_2H_2)^e$ —" $(C_2H_4)^e$ "—which is supposed to raise the boiling point 17°. Subsequently (*Pogg. Ann.*, lxiv., 101) the latter number was changed by Schröder to 16°.

A fourth component was made up of a double atom of hydrogen, (H_2)—" (H_4) "—which was supposed to lower the boiling point 3°; but this also was afterwards changed to 10° (*Pogg. Ann.*, lxiv., 372). (The other three components, having no direct bearing on the hydrocarbons, are omitted.) By means of these components Schröder (*Pogg. Ann.*, lxii., 188) proposed to calculate the boiling points of different substances in the following manner:—Having estimated the sum of the influence of the different components of a body, the number 70 was in all cases to be deducted. Subsequently Schröder[§] was led to substitute, in these calculations, the influence of the separate elements for that of the components. Each double atom of carbon (C_2) was estimated to raise the boiling point of a compound 31°; and each double atom of hydrogen (H_2) to lower it 10°. As in the former case, the number 70 was to be deducted from the sum of the influences of the different elements contained in the compound, to give the true boiling point. Example: Calculation of the boiling point of benzole, $C_{12}H_6$; $C_{12} = 6C_2$; $31 \times 6° = 186°$; $H_6 = 3H_2$; $— 10° \times 3 = — 30°$; $186° — 30° — 70° = 86$ = the calculated boiling point of benzole by this method; which agrees exactly with the latest determination at the date of Schröder's memoir.

Löwig[‖] estimates the influence of the elementary atoms on the boiling point differently from Schröder; and obtains numbers such that, to find the boiling point of a compound, it is only required to add together the numbers corresponding to the elementary atoms which it contains, without deducting from this sum a constant number, as by Schröder's method. According to Löwig's theory, one atom of carbon (C) raises the boiling point 38·4°, and one atom of hydrogen (H) lowers it 29·2°; these numbers being for carbon nearly two and one-half times, and for hydrogen nearly three times as great, as those of Schröder.

Gerhardt,[¶] in a special paper "On the Boiling Point of the Hydrocarbons," observes that "The boiling point of the hydrocarbons appears to obey a very simple law, according to which it is raised or depressed a certain number of degrees, corresponding to the number of equivalents of carbon or hydrogen contained in its equivalent."[**] From a comparison of the boiling points and formulæ of several well-known hydrocarbons, the determinations of which were repeated with special care for this purpose, Gerhardt finds that the addition of C_2 to the molecule of an hydrocarbon raises its boiling point 35·5°, and that the addition of H_2 lowers it 15°. The boiling point of a body is calculated from these numbers by comparing its formula with oil of turpentine, $C_{20}H_{16}$, as a standard, the boiling point of which is taken at 160° C. Example: cumole (from cuminic acid) has the formula $C_{18}H_{12}$; hence it contains C_2 less than oil of turpentine; therefore, 35·5° must be deducted from 160° (the boiling point of oil of turpentine), which leaves 124·5°; but as the cumole contains $2H_2$ less than oil of turpentine $15° \times 2 = 30°$ is to be added to the above remainder; thus $124·5° + 30° = 154·5°$, the calculated boiling point of cumole. Gerhardt's direct determination was 153°, which very nearly coincides with his theory.

It would be foreign from my purpose on the present occasion to consider these different hypotheses, or even the empirical law of Kopp, beyond their special relation to the boiling points of the hydrocarbons, and such other series, derivatives from the hydrocarbons, as have been made the subjects of my own experiments. Anything more than this would be merely speculative. The want of more accurate determinations of boiling points as essential to safe and reliable deductions and generalisations on this question has frequently been observed. The need of this will be made strikingly apparent by comparison of my results with those of previous observers. Indeed, if my determinations may be taken as a criterion—which, considering the nature of the materials operated upon, might not be quite fair—the inaccuracies of the boiling points which have hitherto been published are probably so numerous, and in many cases so considerable, as to make it appear almost useless to attempt further generalisations upon those unreliable data. It may be hoped, however, that the superior means which my process furnishes for separating mixtures of liquids will lead to the accumulation of reliable facts of sufficient number and variety for a profitable review of this question in its different bearings, which from its importance, it clearly merits.

The frequent inaccuracy of the determinations of boiling points, upon which Kopp has justly laid so much stress, may, I think, be more reasonably attributed, at least in a majority of cases, to a want of purity in the substances themselves, rather than to a neglect of the precautions and corrections which he recommends to be observed in such determinations; although errors as great as those mentioned by Kopp[††] may doubtless occur, and in the particular instances which he had in mind may have occurred from the cause which he assigned for them. It should be borne in mind, however, that these errors, in the case of an impure substance, may be compensating errors; or, on the other hand, they may go to increase that which would arise from impurity.

That the conditions under which my results have been obtained may be clearly understood, and hence the value of these results fairly estimated, in comparison with those of others, I shall endeavour, as I proceed with these researches, to specify, in sufficient detail, the processes which I have employed. Having, in the memoir previously referred to, described the process by which the hydrocarbons were separated, the special object of this paper only requires, in this regard, that I should add a description of the method employed in determining the boiling points of these bodies, which has already been partially given in the foregoing memoir, when treating of the boiling point of benzole.

(To be continued.)

Chemical Society.—The next meeting will be held on Thursday, February 1, at 8 o'clock, when the following paper will be read:—"Utilisation of Town Sewage," by Dr. Gilbert.

[§] *Pogg. Annalen*, 1845, lxiv, 367; 1846, lxvii., 45.

[‖] *Idem*, 1845, lxv., 250.

[¶] *Annales de Chimie et de Physique*, 1845, [3], xiv., 107.

[**] "Il paraît que le point d'ébullition des hydrogènes carbonés est soumis à une loi fort simple, d'après laquelle il s'élèverait ou s'abaisserait d'un certain nombre de degrés suivant le nombre des équivalents de carbone ou d'hydrogène renfermés dans leur équivalent."

[††] "Bestimmung des Siedepunkts." *Poggendorff's Annalen*, 1847, lxxii., 38.

TECHNICAL CHEMISTRY.

Memoir on the Utilisation of Chlorine Residues and Soda Waste, by M. E. Kopp.*

(Continued from page 28.)

By the treatment described in our last 10,000 litres of chlorine residues ought to separate from the soda waste thirty-six kilogrammes of pure sulphur, which would be found in the wells excavated at the lowest part of the reservoir, and only require washing and drying to be made ready for use in the manufacture of sulphuric acid.

The next step in M. Kopp's process is the saturation of the acid liquor which has been syphoned from the reservoir into an appropriate cistern. This liquor contains the hydrochloric acid originally present (only a part of which has been saturated by the soda waste), and some formed by the decomposition of the sulphuretted hydrogen—

$$Fe_2Cl_3 + HS = 2FeCl + S + HCl.$$

Manganous, ferrous, barytic, and calcic chlorides are also present. We need not quote the author's special remarks on the presence of chloride of barium, since English residues in general contain but little, if any of this salt.

The liquor having been pumped or syphoned into a vessel is to be completely saturated with soda waste. In this operation a large amount of sulphuretted hydrogen is evolved, which is to be utilised. The author describes at length the apparatus in which the operation is best carried on. We may mention shortly that it consists of a large leaden chamber, capable of holding 30,000 litres of liquor, the sides of which are supported on the inside with wood. Very near the bottom is an opening by which the solid deposit may be removed; and above this is another opening with a tap by which the liquor may be run off. At the top is a man-hole, which is closed by a lead-covered sheet-iron lid fitting into a groove filled with lime-water, to make the lid air-tight. This lid also acts as a safety-valve, for in case of an explosion in the interior only the lid is blown away.

Around the man-hole are arranged: 1. Another opening (also trapped) by which the liquor enters the vessel. 2. A tube to carry off the sulphuretted hydrogen. 3 Another tube to carry a jet of steam into the apparatus. 4. A box sufficiently large to hold the soda waste necessary to completely saturate the liquor in the reservoir. This may be an upright vessel of sheet-iron, the sides of which are contracted towards the top, so that it may more easily be fitted with a water-trapped cover. The box is fitted with an Archimedean screw to push the waste into the leaden chamber. Our readers will understand that all parts of this apparatus must be air-tight, to prevent the escape of sulphuretted hydrogen into the atmosphere.

The chamber being charged with the acid liquor, and the box with the soda waste, steam is passed into the liquor to raise the temperature to about 30° C. The screw is then set in motion, and the waste pushed gradually and regularly into the chamber. In the reactions which ensue a mixture of carbonic acid and sulphuretted hydrogen is evolved, generally about 27 volumes of H_2S to 13 volumes of CO_2.

To remove the carbonic acid, the mixed gases are made to traverse moist and warm soda waste. Here the carbonic acid and vapour of water decompose sulphide of calcium, forming carbonate of lime and sulphuretted hydrogen. This reaction is best effected in a cylinder of sheet iron fitted with a perforated double bottom. Well drained, but moist waste is placed on this bottom, so as to nearly fill the cylinder. The mixed gases pass in below, and the sulphuretted hydrogen escapes by a pipe at the top, which carries it away to a gasometer. In winter it is advisable to have an outer cylinder, so that a steam heat may be applied to the inner cylinder containing the waste; but in summer, and when operating on a large scale, external heat is not necessary.

This part of the operation, it will be seen, is of some importance, since each volume of carbonic acid is made to liberate an equal volume of utilisable sulphuretted hydrogen.

The sulphuretted hydrogen might be conveyed at once to the burners, but it is convenient to interpose a small gasometer as a regulator. The gasometer may be arranged in the ordinary way, but in place of pure water a very weak solution of polysulphide of calcium must be employed; drainings from the heaps of waste will answer well for the purpose. The reason for employing the alkaline solution is evident. Sulphuretted hydrogen in solution in water soon decomposes, and the water, becoming acid, would act on the metal of the gas holder. Some decomposition also takes place with the alkaline solution, but this remains alkaline a long time, and it is only necessary to renew it at distant intervals.

The author next proceeds to the best methods of utilising the sulphuretted hydrogen by combustion, to which we shall return next week.

(To be continued.)

On the Manufacture of Citric Acid, by Frederick Row, *F.C.S.*

As so little attention has hitherto been given to the manufacture of these organic acids by scientific men (probably on account of the small quantity annually produced), a few observations from practical experience may not be uninteresting.

The first point of importance in this manufacture is the defecation of the lime or lemon-juice imported, and from which almost all the citric acid of commerce is produced.

This juice contains, beside the citric acid, a large quantity of colouring matter, mucilage, and other impurities, which in the ordinary method of working so contaminates the citrate of lime next produced as to render the subsequent solution, and also the crystals of citric acid, so impure that repeated re-crystallisation and re-saturation are necessary to render them fit for the market.

Hitherto it seems to have baffled the efforts of manufacturers to overcome this difficulty, and hence the great cost at which the acid is prepared; but the writer of this paper has found that when the concentrated juice is diluted to the same strength as the fresh juice (which contains about twelve ounces of citric acid to the gallon) that a great part of the mucilaginous and other impurities will separate by subsidence in a flocculent form, and the citrate of lime and also the citric acid produced from the juice so purified will be in a state of comparative purity.

Another very important point for consideration of the manufacturer is the way in which the solutions of these acids are evaporated; the sulphuric acid necessary to be in slight excess at first so accumulates in percentage by

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* Abridged translation from the *Bulletin de la Société Chemique*, p. 335, 1865.

the repeated evaporation and crystallisation of the citric acid out of the solutions, as to cause a most destructive action upon that remaining in the mother liquors. Various means have been used to prevent this, the most successful being doubtless the substitution of water for steam heat during evaporation, but as the lower temperature requires longer exposure to heat, the advantage thus gained is almost counteracted.

The most effectual means of remedying this is by passing the mother liquors so soon as they are found to contain any dangerous amount of sulphuric acid through a fresh portion of citrate of lime, which not only removes at once all free sulphuric acid contained, but there is also deposited a quantity of flocculent matter which was held in solution by it, and which is no doubt the cause of the mother liquors when old crystallising only with such difficulty. The flocculent precipitate referred to consists for the most part of sulphate of lime, but contains also some phosphate of iron and alumina, and accumulates more or less according to the care bestowed in evaporating the solution, it being most insoluble when the liquor contains about 6 lbs. of citric acid to the gallon, marking 1200 to 1250 (according to temperature) on the hydrometer, and if not separated from the solutions at that point it partly dissolves again as they became more concentrated.

As a consequence of this, it is found necessary, in the usual working, to re-saturate these solutions so soon as they became surcharged with these matters and the sulphuric acid above referred to, and thus renew the whole process continually, which of course necessarily increase greatly the expense of working, as well as loss both in time and material; but when the process of purifying referred to is adopted, it is found practicable to work continuously with the same liquors without saturating, (of course depending upon the amount of carefulness in the manipulation), and in such case the cost of production is lessened nearly one-half. The crystals of citric acid also being most tenacious of sulphate of lime will often hold it so as to render them contaminated even to the second or third crystallisation, producing an opacity which when dried gives them an appearance of efflorescence; materially affecting their commercial value.

This difficulty, which is also, in the opinion of the writer, to be overcome, will form part of a future paper.

Braintree, January 13, 1866.

PHARMACY, TOXICOLOGY, &c.

A New Anæsthetic.

Bichloride of carbon, the new anæsthetic, was first, I believe, discovered by M. Regnault, in 1839. It has already received various appellations from various chemists, as perchloroformene, perchlorinated chloride of methyl, dichloride of carbon, carbonic chloride, tetrachloride of carbon, superchloride of carbon, perchloruretted hydrochloric ether, and perchloruretted formene (see Gmelin's "Handbook of Chemistry," vol. vii, p. 355, and Watts' "Dictionary of Chemistry," vol. i., p. 765).

If it becomes, as I believe it will, for some medicinal purposes, an article of the Materia Medica, it will require to have a pharmaceutical name appended to it, and perhaps the designation of Perchloroformene, or the shorter term Chlorocarbon, may prove sufficiently distinctive. In its chemical constitution, bichloride of carbon, or chlorocarbon, is analogous to chloroform; with this difference, that the single atom of hydrogen existing in chloroform is replaced in chlorocarbon by an atom of chlorine; for the relative chemical constitution of these two bodies may be stated as follows:—

Chloroform $= C_2HCl_3$
Chlorocarbon $= C_2ClCl_3$.

The chlorocarbon can be made from chloroform by action of chlorine upon that liquid, and Geuther has shown that the process may be also reversed, and chloroform produced from chlorocarbon, by treating it in an appropriate vessel with zinc and dilute sulphuric acid, and thus exposing it to the action of nascent hydrogen. The most common way hitherto adopted of forming bichloride of carbon consists in passing the vapour of bisulphide or bisulphuret of carbon, together with chlorine, through a red hot tube either made of porcelain or containing within it fragments of porcelain. There result from this process chloride of sulphur and bichloride of carbon, the latter being easily separated from the former by the action of potash.

The Bichloride of carbon or chlorocarbon is a transparent, colourless fluid, having an ethereal and sweetish odour, not unlike chloroform. Its specific gravity is great, being as high as 1·56, chloroform is 1·49. It boils at 170° F., the boiling point of chloroform being 141°. The density of its vapour is 5·33, that of chloroform being 4·2.—*Extracted from a paper by Dr. Simpson.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, January 18.

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 donations to the Society's library duly acknowledged. Dr. Edmund J. Mills, Mr. A. Gardiner Brown, M.R.C.S., and Mr. Ernest T. Chapman were formally admitted Fellows of the Society; and the following gentlemen were duly elected by ballot—viz., Mr. John Conroy, Christ Church, Oxford; Mr. Thomas B. Redwood, 19, Montague Street, Russell Square; Mr. Robert Henry Smith, Rodney Street, Pentonville; and Mr. James Speir (of Messrs. Barclay and Speir), Newcastle-on-Tyne. A proposition was made from the chair for the purpose of removing from the list of Fellows the names of certain members who had allowed their annual subscriptions to remain unpaid during three years and upwards. The President read the 4th bye-law applicable in such cases, and stated that the ballot for their expulsion would be taken at a future meeting. Their names were then read, as under:—C. W. Bingley, Ph.D., Henry Brunner, John Christian, Samuel Highley, Dr. E. T. Kirkpatrick, T. Ludwig, John Mitchell, Peter MacOwen, James Napier, C. W. Quin, H. C. Salmon, W. V. Simons, C. A. Sauceau, James Taylor, A. N. Tate. The President said he had much pleasure in mentioning a circumstance which proved how highly the connexion with the Society was appreciated in other quarters. Mr. John Jones, of Newport, Monmouthshire, had his name struck off the list of members twelve months ago as being nine years in arrear of payment, and his address being at the time unknown. Mr. Jones had, however, just now sent a cheque for the whole amount due to the Treasurer, with a request that he might be reinstated a Fellow of the Society. Such a step could only be decided by the result of a fresh ballot, which was accordingly taken, and the gentleman in question was unanimously re-elected. The names of the candidates proposed for the first time were—Mr. G. B. Ferguson, B.A., Magdalen Hall, Oxford; Mr. Benjamin Nickels, Making Place Hall, Ripponden, near Halifax; Mr. Samuel Crawley, Training College, York; and Mr.

W. H. Walenn, Talbot Road, Tufnell Park West. For the second time were read the names of Mr. Arthur E. Davies, Surgeons' Hall, Edinburgh; Mr. Franklin Epps, Great Russell Street; Mr. Edward Purser, jun., 116, Fenchurch Street; and Mr. William Thorpe, 13, York Terrace, Kingsland Road.

Dr. J. H. GLADSTONE read a paper "*On Pyrophosphotriamic Acid.*" The substance in question was produced by the action of ammonia gas upon oxychloride of phosphorus, kept cold at first, but afterwards maintained at the temperature of 100° C. The resulting mass, being acted upon by cold water, leaves insoluble the white flocculent pyrophosphotriamic acid which requires to be washed with water, and finally with dilute alcohol, until free from ammoniacal salt. Its formation is thus explained—

$$2(PCl_3O + 4NH_3) + 2H_2O = P_2N_3H_7O_4 + 5NH_4Cl + HCl.$$

The constitution of this acid relative to the other members of the series will be seen in the following comparison:—

Pyrophosphoric acid . .	P_2		H_4O_7
Pyrophosphamic acid . .	P_2	(NH_2)	H_3O_6
Pyrophosphodiamic acid .	P_2	$2(NH_2)$	H_2O_5
Pyrophosphotriamic acid .	P_2	$3(NH_2)$	$H\ O_4$

Like the acid itself, the compounds are all insoluble, or very sparingly soluble, in water, the salts of the alkalies not excepted. Another peculiarity is the power of combining with one, two, three, or four atoms of the base, according to the properties of the metal itself, or the manner in which it is presented. Thus, the potassium and ammonium salts are mono-metallic; cobalt, dimetallic; copper unites in two proportions, forming a blue mono-salt and a greenish di-salt; barium behaves like copper; lead compounds were produced containing one, two, and three atoms respectively of the metal; silver forms a white mono-salt and an orange-yellow, tri-metallic compound; mercury and platinum form only tetra-salts. Aluminium, chromium, and gold do not combine with the acid, but there is a definite thallium salt, and also a ferrous compound, but no ferric-pyrophosphotriamate.

The PRESIDENT made some inquiries respecting the anomalous constitution of the mercury and platinum compounds, and

Dr. ODLING cited a parallel in benzamide, the hydrogen of which leaves the nitrogen in certain reactions, enabling a metal or other radical to enter into its place. He did not, therefore, conceive it impossible for a tetra-compound to be formed from pyrophosphotriamic acid.

Professor WANKLYN then gave an account of his recent researches "*On the Action of Carbonic Oxide upon Sodium-Ethyl.*" A short notice of the changes in question appeared in the CHEMICAL NEWS of the 29th ult., and the reaction was thus expressed:—

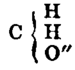
$$CO + 2NaC_2H_5 = Na_2 + CO(C_2H_5)_2.$$

The product is diethylated formic aldehyde, or the ketone of ethyl-propionyl, and is an oily body having a boiling-point of 105° C. Its analysis gave the following numbers:—

	Experiment.	Theory.
Carbon . . .	68·55	69·77
Hydrogen . .	12·31	11·63

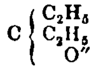
And its constitution must accordingly be as follows:—

Formic Aldehyde.



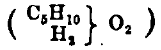
$$C\left\{\begin{array}{l}H\\H\\O''\end{array}\right.$$

New Body.



$$C\left\{\begin{array}{l}C_2H_5\\C_2H_5\\O''\end{array}\right.$$

For the preparation of this substance ten grammes of zinc-ethyl, mixed with one gramme of sodium-ethyl, were introduced into a Winchester quart of carbonic oxide gas, by which operation from one to two cubic centimetres of the oily body were produced, with liberation of the metals in the form of a black powdery deposit, very similar in appearance to finely-divided charcoal. The greater part of this liquid product boiled at 105° C.; the rest at 150°, and a little ether was found in that portion which distilled over at about 110° C. Like the propione of Morley, this substance refused to combine with bisulphite of sodium. The ketone takes up oxygen and hydrogen with formation, it was believed, of the hydrate of amylene of Wurtz,



$$\left(\left.\begin{array}{c}C_5H_{10}\\H_2\end{array}\right\}O_2\right)$$

A larger quantity of material will be required to decide whether this is actually the case; and the author considered that he had obtained evidence of the synthetical formation of heptylic alcohol; but upon this point, likewise, he could not speak with confidence at present. Prof. Wanklyn concluded with some remarks upon the constitution of carbonic oxide, and suggested that the oxygen in this compound might have an atomic value equal to 8.

The PRESIDENT, in proposing a vote of thanks to the author, said that, without disparaging the value of the results already obtained by Mr. Wanklyn, he much regretted that they had been brought forward in an obviously incomplete condition, for many of the most important considerations must remain for the present unanswered. No one could doubt the ability of the author to accomplish all he proposed; but it was nevertheless a matter of regret that he had not studied more of the details before deciding upon their publication.

Professor WANKLYN explained that his paper had been promised for that evening, and he had been somewhat unfortunate in the interim, or it was his intention to have illustrated the reaction by an experiment in the meeting-room. His apparatus had, however, been destroyed by an explosion that same morning.

Dr. FRANKLAND compared the new body with common acetone, from which it differed only in the substitution of ethyl for one atom of hydrogen. The action of the alkaline bisulphite was likewise another point of difference.

Professor G. C. FOSTER cited other instances of anomalous constitution which, in his opinion, could not be explained by admitting the alleged peculiarity of the oxygen in carbonic oxide. He thought that the carbon should be considered diatomic rather than the oxygen tetratomic.

Dr. WILLIAMSON offered some observations upon the same subject, quoting the instances of the ter- and pentachlorides of arsenic and phosphorus in proof of the necessity for assuming a different "equivalence" in the case of the elements—phosphorus and arsenic—in those compounds. He thought it would be proper to admit that the tetra-equivalent atom of carbon in carbonic oxide was saturated by oxygen.

Mr. NEWLANDS suggested another interpretation of the chlorides of antimony by referring them to the type of ammonia; the terchloride would then become trichlorostibine.

Dr. DEBUS then offered some remarks "*On the Constitution of Glyoxylic Acid,*" which he explained on a bimolecular theory; and proceeded to show how he arrived at the conclusion that the hydride of ethyl and the body named methyl *must* be identical, as asserted by Mr. Schorlemmer, but not yet assented to by Dr. Frankland. The formulating of Dr. Maxwell Simpson's new acid by an infinity of methods brought the proceedings to a close at an unusually late hour.

The next meeting will be held on February 1, when Dr. Gilbert will deliver a lecture "*On the Composition, Value, and Utilisation of Town Sewage.*"

The Council has recently issued the following memorandum:—

"Notice is hereby given that, in accordance with a resolution passed at an extraordinary general meeting of the Chemical Society, held on November 16, the Council are about to dispose of the Society's collection of chemical specimens. Donors wishing to have their respective specimens returned to them are requested to apply at once to the Secretaries.

"W. Odling,
"A. V. Harcourt, } Hon. Secs."

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 4.

(*Continued from page 30.*)

Tuesday, April 25, 1865.

On some of the Discoveries in Agricultural Chemistry.

Before asking your especial attention to some of the most important mineral matters which exist in soils, I wish to say a few words on some of the researches published a few years since by Professor Way, in which that gentleman showed that soils had the power to retain with great tenacity certain mineral matters, which, although soluble in water, could not be removed from soils even when brought into contact with great quantities of water. He further demonstrates that if he made to percolate through a given quantity of soil certain soluble salts, such as those of soda, potash, and ammonia, these would be retained in the soil, whilst the acids with which these bases had been combined would unite with some of the elements previously existing in the soil, pass off, and the alkalies themselves remain fixed. Thus, according to him, the retentive power of soils was due to the presence in them of a small quantity of double silicate of alumina. Thus, for instance, a double silicate of alumina and soda, when brought in contact with lime, will part with soda and take up lime; but if this silicate, in its turn, is in presence of magnesia, the lime will pass in solution and the magnesia be retained. If, then, a salt of potash is employed, the magnesia will be removed from the double silicate and the potash take its place. If ammonia be brought in contact with the above silicates, except that of potash, it will substitute itself for soda, lime, or magnesia. These valuable researches prove to farmers that they have nothing to fear as to the loss of any valuable manure, such as compounds of ammonia and potash, which they might employ as manure on their lands, even if these were drained, for the potash or ammonical salts employed by them as manures, and spread on the surface, would not pass off in the drainings of the land, but be retained by the soil under the form of a double silicate until required by plants, and decomposed under the influence of that mild but still all-powerful force called vitality. The researches of Professor Way have been extended by those of Dr. Voelcker, who, instead of employing simple salts, employed complicated liquids on various classes of soils—namely, calcareous clay soils, and ferruginous, sterile, sandy soils—and obtained the following results:—

1. That the calcareous clay soil absorbs about six times as much ammonia from the liquid manure as the sterile sandy soil.
2. That the liquid manure in contact with the calcareous clay soil becomes much richer in lime; whilst during its passage through the sandy soil it becomes poorer in lime.
3. That the calcareous soil absorbs much more potash than the sandy soil.
4. That chloride of sodium, in conformity with the results of other observers, was not absorbed to any extent by either soil.
5. That both soils removed from the liquid most of the phosphoric acid.
6. That the liquid in passing through the calcareous soil becomes poorer; and, on the other hand, in passing through the sandy soil becomes richer in soluble silica.

These researches of Dr. Voelcker led him to a somewhat different conclusion to that adopted by Professor Way. He does not think that the silicates of alumina and magnesia that exist in soils have all the retentive power attributed to them by Professor Way, but that potash and ammonia are retained in soils by the peroxide of iron and alumina which they contain, acting as weak acids with respect to the alkalies. He also considers that it is the same oxides which act as fixing agents of the phosphoric acid that may be added on soils as manure, under the form of superphosphate of lime, or similar compounds. The researches of P. Thénard, Way, and Voelcker point to the interesting fact that some of the most apparently useless elements in soils, such as alumina, oxide of iron, &c., are in reality the most useful; for although they do not take an active part in promoting vegetation, still they are the medium by which essential substances, such as fumic acid, phosphoric acid, potash, and ammonia are retained and stored in soils until required to promote growth and vegetation.

Before drawing your attention to a few of the substances that a soil should contain, not only to enable it to support vegetation, but to promote it in a high degree, I deem it my duty first to give here a few tables which shall give you an idea of the various mineral matters which chemists have found to exist more or less abundantly in vegetables, and which are found to compose the ashes left by vegetable matters when incinerated. The first table gives the amount of mineral matters in a thousand parts of many of our ordinary agricultural products:—

Mineral Matters in Plants in 1000 Parts.

Wheat, about	20
Barley	30
Oats	40
Rye	20
Maize	15
Beans	30
Peas	30
Potatoes	8 to 15
Turnips	5 to 8
Carrots	15 to 20
Wheat straw	50
Barley straw	50
Oat straw	60
Rye straw	40
Meadow hay	50 to 100
Clover hay	90
Ryegrass hay	95

The second table gives you an outline of the relative proportions of some of the most important mineral substances existing, in the ashes of several of the commonest cereals and roots cultivated by our farmers:—

Mineral Matters in Plants.

	Wheat.	Barley.	Oats.	Rye.	Potatoes.	Turnips.
Potash	237	136	262	220	557	419
Soda	91	81	—	116	18	51
Lime	28	26	60	49	20	136
Magnesia	120	75	100	103	52	53
Oxide of iron	7	15	4	13	5	13
Phosphoric acid	500	390	438	495	125	76
Sulphuric acid	3	1	105	9	136	136
Silica	12	273	27	4	42	79
Chlorine	—	traces.	3	—	42	36
	998	997	999	1009	997	999

These tables naturally point out the great variety of mineral matters that enter into the composition of the ashes of plants, and also will familiarise your minds with the important relations which some of those minerals have to the growth of plants which contain them. But before adverting to the part which some of these minerals play in vegetation, it is desirable that I should refer to the relative quantities of mineral matters taken from the soil where they are grown, in what is called by farmers a rotation of crops.

Rotation of Crops. Quantity of Produce Removed from One Acre of Ground.

				lbs.
1st year	Turnips	Bulbs		51,000
		Tops		14,000
2nd ,,	Barley	Grain		2,116
		Straw		2,040
3rd ,,	Clover			2,030
	Ryegrass			2,060
4th ,,	Wheat	Grain		920
		Straw		3,570
				77,736
	Moisture		19,230	
	Mineral		1,284	
				20,514
	Organic			57,222

Although these tables illustrate the quantity of the mineral matters, their variety, and relative proportions, existing in plants, and lastly the total amount of the various minerals which a rotation of crops removes from the soil, still they do not point out to you which are the most essential to vegetation. Perhaps the word "essential" which I have just used is not correct, for all the mineral matters found in a plant must be essential to its existence and to its growth; but some of these minerals exist, generally speaking, in soils, and that in sufficient quantities for the wholesome growth of the plant; others are in minute quantities, and they are soon removed by successive crops, and if the mineral elements which compose that soil cannot by their decay or chemical decomposition set free or bring into fit condition for the coming crop these peculiar, rare, and still essential elements of vegetation, the soil will not reproduce the crops which require for their production those peculiar mineral substances. For example, a sufficient quantity of phosphates for turnips, or a sufficient quantity of potash for mangolds, or a sufficient quantity of silicates and phosphates for wheat and other graminous plants. It therefore becomes necessary that I should dwell for a few minutes on some of the most important mineral substances that should exist in the soil for peculiar crops, or should be added to it as a manure if that soil is not exhausted of those treasures of vegetation.

The first substance belonging to this class to which I desire to draw your attention is phosphorus. It is only within the last fifteen or twenty years that the importance of phosphorus to vegetation has been demonstrated. Although experience has led certain farmers to the knowledge that phosphates—for example, ground bones—would promote the growth of meadow lands, still the honour is due to Liebig, not only of having pointed out, but proved the importance of phosphorus, or rather of phosphates, as essential elements of the rapid growth of plants, and especially of roots, for he was the first to call the attention of the agricultural world to the benefits to be derived, if, instead of using phosphate of lime in its insoluble state as it exists in bones,[*] it was added to soils either in a soluble condition or in one which might easily become so under the influence of certain agents to which I shall hereafter refer. It is since the publication of his ideas that we have had the researches of Boussingault, Lawes, Dr. Gilbert, Dr. Voelcker, and Ville, who have shown, on the one hand, the importance of phosphates to vegetation, and, on the other, the extremely small quantities which exist naturally in soils; for chemists have been able to discover only traces of phosphoric acid in ordinarily cultivated soils, and these minute quantities had been traced as existing in primitive rocks forming those soils; and although I am quite ready to admit that agricultural chemistry is still in its infancy, and can at the present time give only here and there useful information to the farmer, or insights into certain phenomena which take place in agriculture, still it cannot be denied that when we consider that it is only within the last twenty or thirty years that chemistry has really attempted to unravel the mysteries attending vegetation, and also to give a clear and scientific explanation of facts which hundreds of years have revealed to man, we cannot deny that in pursuing the same course for a hundred years most invaluable and enlightened information will be thrown upon agriculture, and instead of being the result of mere experience, which often leads to failures, the farmer will base his operations on sound and scientific principles, which will enable him to obtain from his land the full yield it is capable of producing. The best proof of the correctness of this statement is that in England, where chemical agriculture has made the greatest advance, farmers, as a rule, have ceased to allow the land to lie fallow—an operation which had for its object to allow the atmosphere to act upon the mineral elements of the land, so as to modify them in such a way as to liberate some of the scarce and still essential elements of vegetation, such as potash and phosphoric acid. In fact, so true is the rapid removal of phosphoric acid from what we call fertile land and its importance to the successful rotation of crops now adopted by most of the intelligent farmers of this country, that not only are bones imported from Australia, South America, and the Continent, but even minerals, such as apitite, are imported from Norway, and phosphorite from Estremadura, in Spain, and also under the form of semi-fossilised guano, under the names of Sombrero and Kooria Mooria guanos. But even these abundant sources of phosphoric acid do not appear to be sufficient to supply the large demand that there is at the present day for phosphates or super-phosphates for agricultural purposes, for large quantities of fossilised coprolites abundantly found in Cambridgeshire, Suffolk, and Bedfordshire are used especially under the name of super-phosphate of lime. As to the mode in which they are treated to produce the valuable agricultural manure (super-phosphate of lime), I must refer you to the first lecture which I had the honour to deliver before you last year, in which also you will find the proportions of such super-phosphates of lime, the average composition of which I shall take the liberty of repeating here:—

Soluble phosphate	22	to 25	per cent.
Insoluble ,,	8	10	,,
Water	10	12	,,
Sulphate of lime	35	45	,,
Organic matter	12	15	,,

Nitrogen 0·75 to 1·5 per cent.

Although super-phosphate of lime is a soluble salt when added by the farmer on the surface of his land either dissolved in water or in the state of a powder, still this solubility must rapidly disappear when in contact with the soil, for the soluble phosphate of lime is due to the excess of phosphoric acid which it contains, and the excess disappears when in contact with the soil, as it meets, generally speaking, carbonate of lime or of magnesia, or oxide of iron, which neutralise the excess of acid, rendering thereby the remaining portions of phosphate of lime insoluble. It, therefore, becomes interesting to inquire

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[*] The general composition of bones may be considered to be as follows:—

Bones.

Organic Substances.	Bloodvessels	1
	Osseine	32
	Fatty matters	9
Mineral Substances.	Water	8
	Phosphate of lime	38
	Phosphate of magnesia	2
	Carbonate of lime	8
	Divers salts	2
		100

how an insoluble substance becomes soluble to render it fit to be absorbed by the spongioles or the roots of plants so as to convey it into the plants themselves. This is effected by carbonic acid gas dissolved in water, which penetrates into soils, or by the fumic acid discovered in soils by Thénard, or by a non-neutral substance, similar in its composition to sugar, which has also the power of rendering soluble the insoluble phosphates existing naturally in the soil or added to it by the hand of man.

(To be continued.)

ACADEMY OF SCIENCES.

January 15, 1866.

M. J. Pelouze presented a "*Memoir on the Sulphides,*" the first part of which is devoted to an account of the "*Action of Soluble Sulphides on Salts of Lime and Magnesia.*" The author experimented with pure monosulphide of sodium, prepared by passing sulphuretted hydrogen into soapmaker's ley. The crystals obtained were drained, redissolved, and recrystallised once or twice, until they were colourless and quite pure. With a solution of this salt a weak solution of acetate and chloride of calcium give a distinct white precipitate; strong solutions give an abundant precipitate. A solution of sulphate of calcium also shows a cloudiness. When an excess of the calcic salt is employed a precipitate is not seen, or it instantly redissolves, whatever may be the strength of the solutions. This circumstance explains how it happened that chemists have asserted that sulphides give no precipitate with calcic salts. The precipitate which is formed consists of *hydrate of lime;* the supernatant liquor contains *sulphydrate of sulphide of sodium*. The reaction with the acetate is represented by the following equation:—

$$CaO,\bar{A} + 2NaS + 2HO = CaO,HO + NaO\bar{A}, + NaS,HS.$$

With the salts of magnesia a corresponding reaction takes place, hydrate of magnesia being precipitated, and the before-mentioned sodium compound remaining in solution. But the reaction in the case of magnesia is more definite than with lime, since the hydrate of the latter is, to a certain extent, soluble in water, while the hydrate of magnesia is completely insoluble. The sulphydrates of alkaline sulphides appear to be much more stable than they have been supposed to be; for the mixture of these with the hydrates above mentioned may be boiled without producing any change; and it is curious, as M. Pelouze remarks, to find an energetic base like the hydrate of lime existing in contact with the solution of an acid salt. With salts of alumina and glucina, the alkaline sulphides precipitate the hydrates of alumina and glucina, sulphuretted hydrogen being set free. This reaction is well known.

The second part of the memoir is devoted to a notice of the "*Sulphides and Sulphydrates of Calcium and Magnesium.*" Sulphide of calcium cannot be obtained by precipitation; it must be made by decomposing the sulphate of calcium with charcoal. The author confirms the statements of Mr. Gossage and M. Scheurer-Kestner as to the insolubility of this compound, and also that of Rose, to the effect that by long contact with water the sulphide decomposes, producing lime and sulphydrate of sulphide of calcium. It is curious that sulphide of calcium cannot be procured by passing sulphydric acid into milk of lime. It is always sulphydrate of the sulphide which is produced, and the undissolved lime, when washed, shows no trace of the mono-sulphide. Sulphide of magnesium is also but very little known. Berzelius says that it is best prepared by passing sulphydric acid into a milk of magnesia until a considerable quantity of the hydrate of magnesia is dissolved. M. Pelouze has tried this method, and found that a sulphide is never formed under these circumstances, but that the same happens as with hydrate of lime. A sulphydrate of sulphide of magnesium is obtained in solution, and hydrate of magnesia remains undissolved. No monosulphide of magnesium is ever formed. The author intends to return to the subject in a future communication.

M. Terreil communicated "*A Method of Separating Cobalt from Nickel, and Manganese from Cobalt and Nickel.*" To separate cobalt from nickel, the author proceeds as follows:—To a solution of the two metals he adds ammonia until the oxides are redissolved. He then heats the liquor, and to the hot solution adds a solution of permanganate of potash until the mixture remains violet from an excess of permanganate. He then boils for a few minutes and redissolves the oxide of manganese with a slight excess of hydrochloric acid. The liquor is kept hot for some hours, and then set aside for twenty-four hours. At the end of this time all the cobalt is deposited in the form of a crystalline powder of a beautiful reddish violet colour. This precipitate is roseocobaltic hydrochlorate, 100 parts of which correspond to 22·761 of metallic cobalt or 28·929 of the protoxide. For a very accurate determination, however, a known weight of the compound may be reduced by dry hydrogen, and the pure metal weighed.

The solution containing nickel and manganese is saturated with ammonia, and then an excess of permanganate of potash or an alkaline hypochlorite is added, and the mixture is boiled. All the manganese is now precipitated and the nickel remains in solution, from which it may be separated as sulphide or oxide.

If the ore to be analysed contains nickel and cobalt and also manganese, a standard solution of the permanganate of potash should be employed, and the amount of manganese added must be subtracted from the amount obtained.

M. Perrot sent a note on "*An Apparatus for Producing an Intense Heat by the Combustion of Coal Gas and Air.*" The apparatus is not described, but we gather that it somewhat resembles Mr. Gore's furnace in being composed of a bundle of Bunsen's jets; but in what way the materials to be fused are supported we are not told.

M. Danton presented a note "*On the Periods through which the Earth has Passed in its Formation.*"

NOTICES OF BOOKS.

Manual of Materia Medica and Therapeutics. Being an Abridgement of the late Dr. Pereira's Elements of Materia Medica, arranged in Conformity with the British Pharmacopœia, and adapted to the Use of Medical Practitioners, Chemists and Druggists, Medical and Pharmaceutical Students, &c. By John Farre, M.D., F.L.S., &c., &c., assisted by Robert Bentley, M.R.C.S., F.L.S., &c., and Robert Warington, F.R.S., F.C.S., &c. London: Longmans and Co. 1865.

The great work of Dr. Pereira will ever remain a monument to the industry of its lamented author. Although modestly styled "The Elements," it was in reality a perfect encyclopædia of Materia Medica and Therapeutics. Dr. Pereira was an enthusiast, and he made the common mistake of enthusiasts in imagining that every one took the same interest in his subject that he did himself. To him the smallest fact relating to a drug was of importance, and his book consequently became swollen to enormous dimensions. But, large as the book was, it had a great success. The author lived to see three editions through the press, and a fourth was published after his decease.

Had Dr. Pereira lived until now he would probably have seen the advisability of making some alterations in his work, or of publishing some sort of abridgement for special classes. How he would have made his abridgement it is not difficult to speculate.

There are two ways of condensing a book. It can be done easily with the aid of a pair of scissors; or with much more labour by re-writing whatever it is thought necessary to retain in abridgement—writing the "essentials," in fact. We believe that Dr. Pereira would have adopted the latter plan, and in that case would have produced a better and smaller book than the one we now notice.

Our own opinion is that it would have been better to have made the work into three separate books, to suit the wants of the three classes for whose use this one is said to be adapted. The medical practitioner wants a manual of Therapeutics; the chemist and druggist wants a book on Pharmacy and Materia Medica only, while the medical student necessarily requires a little of both. This manual, we believe, will be found better fitted for the medical practitioner than any other class. It is fullest of therapeutics.

There are few of our older readers, we dare say, to whom the original work is unknown, and for their information we may quote the rules which the editor has followed in making this abridgement. "1. To omit all remedial agents except those which the author termed pharmacological, such as mental, physical but imponderable, and hygienic remedies; or to be more specific, the influence of the mind, of light, heat, electricity, food, exercise, climate, &c. 2. To omit all pharmacological remedies which are not officinal or contained in the British Pharmacopœia. 3. To omit all classifications of medicines except the two classifications which the author himself adopted: one founded on the chemical classification of the inorganic bodies, and on the botanical and zoological classifications of the plants and animals which yield the organic bodies; the other founded on their physiological effects." The editor has also somewhat abridged the botanical and zoological characters, and in many cases the descriptions of the drugs themselves; and in this way, although much new matter has necessarily been added, the large work of Dr. Pereira has been reduced to about one-third of its size.

We shall content ourselves on the present occasion with this brief notice. At a future time we may have some remarks to offer on the additions which have been made, and also point out what appear to us some important omissions.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

2702. W. Clark, Chancery Lane, "Improvements in the manufacture of chromates of ammonia and chromic acid, and in the preparation of nitrates of lime and baryta." A communication from F. Dehaut, M.D., Boulevart St. Martin, Paris.—Petition recorded October 19, 1865.

2972. F. Wilkins, Oxford Street, Middlesex, "Improvements in apparatus for the production of hydrocarbon or other vapours, parts of which apparatus are also applicable to measuring gaseous or fluid matter."—November 18, 1865.

3107. L. J. Bouchart, Rue de l'Echiquier, Paris, "Improvements in the mode of applying mineral soda to the scouring and lubrication of textile matters and machinery, and in the manufacture of soap."—December 4, 1865.

3256. C. Pengilly, Church Street, Falmouth, Cornwall, "Improvements in the treatment of sulphurous and arsenical pyrites, containing copper and tin."—December 16, 1865.

3268. H. Planck, Manchester, "Improvements in apparatus for regulating heat obtained by the combustion of gas."—December 18, 1865.

3312. D. McGrath, Kilberry, Kildare, Ireland, "Improvements in the purification, refining, and treatment of the volatile and fixed oils produced from the destructive distillation of peat or turf."

3318. J. A. Cooper, Trowbridge, Wiltshire, "Improvements in the manufacture of yarns, string, and paper, and in the preparation of dyes, and in dyeing fabrics by the application of vegetable substances not hitherto used for such purposes."—December 22, 1865.

3340. M. Henry, Fleet Street, London, "Improvements in the manufacture of soda, and in the apparatus employed in the said manufacture." A communication from A. Laurent, Boulevard St. Martin, Paris.—December 26, 1865.

3355. E. V. Gardner, Berners Street, Middlesex, L. A. Israel, and H. A. Israel, Crescent, Middlesex, "Improvements in compounds for deodorising and disinfecting."

3359. E. Oppenheim, Leadenhall Street, London, "A new kind of fireworks of a non-explosible and non-offensive nature fit to be used in drawing-rooms." A communication from J. B. F. Fredureaur and H. de Chavaunes, Rue de Faubourg Poissonière, Paris.—December 28, 1865.

3372. W. Cormack, Commercial Road, Middlesex, "Improvements in revivifying, deodorising, and calcining animal and vegetable charcoal and other matters."—December 29, 1865.

14. W. Stanfen, Devonshire Terrace, Fulham Road, Brompton, "Improvements in the treatment and application of vegetable fibres."—January 2, 1866.

26. A. V. Newton, Chancery Lane, "Improvements in the preparation of pigments."—A communication from S. Gwynn, New York, U.S.A.—January 3, 1866.

31. W. E. Newton, Chancery Lane, "Improvements in distillation."—A communication from O. Lugo, New York, U.S.A.—January 4, 1866.

69. W. Anderson, Erith, Kent, "Improvements in the mode of, and apparatus for extracting liquor from, macerated fibres employed in the manufacture of paper."—January 9, 1866.

83. R. A. Brooman, Fleet Street, London, "Improvements in the manufacture and purification of lamp-black, and in apparatus employed therein."—A communication from B. Perra, Petit Vauves, France.—January 10, 1866.

Invention Protected for Six Months by the Deposit of a Complete Specification.

33. W. H. Towers, New York, U.S.A., "An improved method or process of curing and tanning hides or skins."—Petition recorded January 4, 1866.

Notices to Proceed.

2195. J. Fordred, Blackheath, Kent, "Improvements in the treatment of certain products obtained in the refining of petroleum and other hydrocarbon oils."—Petition recorded August 26, 1865.

2229. W. Crookes, F.R.S., Wine Office Court, Fleet Street, London, "Improvements in extracting and separating gold and silver from their ores or matrices, and in the treatment of mercury employed for such purposes."—August 30, 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."—September 2, 1865.

2316. R. P. Roberts, Kennington Park Road, Surrey, "Improvements in cleaning and coating the bottoms of ships and other submerged surfaces, to prevent oxidation and adhesion of marine animals and plants, also in compositions to be employed for these purposes."—September 9, 1865.

2322. W. Hewitt, Brewer Street, Pimlico, Middlesex, "An improved composition for preventing incrustation in steam boilers."

2327. J. Lightfoot, Accrington, Lancashire, "Improvements in dyeing and printing fabrics and yarns, and animal or mixed animal and vegetable substances."—September 11, 1865.

2439. A. V. Newton, Chancery Lane, "Improved apparatus for generating illuminating gas." A communication from J. Invin, Chicago, Illinois, U.S.A.—September 23, 1865.

2443. M. Schaffner, Aussig, Bohemia, "Improvements in treating soda waste to obtain sulphur therefrom."—Sept. 23, 1865.

2461. J. F. Cashin, 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."—September 26, 1865.

3043. W. R. Lake, Southampton Buildings, Chancery Lane, "Improvements in the mode of, and means for, preserving fruits and other perishable substances." A communication from B. M. Nyce, Cleveland, Ohio, U.S.A.—November 27, 1865.

33. W. H. Towers, New York, U.S.A., "An improved method or process of curing and tanning hides or skins."—January 4, 1866.

CORRESPONDENCE.

Continental Science.

Paris, January 23.

I have on two or three occasions mentioned the *gratuitous* course of practical chemistry, conducted by MM. Chevreul and Frèmy, at the Museum of Natural History, not altogether as a thing to be imitated in London, but as a matter reflecting the highest honour on the worthy professors who thus open their laboratory. The course for this year was commenced last Tuesday, and will be continued three days a week through the session. You will notice in last week's report of the Academy a paper by one of the pupils, M. Terreil, on the separation of cobalt from nickel, which shows that good work is done in the class. It should be known that although the teaching is given gratuitously the pupils find their apparatus and reagents; and some people are ill-natured enough to say that the teaching is left to an assistant, and often devolves upon a sub-assistant, who is not unfrequently absent. This, however, is not to be wondered at; and I have known pretty much the same thing happen in a rather dear laboratory.

Among the latest novelties in chemical technology I have seen is a method of making oxalic acid from leather shavings, woollen rags, horns, and animal residues in general. The patentees first boil them with dilute sulphuric acid, and then treat them with dilute nitric acid. What they do after that I have not read, and will not guess; but it is said that oxalic acid is got in the end.

Your pharmaceutist readers will be pleased to see M. Purisel's notice of the Pharmaceutical Conference in *Revue Pharmaceutique* for 1865. Such professional "love-feasts," he says, ought to be encouraged. "The pharmaceutist," he adds, "is an isolated being, and isolation is atrophy, is death."

Looking over my old volumes of the Chemical News some time ago, I saw a remark you made that the first maker of lucifer matches was unknown. Let me inform you that he has just turned up; at all events, there is some evidence that the "Briquet oxygéné," as the match was called, was invented by J. L. Chancel, assistant to Thénard, in 1805. This announcement is made by M. Nicklés in a memoir on the industry of chemical matches, published in the *Annales des Génie Civil.* I may call your attention to this paper as one which would probably interest many of your readers.

It is now considerably more than three years since the International Exhibition closed, and the number of the *Moniteur Scientifique* published a few days ago contains the last of M. Kopp's translation of Dr. Hofmann's report. I do not know whether it is intended to republish this translation, but, as the original is so scarce, some persons will be glad to know that the entire work will be found in the journal mentioned, translated with such fidelity, accuracy, and skill as is not often seen in work of this kind. It is enough to say that M. Kopp has done himself and his friend Dr. Hofmann full justice.

On the Toxic Properties of Mercuric Methide.

To the Editor of the Chemical News.

Sir,—In a letter by Dr. Hofmann, communicated a little time back to the Chemical News (to which I have before alluded), this chemist speaks of the "*altogether exceptionally poisonous nature*" of mercuric methide, and states that other chemists who have worked upon it do not appear to have suffered or even to have been annoyed by it.

Now, if Dr. Hofmann will kindly furnish me with an instance of any chemist who, like the late Dr. Ulrich, has worked for three entire months upon the preparation of this substance; or if he can mention any compound of mercury, containing 87 per cent. of that metal, which is *not* an active poison (especially in a state of vapour), I shall be more prepared to accept the "altogether exceptionally poisonous properties" with which Dr. Hofmann appears anxious to invest mercuric methide.

In the absence of such data the learned chemist will excuse me if I hold a different opinion.

I am, &c.
T. L. Phipson, Ph.D, F.C.S., &c.

London, January 22.

MISCELLANEOUS.

New Scientific Baronets.—We may mention that the name of Dr. J. D. Corrigan, late President of the College of Physicians, Ireland, has been added to the list of the professional and scientific men who are to have a baronetcy conferred upon them.

University of London.—From a letter which has been forwarded from the University to the medical schools, we learn that at the "preliminary scientific" examination in July last, forty-three out of seventy-five candidates were rejected. The failures, it appears, were principally in botany and zoology, two subjects with which we should have thought the unfortunate and much belectured and examined medical student might well be forgiven a slight acquaintance.

Transmutation of Metals.—M. Franz, a metallurgist, and M. Henri Faure, editor of the *France Médicale*, have just announced to the learned world that they have discovered a method for transmuting silver, copper, and mercury into gold, "which," they say, "are only one and the same metal in different dynamic states" ! ! !

Royal Institution.—The following are the arrangements for the ensuing week:—Tuesday, January 30, and Thursday, February 1, at 3 o'clock, Professor Tyndall, F.R.S., "On Heat." Friday, February 2, at 8 o'clock, Earl Stanhope, F.R.S., "On the Influence of Arabic Philosophy on Mediæval Europe." Saturday, February 3, at 3 o'clock, Professor Westmacott, R.A., F.R.S., "On 'Art Education,' and How to Observe in Fine Arts."

Spurious Lymph. — A New Manufacture. — A correspondent of the *Times* asserts that a mixture of collodion, and croton oil, and tartar emetic is being supplied for the inoculation of cattle, in place of genuine vaccine lymph. We hope the story is not true.

The Patent Office.—The final report of the Commissioners appointed to investigate the affairs of the Patent Office, in consequence of Mr. Edmunds's delinquencies, contains a paragraph which meets with our entire approval. It is as follows:—"The Patent Office in every department of it requires greatly enlarged space for the business which is carried on. Numerous suggestions have been made from time to time respecting sites proper for erecting buildings for the office; but, notwithstanding the urgent need for additional accommodation, nothing has been done, and the duties of the office have to be carried on in very limited offices in Southampton Buildings, very much to the hindrance of business and inconvenience to the public. We think that the Museum ought to be in the same building as the Patent Office, or in some place near to it, but no accommodation can be obtained for the Museum in any existing building near to the present Patent Office." The present offices in Southampton Buildings are certainly a disgrace to the country, and the inconvenience of having the Museum (supposing it to be of any use) miles away from the office is very great. South Kensington is very accessible to people who reside in the neighbourhood or those who are out for a holiday; but to get there involves a great loss of time to business people, who have little time to waste.

The Polytechnic Institution.—Some very clever optical illusions have lately been perfected by Mr. Pepper, which appear to be based upon the principle of his clever "Proteus" exhibition. The best of these, entitled "The Cherubs in the Air," is a representation of great merit, and is suggested by the subject of Sir Joshua Reynolds's celebrated picture in the National Gallery. Four children's heads are peering out of a fleecy cloud in a clear blue firmament, with stars and moon shining; their voices, tuned to a lovely chant, utter strains of melody which contribute in no small degree to the calm, devotional spirit pervading the whole conception. Another tableau of a similar character is intended to depict the resurrection of Socrates in obedience to the demand and incantations of an Athenian noble. The bodily form of the old Greek philosopher is restricted to the bust, which is, however, endowed with speech, and delivers himself of a few lines in blank verse,—an illustration which finds a parallel, we think, in the marvellous Sphinx of human attributes which nightly addresses an audience in the Egyptian Hall. The "Fairy Casket" has charms for young people, and, whilst apparently filled with a variety of commodities in the shape of textile fabrics both black and white, charcoal, flowers, &c., is the hiding-place of a little columbine and a youthful negro, who proclaims anti-slavery sentiment upon his introduction to the public. With the assistance of the Messrs. Darker, Mr. Pepper has at length succeeded in exhibiting upon a screen the ever-changing figures of the kaleidoscope, which, together with other optical effects, is included in an entertainment entitled "Half Hours with Sir David Brewster." A lecture on Gun-cotton is likewise included in the morning programme of the Polytechnic Institution.

Appearances of Good and Diseased Meat.—The following information, though not strictly chemical, will probably be of interest to all our readers:—"Good meat is neither of a pale pinkish colour nor of a deep purple tint. The former is indicative of disease, and the latter is a sign that the animal has died from natural causes. Good meat has also a marbled appearance from the ramifications of little veins of intercellular fat; and the fat, especially of the internal organs, is hard and suety, and is never wet; whereas that of diseased meat is soft and watery, often like jelly or sodden parchment. Again, the touch or feel of healthy meat is firm and elastic, and it hardly moistens the fingers; whereas that of diseased meat is soft and wet,—in fact, it is often so wet that serum runs from it, and then it is technically called wet. Good meat has but little odour, and this is not disagreeable; whereas diseased meat smells faint and cadaverous, and it often has the odour of medicine. This is best observed by cutting it and smelling the knife, or by pouring a little warm water upon it. Good meat will bear cooking without shrinking, and without losing very much in weight; but bad meat shrivels up, and it often boils to pieces. All these effects are due to the presence of a large proportion of serum in the meat, and to the relatively large amount of intercellular or gelatinous tissue; for the fat and true muscular substance are to a greater or less extent deficient. If, therefore, a hundred grains of the lean or muscular part of good meat are cut up and dried at a temperature of boiling salt and water (224° Fahrenheit), they lose only from 69 to 74 grains of their weight; but if diseased meat is thus treated, it loses from 75 to 80 per cent. of its weight. I find that the average loss of weight with sound and good beef is 72·3 per cent., and of mutton 71·5 per cent., whereas the average loss of diseased beef is 76·1 per cent., and of diseased mutton 78·2 per cent. Even if it be dried at a higher temperature, as at 266° Fahrenheit, when all the moisture is expelled, and when good meat loses from 74 to 80 per cent. of its weight, the proportions of loss in bad meat is equally great. Other characters, of a more refined nature, will also serve to distinguish good from bad meat. The juice or serosity of sound flesh is slightly acid, and it contains an excess of potash salts, chiefly the phosphate; whereas diseased meat, from being infiltrated with the serum of blood, is often alkaline, and the salts of soda, especially chloride and phosphate, abound in it. Lastly, when good meat is examined under the microscope, the fibre is clean and well defined, and free from infusorial creatures; but that of diseased meat is sodden, as if it had been soaked in water, and the transverse markings are indistinct and far apart; besides which, there are often minute organisms like infusorial bodies. These are very perceptible in the flesh of animals affected with the cattle plague, and Dr. Beale has described them as entozoa like objects. They differ altogether from the parasites which constitute the trichina disease, and the measles of pork. How far the use of diseased meat affects the human constitution is unknown. In those cases where certain parasitic diseases exist in animals, there is no doubt of its injurious nature; for the tape-worm, the trichina, and certain hydatid or encysted growths are unquestionably produced by it. Experience also points to the fact that carbuncle and common boils are in some degree referable to the use of the flesh of animals affected with pleuro-pneumonia; and occasionally we witness the most serious diarrhœa and prostration of the vital powers after eating diseased meat. It is, therefore, safest to forbid its use; and it is at all times best to guard against the possibility of injury by having meat well cooked. It should be so cooked that the very centre of the joint should be exposed for some time to the temperature of 212° Fahrenheit. The instructions of Liebig in this particular are hardly safe; for although a temperature below that of boiling water may coagulate albumen and develope the flavours of cooked meat, it may not ensure the destruction of dangerous parasites. It is therefore better to have the meat a little overcooked than otherwise."—*Dr. Letheby, Report on the Cattle Plague.*

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. XII. 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. XIII. commenced on January 5, 1866, and will be complete in 26 numbers.

Mr. Sugg, Gas Engineer, requests us to state that his correct address is Vincent Works, Vincent Street, Regent Street, Westminster.

D. J. J.—See Gesner "On the Distillation of Petroleum and other Oils," published by Baillière.

A Constant Subscriber.—Separate the baryta by means of a current of carbonic acid.

Mr. C. H. Wood's letter is too long for insertion. A shorter communication can be inserted next week.

Books Received.—"Lectures on the Commercial Use of Flowers and Plants," by Eugene Rimmel; "Lectures on Clinical Medicine," by M. A. Trousseau, translated and edited by P. V. Bazire, M.D.; "Photographic Mosaics," by M. Carey Lea; "Companion to the Medicine Chest," by P. Squire; "Time, Space, and Eternity," by J. Gumpach; "Our Weekly Gossip," by J. Gumpach.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

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

Part II.

Theory of Types and Atomicity.

Section I.—*Theory of Types.*

(*Continued from page* 38.)

Condensed Types.—It will be seen that this theory embraced a very large number of compounds, but it was far from including them all. It was, in fact, impossible to compare the molecule of the polybasic acids to a single molecule of water, and Dr. Williamson* was the first to make known the convenience of adopting types resulting from the condensation of several molecules of water. Thus he referred sulphuric acid to the double type,—

$$\left.\begin{matrix}H_2\\H_2\end{matrix}\right\}\Theta_2 \text{ or } \left\{\begin{matrix}\left.\begin{matrix}H\\H\end{matrix}\right\}\Theta\\\left.\begin{matrix}H\\H\end{matrix}\right\}\Theta\end{matrix}\right.$$

writing the formula of this acid

$$\left.\begin{matrix}S\Theta_2\\H_2\end{matrix}\right\}\Theta_2 \text{ or } \left.\begin{matrix}H\\S\Theta_2\\H\end{matrix}\right\}\Theta_2$$

The two molecules of water are bound together by the bibasic radical sulphuryle (SO_2), which takes the place of two atoms of hydrogen. This is an important development of the theory of types. It is the origin of condensed types and of the theory of polyatomic radicals. Such radicals have the power of replacing the hydrogen of several molecules of water, so as to encroach on each of them and bind the remainders closely together. This property has been illustrated in a most evident manner by my experiments on the formation of glycol. I showed that two molecules of acetate of silver are bound together by the diatomic radical ethylene, when iodide of ethylene reacts on acetate of silver.

$$\underset{\text{Two molecules of acetate of silver.}}{\begin{matrix}\left.\begin{matrix}C_2H_3\Theta\\Ag\end{matrix}\right\}\Theta\\\left.\begin{matrix}Ag\\C_2H_3\Theta\end{matrix}\right\}\Theta\end{matrix}} + \underset{\text{Iodide of ethylene.}}{C_2H_4I_2} = \underset{\text{Diacetic glycol.}}{\left.\begin{matrix}C_2H_3\Theta\\(C_2H_4)\\C_2H_3\Theta\end{matrix}\right\}\Theta_2} + 2AgI.$$

In glycol the same radical unites the remains of two molecules of water $(2H_2\Theta - H_2)$ by replacing in each of them one atom of hydrogen.

$$\begin{matrix}\left.\begin{matrix}H\\\ \end{matrix}\right\}\Theta\\H_2\\\left.\begin{matrix}H\\\ \end{matrix}\right\}\Theta\end{matrix} \qquad \underset{\text{Glycol.}}{\begin{matrix}\left.\begin{matrix}H\\\ \end{matrix}\right\}\Theta\\(C_2H_4)\\\left.\begin{matrix}H\\\ \end{matrix}\right\}\Theta\end{matrix}}$$

I had already applied this view to glycerine. Interpreting in a manner then new the fine results obtained by M. Berthelot in the synthesis of the neutral fatty bodies, I had stated that glycerine could be looked upon as being derived from a water type thrice condensed. The remains of three molecules of water $(3H_2\Theta - H_3)$ are there united by the triatomic radical glyceryle $(C_3H_5)'''$.

$$\left.\begin{matrix}H_3\\H_3\end{matrix}\right\}\Theta_3 \qquad \underset{\text{Glycerine.}}{\left.\begin{matrix}(C_3H_5)'''\\H_3\end{matrix}\right\}\Theta_3}$$

Glycerine was compared to ferric hydrate and aluminic hydrate which were then regarded as triatomic. Dr. Odling had represented their composition by the formulæ

$$\left.\begin{matrix}Fe'''\\H_3\end{matrix}\right\}\Theta_3 \text{ and } \left.\begin{matrix}Al'''\\H_3\end{matrix}\right\}\Theta_3$$

and had thus admitted the triatomicity of iron and aluminium.

Thus the most diverse organic and inorganic compounds were referred to the doubly and trebly condensed water type, the polybasic acids by Dr. Williamson and by Gerhardt, the polyacid bases by Dr. Odling, and the polyatomic alcohols by myself.

We must add that M. Cannizzaro was the first to consider (in 1858) certain metals as diatomic, which has permitted us to connect with the diatomic alcohols a great number of the hydrates of inorganic chemistry.

Type.	Hydrated Inorganic Bases.	Alcohols.	Inorganic Acids.	Organic Acids.
$\left.\begin{matrix}H_2\\H_2\end{matrix}\right\}\Theta_2$	$\left.\begin{matrix}(Ca)''\\H_2\end{matrix}\right\}\Theta_2$ Hydrate of lime.	$\left.\begin{matrix}(C_2H_4)''\\H_2\end{matrix}\right\}\Theta_2$ Glycol.	$\left.\begin{matrix}(C\Theta)''\\H_2\end{matrix}\right\}\Theta_2$ Carbonic acid (hypothetical hydrate).	$\left.\begin{matrix}(C_2H_2\Theta)''\\H_2\end{matrix}\right\}\Theta_2$ Glycolic acid.
	$\left.\begin{matrix}(Ba)''\\H_2\end{matrix}\right\}\Theta_2$ Hydrate of baryta.	$\left.\begin{matrix}(C_3H_6)''\\H_2\end{matrix}\right\}\Theta_2$ Propoglycol.	$\left.\begin{matrix}(S\Theta)''\\H_2\end{matrix}\right\}\Theta_2$ Sulphurous acid.	$\left.\begin{matrix}(C_2\Theta_2)''\\H_2\end{matrix}\right\}\Theta_2$ Oxalic acid.
	$\left.\begin{matrix}(Cu'')\\H_2\end{matrix}\right\}\Theta_2$ Hydrate of copper.	$\left.\begin{matrix}(C_5H_{10})''\\H_2\end{matrix}\right\}\Theta_2$ Amylglycol.	$\left.\begin{matrix}(S\Theta_2)''\\H_2\end{matrix}\right\}\Theta_2$ Sulphuric acid.	$\left.\begin{matrix}(C_4H_4\Theta_2)''\\H_2\end{matrix}\right\}\Theta_2$ Succinic acid.
$\left.\begin{matrix}H_3\\H_3\end{matrix}\right\}\Theta_3$	$\left.\begin{matrix}(Sb)'''\\H_3\end{matrix}\right\}\Theta_3$ Hydrate of antimony.	$\left.\begin{matrix}(C_3H_5)'''\\H_3\end{matrix}\right\}\Theta_3$ Glycerine.	$\left.\begin{matrix}P'''\\H_3\end{matrix}\right\}\Theta_3$ Phosphorous acid.	$\left.\begin{matrix}(C_3H_3\Theta)'''\\H_3\end{matrix}\right\}\Theta_3$ Glyceric acid.
	$\left.\begin{matrix}(Bi)'''\\H_3\end{matrix}\right\}\Theta_3$ Hydrate of bismuth.	$\left.\begin{matrix}(C_5H_9)'''\\H_3\end{matrix}\right\}\Theta_3$ Amyl-glycerine.	$\left.\begin{matrix}(P\Theta)'''\\H_3\end{matrix}\right\}\Theta_3$ Phosphoric acid.	

Types still more condensed have been admitted; but at present we will confine ourselves to indicate the precedents which explain the principal of them.

As a polyatomic radical can unite several molecules of water, so also it can unite into one bundle several molecules of hydrogen or ammonia. The following examples show that a number of compounds can be referred to the hydrogen and ammonia types, more or less condensed:—

Type.	Type.	Type.	Type.
$\left.\begin{matrix}H_2\\H_2\end{matrix}\right\}$ or $\left\{\begin{matrix}Cl_2\\H_2\end{matrix}\right.$	$\left.\begin{matrix}H_3\\H_3\end{matrix}\right\}$ or $\left\{\begin{matrix}Cl_3\\H_3\end{matrix}\right.$	$\left.\begin{matrix}H_2\\H_2\\H_2\end{matrix}\right\}N_2$	$\left.\begin{matrix}H_3\\H_3\\H_3\end{matrix}\right\}N_3$
$\left.\begin{matrix}(S\Theta_2)''\\Cl_2\end{matrix}\right\}$ Chloride of sulphuryle.	$\left.\begin{matrix}(P\Theta)'''\\Cl_3\end{matrix}\right\}$ Chloride of phosphoryle.	$\left.\begin{matrix}(C\Theta)''\\H_2\\H_2\end{matrix}\right\}N_2$ Urea.	$\left.\begin{matrix}Cy_3\\H_3\\H_3\end{matrix}\right\}N_3$ Melamine.
$\left.\begin{matrix}(C\Theta)''\\Cl_2\end{matrix}\right\}$ Chloride of carbonyle. (phosgen gas).	$\left.\begin{matrix}Bo'''\\Cl_3\end{matrix}\right\}$ Chloride of boron.	$\left.\begin{matrix}(C_2\Theta_2)''\\H_2\\H_2\end{matrix}\right\}N_2$ Oxamide.	$\left.\begin{matrix}(C\Theta)''\\(C\Theta)''\\H_5\end{matrix}\right\}N_3$ Biuret.
$\left.\begin{matrix}Ca''\\Cl_2\end{matrix}\right\}$ Chloride of calcium.	$\left.\begin{matrix}Bi'''\\Cl_3\end{matrix}\right\}$ Chloride of bismuth.	$\left.\begin{matrix}(C_2H_4)''\\H_2\\H_2\end{matrix}\right\}N_2$ Ethylene-diamine.	$\left.\begin{matrix}(C_2H_4)''\\(C_2H_4)''\\H_5\end{matrix}\right\}N_3$ Diethylene-triamine.
$\left.\begin{matrix}(C_2H_4)''\\Cl_2\end{matrix}\right\}$ Chloride of ethylene.	$\left.\begin{matrix}(C_3H_5)'''\\Cl_3\end{matrix}\right\}$ Trichloride of allyle.	$\left.\begin{matrix}(C_6H_4)''\\H_2\\H_2\end{matrix}\right\}N_2$ Phenylene-diamine.	$\left.\begin{matrix}(C_6H_3)''\\H_3\\H_3\end{matrix}\right\}N_3$ Picramine.

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* *Quarterly Journal of the Chemical Society*, vol. iv., page 353. *Ibid*, vol. vii., page 182.

It is seen that all these combinations, which are referred to condensed types, contain either an element or a polyatomic radical. Several molecules are thus united in a more complex one, because, in each of them, an atom is removed, and the space thus formed is filled by a single element or by a single indivisible group. It is necessary well to understand this action of the radicals or polyatomic elements, and it may be represented by the following notation:—

$\begin{matrix}ClH\\ClH\end{matrix}$	$\left.\begin{matrix}Cl\\Cl\end{matrix}\right\}Ca''$	$\left.\begin{matrix}Cl\\Cl\end{matrix}\right\}(\text{Ꞓ}_2H_4)''$	$\left.\begin{matrix}Cl\\Cl\end{matrix}\right\}(\text{Ꞩ}\Theta_2)''$
	Chloride of calcium.	Chloride of ethylene.	Chloride of sulphuryle.

$\begin{matrix}HHHN\\HHHN\end{matrix}$	$(\text{Ꞓ}O)''\left\{\begin{matrix}HHN\\HHN\end{matrix}\right.$	$(\text{Ꞓ}_2H_4)''\left\}\begin{matrix}HHN\\HHN\end{matrix}\right.$
	Urea.	Ethylene-diamine.

Mixed Types.—It may be similarly understood that an element or a polyatomic radical may connect together several molecules of different natures. Thus a diatomic element or radical can unite a molecule of hydrochloric acid to a molecule of water, replacing in each of them a molecule of hydrogen. By the same means a molecule of water can be joined to a molecule of ammonia. Three molecules, two of hydrochloric acid and one of water, or two of water and one of hydrochloric acid, can be connected by a triatomic radical or by two diatomic radicals. A few examples will suffice to explain the meaning of these mixed types, which were introduced into the science by Dr. Odling:—

Type.	Type.	Type.	Type.
$\left.\begin{matrix}H\\H\end{matrix}\right\}\Theta$ HCl	$\left.\begin{matrix}H\\H\end{matrix}\right\}\Theta$ $\left.\begin{matrix}H\\H\\H\end{matrix}\right\}N$	$\left.\begin{matrix}H\\H\end{matrix}\right\}\Theta$ HCl $\left.\begin{matrix}H\\H\end{matrix}\right\}\Theta$	HCl HCl $\left.\begin{matrix}H\\H\end{matrix}\right\}\Theta$
$\left.\begin{matrix}H\\(\Theta_2H_4)''\end{matrix}\right\}\begin{matrix}\Theta\\Cl\end{matrix}$	$\left.\begin{matrix}H\\(\text{Ꞓ}_2\Theta_2)''\end{matrix}\right\}\Theta$ $\left.\begin{matrix}H\\H\end{matrix}\right\}N$	$\left.\begin{matrix}H\\(\text{Ꞓ}_3H_5)'''\\H\end{matrix}\right\}\begin{matrix}\Theta\\Cl\\\Theta\end{matrix}$	$\left.\begin{matrix}(\text{Ꞓ}_3H_5)'''\\H\end{matrix}\right\}\begin{matrix}Cl_2\\\Theta\end{matrix}$
Hydrochloric glycol.	Oxamic acid.	Monochlorhydrine.	Dichlorhydrine.
$\left.\begin{matrix}H\\(\text{Ꞩ}\Theta_2)''\end{matrix}\right\}\begin{matrix}\Theta\\Cl\end{matrix}$	$\left.\begin{matrix}\text{Ꞓ}_2H_5\\(\text{Ꞓ}_2\Theta_2)''\end{matrix}\right\}\Theta$ $\left.\begin{matrix}H\\H\end{matrix}\right\}N$	$\left.\begin{matrix}H\\(\text{Ꞓ}_3H_5)'''\\(\text{Ꞓ}_2H_3\Theta)'\end{matrix}\right\}\begin{matrix}\Theta\\Cl\\\Theta\end{matrix}$	$\left.\begin{matrix}(\Theta_2H_4)''\\(\Theta_2H_4)''\end{matrix}\right\}\begin{matrix}Cl_2\\\Theta\end{matrix}$
Chlorosulphuric acid of Dr. Williamson.	Oxamethane.	Monochloracetine.	Dichlorhydrine diethylenic.
$\left.(\text{Ꞓ}_3H_5)'''\right\}\begin{matrix}\Theta\\Cl\end{matrix}$	$\left.\begin{matrix}(C_2H_5)'\\(\text{Ꞓ}\Theta)''\end{matrix}\right\}\Theta$ $\left.\begin{matrix}H\\H\end{matrix}\right\}N$	$\left.\begin{matrix}H\\(\Theta_2H_4)''\\(\Theta_2H_4)''\end{matrix}\right\}\begin{matrix}\Theta\\Cl\\\Theta\end{matrix}$	$\left.\begin{matrix}(\text{Ꞓ}_3H_5)'''\\(C_2H_3\Theta)'\end{matrix}\right\}\begin{matrix}Cl_2\\\Theta\end{matrix}$
Epichlorhydrino of M. Berthelot.	Urethane.	Diethylenic monochlorhydrine.	Dichloracetine.

(To be continued.)

On a Variation in the Method of Taking the Specific Gravities of Liquids, by JOHN A. R. NEWLANDS, *F.C.S.*

THE process consists in introducing any portion, without caring to know how much, of the liquid into a small stoppered bottle; taking care, however, not to fill it.

The bottle is now weighed, and after a known volume of liquid has been withdrawn from it by means of a pipette, it is re-weighed; the loss gives the weight of the pipette full of liquid. A similar experiment having been previously performed with distilled water, we have only to divide the weight of the liquid by that of the water in order to obtain its specific gravity.

The pipette required may be constructed with the greatest ease, and in a few minutes, of a small piece of thin glass tubing, by drawing it out in the gas flame.

The lower end of the pipette should be drawn to a fine tube, and the upper portion made as narrow as possible in order to see when the mark is reached with greater accuracy.

The mark upon the stem of the pipette may be conveniently made by melting upon it a small piece of fine glass—of coloured glass by preference, so as to be more readily visible.

In using the pipette one must be careful not to draw the liquid to any great extent above the mark in the stem, as on afterwards letting it down a small portion would adhere to the inside of the tube, and the amount of substance so adhering would differ with various liquids. The same remark, though in a less degree, on account of the smallness of its surface, applies to the lower extremity of the pipette, which should dip into the liquid as little as possible.

When working with a pipette holding about fifty grains, the specific gravities found agreed pretty closely with those obtained by the ordinary process when using a 1000-grain specific gravity bottle.

When very minute quantites of liquid have to be operated upon, a piece of tubing drawn out at one end into a capillary tube may be used as a pipette, a mark being made upon it to show the height to which the liquid should be drawn up.

It is possible that the foregoing process may be new or useful to some of your readers, and I therefore take the liberty of sending it for publication in your valuable journal.

Laboratory, 19, Great St. Helens, E.C., January 24.

Researches on the Volatile Hydrocarbons, by C. M. WARREN.

(Continued from page 39.)

Of the Method of Determining Boiling Points.—I use for this purpose a small tabulated glass retort, and usually operate on about 150 c.c. of the liquid. The thermometer extends into the liquid, even nearly to the bottom of the retort, taking care that the bulb shall not come in contact with the glass, but remain free in the liquid. To prevent abnormal elevation of temperature from adhesion to the glass,—which I have observed in some instances, when operating on impure hydrocarbons, to amount to several degrees, I introduce pieces of sodium, instead of platinum, as it seems to serve at least as well for this purpose, and at the same time tends to preserve the purity of the material. Sodium has also this advantage over platinum for hydrocarbons—viz., that it does not lose its virtue by use, so long as any of it remains; platinum, on the contrary, being liable, especially if the liquid is not quite pure, to become after a while slightly coated, and its efficiency thus impaired.*

Except for low temperatures, the retort rests on a piece of wire gauze laid over the ring of an iron lamp-stand, and is heated with a small gas flame. When operating on liquids of low boiling point, I have observed the liability of the thermometer to be considerably affected by the ascending current of hot air striking the

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* For common use in fractioning, when not desirable to use sodium, I have found pieces of coke to be more effectual and much more durable than platinum. Not unlikely it would be found equally preferable to platinum for general use in taking the boiling points of liquids in which sodium could not be employed. It is certain that nothing could operate better than coke for the nitro-compounds and alkaloids derived from benzole and its homologues.

sides of the retort above the level of the liquid, thus causing an elevation of several degrees of temperature. To prevent this, I proceed as follows:—For low temperatures, and yet above the common temperature, I place upon the gauze on which the retort is to stand a screen of felt or thick woollen paper which has been provided with a hole in the centre about two inches in diameter. This screen extends several inches from the sides of the retort, and has been found effectual for the purpose.

For temperatures below the common temperature, the retort is set in a water bath containing ice water, the temperature of the bath being gradually raised by means of a small gas-flame.

As is customary, in order to ascertain the temperature by which to calculate the correction for the upper column of mercury, a thermometer is attached, by means of elastic bands, to the side of the thermometer in the retort; the bulb being placed, during ebullition, midway between the centre of the cork and the upper extremity of the mercurial column. And, as usual, a paper screen, closely fitting the thermometer, is placed across at the top of the cork to shield the upper column of mercury from the direct influence of the ascending heat.

I have observed that it often requires considerable time—variable according to its length and the thickness of the glass spindle—for that part of the thermometer above the retort to acquire the highest temperature which the boiling liquid can communicate to it. During this time the thermometer evidently is not in a fit state for an observation. While this gradual change in the condition of the thermometer is taking place, it is desirable, for obvious reasons, that no vapours should escape from the retort. I therefore proceed as follows:—The retort, the neck of which has previously been wrapped with a wet cloth, is placed in such a position that the neck shall slightly incline towards the body of the retort. If necessary, some pieces of ice, which will adhere firmly to the cloth, may be laid along the neck to insure complete condensation of the vapours during ebullition. While the retort is in this position, ebullition is continued for a considerable time, until it ceases to have any effect on the height of the mercury in the thermometer. The lamp being now removed for the moment, the neck of the retort is turned down, and quickly connected with a Liebig condenser. The lamp being now replaced, the distillation is commenced. So soon as the mercury in the thermometer shall have become constant, which will now occupy but a few seconds, the temperatures by the retort thermometer and the side thermometer are carefully noted, and also the time at which these observations are made. During the distillation, which is continued nearly to dryness, the readings of the thermometers and of the watch are noted at regular intervals, or so often as any appreciable variation of the retort thermometer shall have taken place. The average of the several observations, or of those corresponding to the longer intervals of time, applying the corrections for atmospheric pressure and for the upper column of mercury, according to Kopp,† is taken for the true boiling point. I have generally obtained the hydrocarbons so pure that the whole quantity operated upon would fall within the range of 1° of temperature, and not [illegible]ently within 0·5°. In a few cases, however, [illegible] the quantity of material at command would not [illegible] of the attainment of so high a degree of purity, [illegible] would range over two or three degrees; [illegible] such cases I have generally taken the average of the temperatures corresponding to the longest interval of time, as probably representing more nearly the true boiling point of the body. In stating my results, however, I shall give the limits of temperature within which the distillation was effected. The thermometers employed in the determinations were the best that I could obtain from Fastré, of Paris; for the temperatures below 100° the instrument used was calibrated, and the scale divided into fifths of a degree. The determinations above 100° were all made with one thermometer.

(To be continued.)

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† Poggendorff's Annalen, 1847, lxxii., 38.

TECHNICAL CHEMISTRY.

A New Aniline Black.

M. Paraf describes a new method of producing aniline black, as follows:—I begin by preparing hydrofluosilicic acid by decomposing a mixture of fluor spar and sand with sulphuric acid. In an aqueous solution of this hydrofluosilicic acid of the gravity 8° Be. I dissolve hydrochlorate of aniline, and such a solution properly thickened and printed on a tissue prepared with chlorate of potash gives a black in the fixing.

The chlorate of potash may be combined with the above, and then the cloth needs no special preparation.

In fixing at 32° or 35° C., the following changes take place:—The hydrofluosilicic acid decomposes the chlorate of potash and forms fluosilicate of potash, setting free chloric acid. A part of the chloric acid acting on the hydrochloric acid of the hydrochlorate of aniline produces a mixture of free chlorine and some intermediate oxygen acids of chlorine, which, acting in concert with the other portion of the chloric acid on the aniline of the hydrochlorate, produces the black.

A chemist may convince himself of the truth of the opinion I advance by operating in the following way:—First prepare fluosilicate of aniline by dissolving aniline in hydrofluosilicic acid, using a gentle heat. As the solution cools a mass of splendid scales of fluosilicate of aniline will deposit. This salt is very soluble in water. By adding a solution of chlorate of potash to an aqueous solution of fluosilicate of aniline, a mixture of fluosilicate of potash and chlorate of aniline will be produced. This solution may be boiled without obtaining a trace of black; but if only a few drops of hydrochloric acid be added a black precipitate will be immediately formed.

The black obtained as above may be associated with any sort of madder colour, and in the subsequent processes may be treated exactly like a logwood black.—*Bulletin de la Société Indust. de Mulhouse.*

Action of Air on a Mixture of Carbolic Acid and Ammonia.—The solution of crystallised carbolic acid in ammonia is attended with a diminution of temperature, varying with the proportions of the two bodies, and amounting to 2° or 4° Centigrade. The solution, which at first is clear, if left with free access of air becomes milky and turbid in an hour or two, the turbidity commencing on the surface. The milky liquid left in the air for several days becomes clear again, but at the same time takes a bright blue colour, which, after a further lapse of time, passes to a violet blue. This coloured solution behaves exactly like litmus. Acids change it to red and alkalies restore the blue. The author ascribes this action of the air on the above-named solution to the presence of ozone. He intends shortly to publish his latest researches on the subject.—*E. Schmidt, Zeitschrift für Chemie, &c.*, p. 727, 1865.

PHARMACY, TOXICOLOGY, &c.

Colchicine.

The chemical and other properties of the above-named substance have been recently investigated by Oberlin, Ludwig and Hubler. The last-named writer prepares it in the following way:—He exhausts the colchicum seeds (it is unnecessary to powder them) with alcohol sp. gr. ·822; adds to the tincture twenty times its volume of water, by which a little oily matter is separated; then treats with basic acetate of lead to remove the colouring matter, and subsequently with phosphate of soda to precipitate the excess of lead. Lastly, he precipitates the colchicine with pure tannin. This precipitation should be fractionated, since the first and last precipitates are less pure than the intermediate.

The flocculent precipitate obtained is very soluble in alcohol, and not altogether insoluble in water; it must therefore be purified by expression. It is formed of three equivalents of colchicine and two equivalents of tannin.

To isolate the colchicine, the precipitate is rubbed with an excess of moist litharge, and the mixed mass is dried on a water-bath. To make certain that all the tannin has combined with the litharge, a small portion of the mass should be boiled with alcohol, which, when filtered, should not be coloured blue by perchloride of iron. If any blue is seen, the mass must be rubbed again with a small quantity of water, and dried afresh.

The colchicine is extracted by means of boiling alcohol, and the solution evaporated; the residue is carefully dried over sulphuric acid. By repeated solution and evaporation, the colchicine is obtained quite pure.

Pure colchicine gives a clear solution with both water and alcohol. Its odour resembles that of hay, and is strongly developed by contact with hot water; its taste is very bitter. It constitutes the poisonous principle of colchicum.

The aqueous solution has no action on test paper; it gives a yellow precipitate with chloride of gold, and a white one with corrosive sublimate. Mineral acids, as well as alkalies, colour it yellow.

When a few colchicum seeds are shaken with a little strong sulphuric acid, each seed is seen surrounded with a green tint, which gradually passes to yellow. If a drop of nitric acid is added, a blue zone is observed, which, on agitation becomes violet, then brown, and finally yellow. If ammonia is now added, a tolerably permanent reddish-brown colour is obtained, which is turned yellow by acids and restored by alkalies.

Towards 140° C. colchicine fuses like a resin, becoming brown. It burns with a smoky flame, leaving a carbonaceous residue. With caustic potash it evolves ammonia.

The composition of colchicine is represented by the formula $C_{34}H_{19}NO_{10}$, which is pretty near that of atropine—$C_{34}H_{23}NO_6$.

According to Oberlin, *colchicine* does not unite with acids, and he gives the name *colchiceine* to the crystallisable principle which Hubler determined to have the percentage composition of colchicine. These two bodies appear to be isomers. Colchiceine behaves like a weak acid, dissolving in alkaline carbonates, and displacing carbonic acid. Alkaline solutions of colchiceine give white precipitates with all the metals which give colourless salts: a green with ferric salts, a red with salts of cobalt, and a yellowish green with sulphate of copper. The last precipitate forms gradually and becomes crystalline; it contains colchicine and oxide of copper in equal equivalents. All these metallic compounds are soluble in alcohol.

Hubler believes that colchiceine is produced by the action of acids, and perhaps of bases, on colchicine. Both of these bodies are poisonous; but Hubler asserts that colchicine is poisonous to the carnivora only, and that a dose which is poisonous to a carnivorous has no effect on a herbivorous animal. This is not in accordance with the observations of Schroff and others; but it must be remembered that Schroff experimented with a very different colchicine, probably impure, prepared by Geiger's process.—*Journal de Pharmacie et Chimie*, December, 1865.

PHYSICAL SCIENCE.

New Differential Anemometer.[*]

I beg to forward for insertion in the Chemical News a description of an instrument for measuring slight variations of pressure, trusting that the information may be of interest to many of your readers, not only on account of its practical value, but also as an ingenious application of a philosophical principle.

The instrument in question is in use at the London and North Western Works at Crewe, and is the invention of Mr. Ramsbottom, the Company's mechanical engineer.

At these works, Siemen's system of gas furnaces is being introduced for the manufacture of iron and steel, and as it has been found advisable to register the pressure of the gas, which only varies a few hundredths of an inch of water, an instrument of more than ordinary delicacy was required.

It occurred to Mr. Ramsbottom that an instrument having the requisite sensitiveness might be constructed on the differential principle by means of a syphon tube containing two fluids of different densities.

As shown by the accompanying diagram, the instrument consists of an oblong box divided by the diaphragm (A) into two cisterns, one of which (B) is air tight and fitted with a tube through which the pressure is applied, and the other (C) merely closed by a lid. The two cisterns are about half filled with water, and are connected by means of a glass syphon tube, the legs of which are equal in length. The ends of the tube pass through glands, and reach nearly to the bottom of the cisterns.

The upper half of the tube is filled with a fluid such as benzole, mobile, insoluble in, and of less specific gravity than water, the lower halves of the two legs being filled with the water, which may be tinged pink with cochineal. To prevent evaporation, the surface of the water in the cisterns is covered with a film of oil; should, however, the level of the two cisterns be disturbed from any cause, it can be restored by means of the stopcock E, connecting the two cisterns.

In the instrument as constructed the lighter fluid is benzole, in which camphor has been dissolved in sufficient quantity to obtain a specific gravity equal to $\frac{8}{10}$ths that of water, or a difference of $\frac{1}{5}$th.

The scale with which the instrument is fitted is divided in this latter proportion, so that each $\frac{1}{10}$th of an inch, pressure in inches of water column, is represented by $\frac{5}{10}$ths of an inch on the scale; these divisions being again subdivided, a variation in pressure of $\frac{1}{100}$th of an inch of water column may be clearly read.

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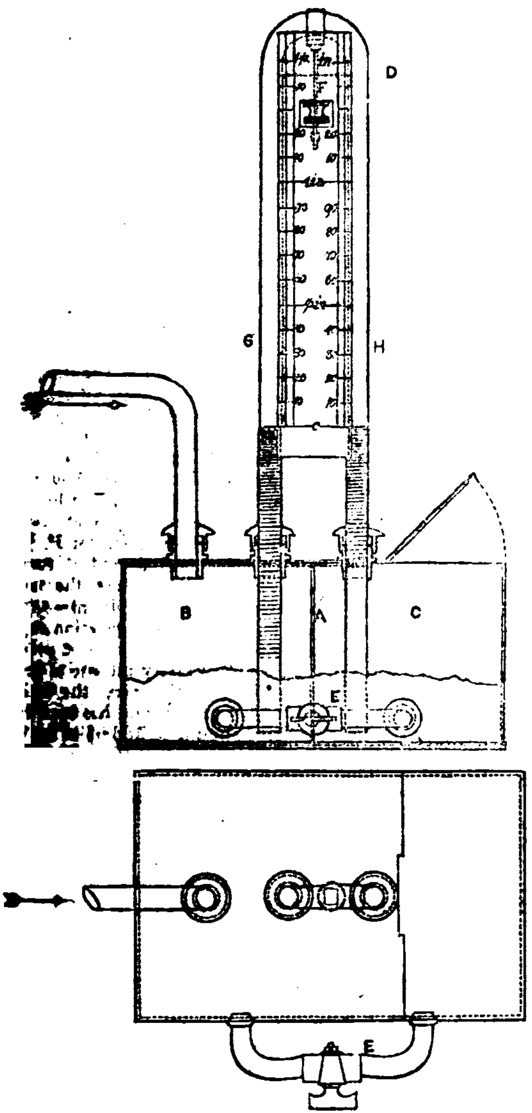
[*] Communicated by permission of Mr. Ramsbottom.

A screwed wire suspended from the bend of the tube by a brass clip, carries the scale, which can be moved by the milled nut, F, to adjust the zero of the scale to the points of contact of the two fluids.

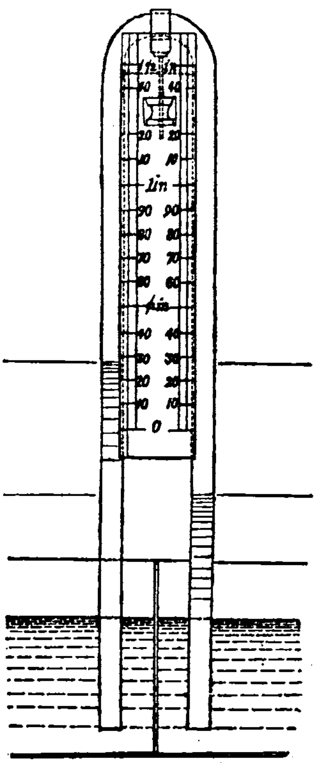
N° 1



The action of the instrument is as follows:—Any excess of pressure in the air-tight cistern, B, raises the level of the water in the leg, G, of the syphon tube, and causes a corresponding depression in the other leg, H, and the amount of variation between the two water levels will be inversely proportional to the difference between the densities of the two fluids.

It will readily be seen that assuming the difference of level in the two legs to be one inch and drawing lines across the figure at the two points, (see Fig. 2) that the benzole in each leg above the higher level, being equal, is balanced, as is also the water below the lower level; there only remains, therefore, the inch of water on the one side against the inch of benzole on the other, consequently the amount of pressure expressed in inches of water will be equal to the difference between the weight of the two columns, which difference in this case ($\frac{1}{5}$th of an inch) is represented on the scale by a distance of one inch, thus giving a scale magnified five times.

N° 2



I should be glad to hear of a suitable fluid of a density approaching nearer to that of water, as the less the difference between the two fluids the larger the scale becomes.

It need hardly be pointed out that the instrument can also be used to indicate negative pressure, the action in the tube being merely reversed, and the reading taken from the opposite column, as in the case of a chimney draught.

E. Swann, F.C.S.

Crewe.

Stannic Chloride.—Dr. Gerlach states that the specific gravity of anhydrous stannic chloride at 15° = 2·234. He adds the following table, giving the amount $SnCl_2$ in solutions of various densities:—

Per cent. of $SnCl_2$.	Sp. gr. of aqueous solution at 15°.
10	1·082
20	1·174
30	1·279
40	1·404
50	1·556
60	1·743
70	1·973

A very concentrated solution left at rest for a long time deposits large perfectly transparent crystals, having the composition $SnCl_2 + 8HO$. These crystals are more deliquescent than those of the pentahydrated bichloride.—*Zeitschrift für Chemie, &c.*, p. 731, 1865.

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 4.

Tuesday, April 25, 1865.

(Continued from page 45.)

Dr. Voelcker published in 1863, in the *Memoirs* of the Royal Agricultural Society, a most valuable paper on the absorption of phosphate of lime and phosphatic manures by root crops. Among the many facts which had a direct interest for those employed in the cultivation of the soil, there is one point connected with these researches to which I desire to call your attention, and that is the relative amount of phosphoric acid which is required by an average crop of wheat or of turnips per acre. You may observe in reading over the following table that whilst turnips require 39¾ lbs. of phosphoric acid, wheat, which is considered a highly nitrogenated crop, only contains 25¾ lbs. of the same substance. This statement is correct so long as you take the total weight of the crop produced by an acre of land, for one acre of land will produce twenty tons of turnips and about two tons of wheat; but if you take 100 lbs. of each of these substances, then, of course, wheat will contain a far larger proportion of phosphoric acid than the turnips:—

One Acre of Land.

	20 tons of turnips.		Wheat.	
	Bulbs. lbs.	Tops. lbs.	Grain. 1920 lbs. lbs.	Straw. 3840 lbs. lbs.
Potash	132·	45·5	9·75	25·
Soda	6·25	7·	—	—
Magnesia	6·25	2·25	3·75	3·75
Lime	36·	68·5	1·	10·5
Phosphoric acid	28·25	11·5	16·25	9·5
Sulphuric acid	36·	25·	·25	5·25
Silica	3·	2·25	1·	128·75
Chloride of sodium	19·	18·25	5·	9·25
Chloride of potassium	—	11·5		
Carbonic acid	47·25	36·25	—	—
	314·00	228·00	32·5	192·00

The researches of Mr. Lawes and Dr. Gilbert have demonstrated thoroughly the truth that the employment of super-phosphate of lime as a manure is useful for promoting the growth of wheat, and is essential to the perfect success of a crop of turnips. M. Ville has also published important papers in the *Comptes Rendus* of the Academy in Paris," on "The Influence of Phosphates on Vegetation;" and the following table will, I hope, convince you of the marked influence which they exercise on vegetation:—

Influence of Phosphates on Vegetation.

Phosphate of lime Alkaline silicates	20·86
Phosphate of lime	18·80
Earths and alkaline silicates	0·60
Earths	1·84

But the most interesting data at which M. Ville has arrived consist in that the presence of phosphates in soils determines a corresponding absorption of nitrogenated compounds by the plant; that is to say, that if phosphates are supplied to a vegetable its growth will be partial; and if, on the other hand, ammoniacal salts or nitrates are supplied to it the growth will be imperfect; but if both of them be added to the soil the absorption of the phosphate will be increased as well as that of the ammonia. This result is most interesting, not only in an agricultural point of view, but also as a physiological fact; for, until this important observation of M. Ville, scientific men had merely studied the immediate influence or absorption which the substance had on the vegetable or animal, without taking into account how these phenomena might be modified by the presence of others. I look upon the observation of M. Ville as one which will ultimately be far more appreciated than it appears to have been, and one which will lead to most important results in animal physiology and agriculture. I shall conclude these observations by giving you a table published by M. Ville, and which clearly sets forth the truth of these remarks:—

Amount of Nitrogen fixed by Wheat under the Influence of the following Salts:—

	Without Nitrogenated compounds.	With Nitrogenated compounds.
Phosphate of lime and alkaline silicate	8·15	20·08
Phosphate of lime	7·25	19·17
Earths and alkaline silicates	5·71	11·16
Earth	3·00	9·50

The extraordinary liberality with which the Emperor of the French has supported and encouraged all scientific researches or inventions which might tend to promote the welfare of his subjects, is exemplified in the case of M. Ville, for the Emperor has not only built a special laboratory for his use, and placed a large greenhouse and other means of investigation at his disposal, but has also allowed him to experiment on one of his private farms. And this encouragement has not been lost, for M. Ville has arrived at some very valuable and practical results. Admitting that he wishes to ascertain what the soil is deficient in, so as to produce a full crop, he divides say an acre of land into four parts, adds to one portion superphosphate of lime, to another portion carbonate of potash, to another portion caustic lime, and lastly nitrate of soda. He then places on these sections of the acre the various crops which are intended to be grown, and he soon finds out which of the four manures should be added to convert an ordinary yielding field into an abundant one. This simple and practical mode of proceeding has led him to use, as a general manure, which he calls mineral manure, the following substances:—Phosphate of lime, 4 parts; carbonate of potash, 4 parts; caustic lime, 1·5 parts; and nitrate of soda, 6·5 parts. The results have been most satisfactory, and among the many he has published during the last two or three years I shall simply give the following:—

Total Corn per Acre.

Unmanured	990	926
Mixed mineral manure	1192	987
Ammonia salts	1471	1618
Mixed mineral manures and Ammonia salts	2407	2295

Straw and Chaff per Acre.

Unmanured	1625	1459
Mixed mineral manure	1804	1528
Ammonia salts	2536	2705
Mixed mineral manure and Ammonia salts	4176	4016

Allow me to pass from these highly-interesting and practical results obtained by M. Ville to those not less valuable published by Dr. Voelcker on another mineral matter which, like phosphoric acid, is only found in small quantities as a natural product in soils, and which, if absent, like phosphoric acid, renders the soil unprofitable to the farmer. That substance is potash. Dr. Voelcker has not only studied the action of one compound of potassium, say the caustic or carbonate of potash, but he has examined the action of these and also of sulphate of potash, chloride of potassium, and nitrate of potash, and to enable him to arrive at the correct result he had compared the action of these different salts of potash on various classes of soils—namely, calcareous stiff clay, fertile sandy loam, pasture land, marly soil, and sterile sand; and he has come to the general conclusion that when salts of potash are added to these soils, although the quantity retained by them varies with the nature of the compound of potassium used or the nature of the soil operated upon, still the soil will retain the potash and not allow it to pass off in the water which may issue from it by drainage or otherwise. If he employs a salt of potash, say the nitrate, sulphate, or chloride, the sulphuric acid, the nitric acid, or the chlorine will combine with the lime or the magnesia, and even in some instances with the ammonia which the soil may contain, while the potash will substitute itself for either of these bases which were in the silicate, demonstrated to exist in soils by Professor Way.

As mankind increase on the surface of the globe, and their wants proportionately become greater, so by a marvellous and admirable dispensation of Providence the power of the production of the soil to meet the wants of man is developed. A striking instance of this is given in the application of chemical discoveries to the cultivation of the land to make it commensurate with the growing requirements of the people. Thus, for example, we find stored in various parts of England—Suffolk, Cambridgeshire, and Bedfordshire—large beds of coprolites, or the refuse of antediluvian animals buried there for thousands of years, unknown to man, and its value unappreciated. Further, chemists have discovered in Norway mountains of phosphate, under the form of apatite, and tracts of land of phosphorite in Estremadura, in Spain. The same remark applies with equal force and truth to salts of potash. Their supply up to the present time has been limited, as I stated to you in my last lecture, in speaking of the discoveries of M. Balard, whose name I mentioned with no undue praise, as showing the benefits which society may derive from the extraction of a double chloride of potassium and magnesium from the ocean. Strange to say, within the last few years this identical salt has been discovered in large quantities as a mineral at Stassfurth, in Saxony, and although this mineral exists as a stratum under beds of ordinary common salt, and its discovery dates only three years back, there are at the present time 14,000 men employed in the factories which have risen on the spot for the extraction of the salt from its mineral, and its conversion into the various products required by the trade. This mineral, which has been called carnallite, and which assumes a thickness of 1000, is composed in 100 parts as follows:—Chloride of magnesium, 31·46; chloride of potassium, 14·24; chloride of sodium, 5·10; chloride of calcium, 1·62; salt of lime, 0·84; oxide of iron, 0·14; and water, 35·37. It may be considered as a definite chemical compound of 1 equivalent of chloride of potassium; 2 equivalents of chloride of magnesium; and 12 of water. I have not the slightest doubt that when this important discovery becomes generally known to our salt manufacturers, they will also turn their attention to the nature of the minerals composing the sub-soils of their salt beds, and will discover carnallite, and thus confer on the country a great boon by promoting its agriculture. The popularising of this fact may confer a great benefit on those salt mine proprietors who are working their mines for rock salt, and who have not filled their mines with water, so as to take from them a brine containing the salt they require. I have no doubt that if carnallite is discovered in England, it will in many instances modify entirely the present method of working salt mines.

Lime.—Too much importance cannot be attached to the presence in certain proportions of lime in soils, for it is one of the essential elements of ashes of plants, and is necessary to their growth. In fact, Dr. Voelcker says:—

"We know practically how essential the presence of lime is for the healthy growth of every kind of cultivated produce. On soils very deficient in lime, most crops, especially green crops, are subject to all kinds of disease; and, consequently, roots fail altogether on such land, even if it has been liberally manured with good yard dung or guano. Up to a certain stage, corn and roots grown under such conditions appear to thrive well, but as the season advances they sustain a check, and at harvest time yield a miserable return. The remedy for such failures, which are not at all uncommon in localities where poor sandy soils prevail, is a good dose of lime or marl, and then, and only then, farmyard manure or guano may be applied to the greatest advantage. Marl or lime alone does not suffice for meeting all the requirements of our cultivated crops on such poor sands; and though calcareous minerals supply a most necessary element of plant-food, and, by acting on the latent stores of food in the soil, produce at first a most strikingly favourable effect upon vegetation, they soon fail to produce the desired effect if repeated too often, to the exclusion of other fertilising matters. On the other hand, the most liberal application of farmyard manure of the best quality never produces so beneficial and lasting an effect on poor sandy soils as when they have been previously well marled or limed. On such land no doubt the proverb holds good—

"Lime and marl without manure
Only make the farmer poor."

"But at the same time I have a strong impression that on such land manure, without lime or marl, does not help much towards paying the rent. There are some soils which swallow up manure, with, so to speak, an insatiable appetite, without ever feeling the better for the manure; they are appropriately called very hungry. On all such soils I have no hesitation in saying much manure is wasted, or the most is not made of it, if, previously to the application of farmyard-manure, guano, &c., the land has not received a good dose of marl or lime.

"My recent filtration experiments point out the reason why marl or lime is peculiarly valuable on poor sands. It is not merely by supplying in a direct manner a deficient element of nutrition that lime acts so beneficially on such soils, but because it preserves in the soil the more valuable fertilising matters, which, like salts of potash or ammonia, rapidly filter through sandy soils, unless a sufficient quantity of marl or lime has been previously applied to the land. By these means the bases of the more valuable saline soluble constituents of rotten dung or of guano are retained in the soil, whilst the acids filter through it in combination with lime—a constituent which is, comparatively speaking, inexpensive."

The evening is too far spent for me to attempt to enter into the valuable researches of Mr. Lawes and Dr. Gilbert connected with meadow lands and the feeding of cattle; but I would strongly recommend those who take an interest in these branches of science to consult the papers published by those gentlemen in the *Journal of the Royal Agricultural Society*. I would also call your attention to a paper on the same subject by Mr. John Coleman, as well as a talented lecture which that gentleman delivered a few weeks since before this Society, in which he gives most important information to the farmer respecting the cheap feeding of cattle.

I hope, ladies and gentlemen, that you are now convinced of the truth of the assertion which I made at the beginning of this lecture, that no country possesses men better informed than those who exist in England on scientific agriculture. In fact, we can boast, especially if we give the lead to Scotch farmers, of being the leading nation in point of agricultural progress.

ACADEMY OF SCIENCES.

January 22, 1866.

The last sitting of the Academy was almost destitute of any chemical interest. M. J. Lefort presented a note "*On the Presence of Urea in the Milk of Herbivorous Animals.*" He evaporated the whey from cow's milk to a syrupy consistence, separating the caseous and albumenoid matters which deposited from time to time. After cooling, the liquid part was poured from the sugar and salts into alcohol, and the mixture was heated on a water-bath to promote the solution of the urea. The filtered solution was now evaporated to the consistence of syrup, and then treated with strong and pure nitric acid. After forty-eight hours an abundant deposit of a yellow colour and very soluble in water was formed, which contained nitrate of urea with a small quantity of nitrate of potash. The aqueous solution of this deposit was treated with carbonate of baryta, and the whole was evaporated to the consistence of a soft extract, from which the nitrate of urea was dissolved by means of pure alcohol. From eight litres of the whey a gramme and a-half of nitrate of urea was obtained.

M. T. Schloesing read a note "*On Some Applications of his Furnace to Laboratory and Industrial Operations.*" All English chemists, we imagine, are fully alive to the value of a gas furnace in a laboratory. Such furnaces will, no doubt, be generally employed in industrial operations, as soon as their economy is placed beyond doubt. At present this point is by no means decided; and so far M. Schloesing only tells us that he thinks there is no serious difficulty in the way of employing gas and air to produce the highest temperatures required in metallurgical operations, if casings sufficiently refractory could be discovered.

NOTICES OF BOOKS.

Report on Water for Locomotives and Boiler Incrustations, made to the President and Directors of the New York Central Railroad. By Charles F. Chandler, Ph.D., Professor of Chemistry in the School of Mines, Columbia College, New York. J. F. Trow and Co. 1865.

The Americans have set a good example to the railroad authorities of this and other countries by initiating a philosophical system of inquiry into the quality of the water supplies available on a long line of railroad, and into the best means of dealing with the various kinds of incrustation which are continually forming around the tubes and upon other internal parts of the locomotive boiler when working under ordinary circumstances. The report now before us is dated November 17, 1865. It describes the composition of about a dozen specimens of boiler incrustation, and includes the analyses of twenty samples of water used in the locomotives of the New York Central Company. The author gives an opinion respecting the causes of corrosion, and, without offering any original suggestion of his own, enumerates the hundred-and-one remedies which have from time to time been proposed as means of preventing incrustations, or of removing ready-formed calcareous deposits. To give an idea of the variation observed in the chemical quality of the water, it may be stated that the total dissolved constituents ranged between the limits of 9 and 42 grains per gallon, of which carbonate of lime constituted 5 and 17 grains respectively, whilst the sulphate of this base varied in other waters from nil to 19 grains per gallon. From these data it must be manifest that the rate of incrustation will be subject to considerable fluctuations; but, taking as the mean or average only 17 grains of "incrusting constituents" per gallon, and the fact that an engine will run sixty-five miles daily and evaporate forty-five gallons of water per mile, it results that seven pounds of calcareous matter will be deposited daily, or upwards of a ton per annum! A large proportion of this incrusting material is got rid of by blowing off or washing the boiler, but the rest remains firmly adhering to the tubes and to the interior surfaces of the boiler plates, forming a non-conducting lining which involves loss of heat and consequent waste of fuel, besides the danger of explosion—two cases of which, attributable to over-heating from this cause, were reported to the Senate of the United States in 1849. As an extreme case, the author mentions under this head an instance of 1300lbs. of scale and refuse having been removed at one time from a heavily incrusted locomotive boiler.

The following numbers are quoted by way of furnishing some indication of the quality of the American waters described at length by Dr. Chandler in his analytical tables. The proportions are stated in grains per gallon:—

	Sulphate of lime.	Carbonate of lime.	Carbonate of magnesia.	Chloride of sodium.
Palmyra .	18·81	8·41	5·98	nil.
Rochester .	6·46	16·92	8·88	4·82
Memphis .	10·12	6·75	4·41	0·26
Jordan .	4·02	5·03	2·30	0·76
Newark .	3·19	9·15	6·01	0·38
Savannah .	nil.	11·93	5·04	nil.

Chloride of potassium was detected in all the samples of water examined; but the amount was less than one grain in every case, excepting that which is quoted below under the name of "Warner's supply," the composition of which is especially interesting from the circumstance of its containing a notable proportion of alkaline carbonates. The Port Byron water, drawn from Owasco Lake, was the purest of the series.

	Warner's.	Port Byron.
Sulphate of lime . . .	nil.	0·01
Carbonate of lime. . .	7·17	5·43
Carbonate of magnesia . .	3·63	1·57
Carbonate of potash . .	2·17	nil.
Carbonate of soda . . .	6·09	nil.
Sulphate of potash . .	1·81	0·32
Sulphate of soda . . .	nil.	0·37
Chloride of potassium . .	1·91	0·39
Oxide of iron . . .	0·11	trace.
Silica	0·37	0·16
Organic matter . . .	0·37	1·28
Total	23·63	9·53

Boiler Incrustations.—The following samples are selected from the series of ten quoted in Dr. Chandler's analytical table. They are numbered and described thus:—

I.	From stationary engine, Syracuse (Structure compact and crystalline)	Scale $\frac{3}{16}$ in. thick.
III.	Locomotive, Syracuse. (Structure like the preceding) .	Thin scale $\frac{3}{32}$ in.
VI.	Do. do. do. .	Scale $\frac{1}{4}$ in. thick.
VII.	Stationary engine, Niagara Falls. (Structure friable and granular)	„ 2 in. thick.
VIII.	Stationary engine, Albany. (Structure like the preceding) . .	„ $1\frac{1}{4}$ in. thick.

	I.	III.	VI.	VII.	VIII.
Sulphate of lime .	74·07	62·86	30·80	4·95	0·88
Carbonate of lime	14·78	12·62	26·93	86·25	93·19
Basic carbonate of magnesia . .	9·19	18·95	31·17	2·61	2·84
Oxide of iron and alumina . .	0·08	0·92	1·08	1·03	0·36
Water. . .	1·14	1·28	2·44	0·63	0·15
Organic matter .	undet.	undet.	undet.	undet.	1·96
Silica . . .	0·65	2·60	7·75	2·07	0·62
	99·91	99·23	100·17	97·54	100·00

The author regards the incrustations described in columns vii. and viii. as exceptional, and due to the use of water containing but a very small proportion of sulphate of lime. The average composition deduced from the whole series of normal specimens (six) is pretty fairly represented by the numbers stated under iii. As a rule, then, the sulphate of lime predominates, and the circumstances under which this ingredient separates from the water have been studied by Dr. Chandler, and his conclusions are well expressed in the following statement:—

"The solubility of sulphate of lime in water (ordinarily about 150 grains per gallon) is modified by the presence of other substances. The chlorides of calcium and magnesium, alcohol, &c., and even a high temperature diminish, whilst the chlorides of sodium and ammonium, sugar, and various other organic substances, somewhat increase its solubility. Hyposulphite of soda is said to increase its solubility tenfold. Above 212° F. the solubility rapidly diminishes as the temperature increases. At 255° F., equivalent to a pressure of 30 lbs., its solubility is diminished nearly three-fourths; at 272° F., equivalent to a pressure of 45 lbs. nineteen-twentieths, and at a temperature of 280° to 300°, it may be said to be totally insoluble."

Respecting the deposition of the carbonates of lime and magnesia, the author adopts the common opinion that it results from the expulsion of the free carbonic acid, and that the more slowly the heat is applied the more crystalline and firmly adherent will be the deposit. Much of the precipitate takes the form of a fine loose powder or mud, but whenever a considerable quantity of the sulphate of lime is at the same time present, there is a disposition to form hard and semi-crystalline incrustations.

The author's views regarding the causes of corrosion and the practical means of preventing the formation of incrustations in steam-boilers are well worthy of attention, and to their full consideration we propose returning next week.

Watts's Dictionary of Chemistry. Vols. I., II., III., and *passim.* Longman and Co.

(Continued from page 33.)

The first article demanding our notice is that on "Congregated Compounds" by the editor. The difference in meaning attached to the expressions congregated and copulated compounds by Gerhardt and Laurent, on the one side, and by Berzelius is explained. Numerous examples of these subtances are given, and the article concludes by showing that there is no reason why the use of congregated radicles in formulation should be retained, as it is easy to represent every change and theory of composition by means of mixed types.

The monograph, also from the editor, on that difficult and intricate subject "Crystallography," the great bugbear to the chemical student, is one of the most complete in the book, running through fifty-five pages, and being illustrated by more than 200 figures of crystalline forms, very few of which are repetitions. Chemists need now no longer complain that this important branch of science is only superficially treated of in the books that come more immediately into their hands. It is singular, we would almost say, with what aversion students take up this confessedly difficult subject; but now that Mr. Watts has added his very complete monograph to the already numerous articles in Miller and Phillips's, Dana's, and other works on mineralogy, it will be a shame if papers are continually read before the Chemical and other Societies in which no mention is made of the crystalline forms of the substances described. The authors of most papers content themselves with a lavish use of the words tubular, acicular, and rhomboidal, whereas the reflecting goniometer ought to be as constantly used in the laboratory as the thermometer. While on this subject, we may be pardoned for somewhat digressively remarking that the terms used by chemists in describing the colour of crystals and precipitates is just as loose and uncertain. Surely some reform is wanting in these two directions? The article concludes by describing the reflecting and ordinary goniometers, detailed directions being given for their use. We are somewhat surprised that the writer has omitted all mention of the nets published by Mr. Jordan, of the Geological Museum, which have hitherto proved so useful to the crystallographic student. A few words on the bibliography of the subject might have been added with very good effect.

"Digestion (Animal)" and "Dimorphism" are also excellent articles from the same pen.

Under Elasticity we have a capital account of this property of matter, tables being given of the compressibility of various liquids from Colladon and Sturm, Grossi, Aimé, and others. A table of the moduli of elasticity of the more common metals, annealed and unannealed, concludes the article.

More than one hundred pages are devoted to "Electricity," theoretical and practical, the newest views on the subject being given with great fulness. This is another article that will rank side by side with "Crystallography," and tends much to render the Dictionary as singularly complete as the editor seems determined to make it.

Under the head of "Equivalents" we find Dr. Odling again displaying his powers of acute reasoning and subtle definition. The distinction he so ably draws between equivalency and atomicity is at once clear and fine, and is shown to be one of the corner stones of the latest system of chemical formulation.

"Ethers," like the article "Alcohols" in the first volume, contains a long account of all the bodies now included under this head, from the simple methylic ether up to the more complicated polyethylenic and polyglyceric members of the group.

Stopping for one moment to glance attentively at a long account of the ethylene bases by Dr. Hofmann, who evidently revelled in describing the preparation and properties of his very large family, ethylene derivatives, we pass on to "Fermentation," by the editor—who, by the way, seems to have had the lion's share of the longer articles in this volume. Commencing with a long but condensed account of fermentation generally, Mr. Watts presents us with the most extended information on this important subject. The subject is then considered in detail under the headings acetous, alcoholic, amygdalous, gallous, lactous, mucous, pectous, saccharous, serapous, and urinous fermentation. An attentive perusal of these articles will convince the student that, with all our knowledge on the subject that we have already gained, we really know but little of the conditions under which these processes are originated and carried on. To the earnest worker searching for some all-absorbing research we know of none so deserving of attention and so promising of valuable results as fermentation. Connected as it is with the theory of spontaneous generation, it is a question that must not only enlist the attention of the chemist, but also that of the naturalist and physiologist.

"Formulæ (Rational)" is by Professor Foster, and forms a fitting pendant to his article on "Classification" in the first volume. Taking hippuric acid as an example, it may be formulated in various ways, according to the number of its reactions, and the particular transformations it is capable of undergoing. He then gives specimens of the methods of formulation adopted by Kulke, Frankland, and others, winding up by showing that most organic compounds may be formulated as derivatives of the type CH_4. A specimen of Gerhardt's exploded system of formulating compounds synoptically is also given.

A highly practical article on "Fuel" is contributed by Dr. B. H. Paul, one of our chief authorities on the subject. An attentive perusal of it is sufficient to convince every one—even a Government official—that the notion of superseding coal by petroleum for consumption as steam fuel is utterly fallacious. One might just as well expect to obtain a ton and a-half of iron from a ton of ore as some of the results put forward by those interested in the matter.

Gases, and the numerous subjects connected with them, are treated of by Drs. Paul and Roscoe and the editor. The article on the "Absorption of Gases by Liquids and Solids," by Dr. Roscoe, is an excellent example of the way in which this chemist has made this subject his own. In diffusion of gases the very latest discoveries of Graham are given at great length.

Dr. Paul also contributes an article on the "Chemistry of Geology," which will be especially useful to both geological chemists and chemical geologists, whose numbers we are glad to find are daily increasing. A little closer communion between chemists and geologists would be of the greatest benefit to both sciences, and would do much to revive the study of mineral chemistry.

The article "Glycerides" gives an interesting account of the latest researches with these interesting bodies, and gives the newest views with regard to the composition of the saponifiable fats and oils.

"Gunpowder, its Composition and Manufacture," are well described by the editor, and the best methods of analysing it briefly given.

Zeitschrift für Chemie, &c. Vol. I., No. 23. 1865.

We notice this, the number of the journal last published, as it contains a communication by Dr. H. Peltzer, claiming the first publication of the discoveries announced in Professor Bloxam's paper "On the Action of Sulphide of Ammonium on Sulphide of Copper." This paper, the Doctor states, is but a short repetition of one published by himself in the *Annalen der Chemie, &c.*, two years ago, "On the Polysulphurets and a New Sulpho-salt of Copper."

Two short communications, "*On the Action of Atmospheric Air on a Mixture of Carbolic Acid and Ammonia,*" and "*On Stannic Chloride,*" we give in another place.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

3054. A. V. Newton, Chancery Lane, "Improvements in the utilisation of waste leather to be employed as a fertiliser." A communication from O. Lugo, New York, U.S.A.—Petition recorded November 28, 1865.

3345. J. Young, Limefield, Mid Lothian, N.B., "Improvements in treating hydrocarbon oils."—December 27, 1865.

3383. W. E. Newton, Chancery Lane, "Improvements in friction matches, in apparatus for using them, and in adapting them for lighting lamps." A communication from P. B. Tyler, Springfield, Mass., U.S.A.—December 30, 1865.

86. G. Chetwynd, Glenmohr Terrace, Blackheath, Kent, "Improvements in the treatment of copper and nickel ores." A communication from Viscount C. de Secqueville, Milan, Italy.

88. J. W. Gray, St. Dunstan's Hill, London, "Improvements in the manufacture of rice starch.—January 10, 1866.

97. C. Crump, Yealmpton, Devonshire, "Improvements in the preparation of tetra-chloride of carbon."—January 11, 1866.

101. F. Sutton, Norwich, Norfolk, "Improvements in the treatment of sewage and urine, in order to recover the manurial constituents therefrom."

105. W. B. Woodbury, Worcester Park, Surrey, and G. Davies, Serle Street, Lincoln's Inn, Middlesex, "An improved method of and apparatus for finishing impressions (in coloured gelatine or other soluble material) obtained from metallic or other plates produced by the aid of photography."—January 12, 1866.

NOTICES TO PROCEED.

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.

2373. F. Carlier, Boulevart de Strasbourg, Paris, "Improvements in the arrangement and fittings of certain apparatuses for extinguishing fires."—Petitions recorded September 16, 1865.

2390. J. S. McDougall, Manchester, "Improvements in the manufacture of insoluble oils and greases."—September 19, 1865.

2413. R. A. Brooman, Fleet Street, "Improvements in blast furnaces, and in charging the same."—A communication from A. Lebrun, Virloy, Paris.

2415. A. Bird, Birmingham, "Improvements in purifying water."—September 21, 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."—September 22, 1865.

2451. E. Brooke, Huddersfield, "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.

2505. J. Duke, Puriton, Somersetshire, "Improvements in the manufacture of cement."—September 29, 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.

2808. H. Y. D. Scott, Ealing, Middlesex, "Improvements in the treatment and deodorisation of sewage water."—October 31, 1865.

26. A. V. Newton, Chancery Lane, "Improvements in the preparation of pigments."—A communication from S. Gwynn, New York, U.S.A.—January 3, 1866.

CORRESPONDENCE.

Continental Science.

Paris, January 27.

The Chemical Society of Paris has elected M. Berthelot as President for the year. M. Dumas is *President d'honneur.* The Vice-Presidents are MM. H. St. Claire Deville, Debray, Troost, and Cloëz.

I read in *Les Mondes* of a new mode of manufacturing sulphuric acid without leaden chambers. It does not appear to be very successful, at least nothing is saved in the cost of production, but the acid must be free from lead, which is some advantage. In place of a chamber, the inventor, M. Verstraet, passes the sulphurous and nitrous vapours into a series of earthenware *bonbonnes* without bottoms piled one on another so as to form a sort of column; several of the columns communicate. The *bonbonnes* are filled with pieces of coke; steam is passed in as required; and the acid condenses on the coke and trickles down into a reservoir below to be afterwards concentrated in the usual way.

In the same journal M. Lemkes, a Dutch Pharmacien, describes pepsine of his own manufacture which surpasses in power of digesting all the pepsines I have read of. Unfortunately, we are not told how the author prepares it; but he describes it as a pulverulent substance, nearly colourless and quite tasteless, one decigramme of which with a little hydrochloric acid will in two hours dissolve twenty-five grammes of moist fibrin. The aqueous solution of this pepsine, he tells us, is neutral, and separates caseine from milk at 40°. It is not precipitated by nitric acid, ferrocyanide of potassium, or bichloride of mercury; but is precipitated by the acetates of lead, especially the tribasic salt.

The Batavian Philosophical Society of Rotterdam has published the annual list of subjects for prizes. Among these are one or two which some of your readers may like to go in for. For example, the following:—"Determine experimentally the temperature at which different simple chemical compounds decompose, and show how the temperature is affected by the presence of other substances and under other circumstances." Rather an extensive inquiry. Again, "M. Tyndall states that his experiments show that the vapour of water absorbs much more radiant heat than dry air. Magnus, on the contrary, asserts that there is no difference in the absorption by moist or dry air. It is desired to see conclusive experiments to terminate the dispute." The essays or replies may be written in English, and must be sent post free before February 1, 1867, to Dr. D. F. Van der Pant, Rotterdam.

The "Briquet Oxygéné" mentioned in my last as invented by Chancel, is not, I ought to say, the common lucifer match ignited by friction. It was the match coated with a mixture of chlorate of potash and sugar, and ignited by bringing it in contact with sulphuric acid. Phosphorus matches ignited by friction appear to have been known in France some time before 1805. With this correction, I leave the article I mentioned before for your further notice, only quoting, for the benefit of your match-making readers, the assertion of the author that the English are very much behind in the manufacture."

Dr. Phipson Again.

To the Editor of the Chemical News.

Sir,—I regret that Dr. Hofmann, in correcting an erroneous impression excited in the minds of his countrymen abroad, should have exposed himself to the attacks in this country of so shifty an antagonist as Dr. Phipson; and still more, that the respected name of Dr. Frankland, who has received no apology for the insolence to which he has been subjected, should thereby again have been sullied in the matter. But why, I ask, should any one enjoying the esteem of his fellows be expected to answer here an attack of Dr. Phipson's? Why, indeed, should not the well-known London correspondent and co-editor of *Cosmos* be left to the undisturbed enjoyment of his own pitiful detractions?

Holding no professorship, why should he not style himself "Professor of Analytical Chemistry in London?" Failing to obtain admission into the Royal Society, why should he not turn round and abuse its proceedings? Having his communications declined by the Chemical Society, why should he not loudly proclaim it a *bêtise*, though appending the initials F.C.S. to his name on every possible occasion? Ignorant of the facts of the case, why should he not publish in his chivalric journal the most infamous charges against Dr. Frankland and me, and, by himself or his coadjutor, refuse insertion to, or grossly garble, our replies. Eager to gratify a private pique, why should he not maliciously exaggerate, distort, and falsify a painful story, shocking enough in its simple truth?

Again, entertaining so poor an opinion of Dr. Frankland's character and skill, why should he not from time to time dazzle the world with his own marvellous discoveries—of the analogy between permanganate and bichromate of potash, of the production of populine from solutions of benzoic acid and salicine, of the increased density of garnets after ignition, and other magnificent mares' nests? Courting the favours of an inappreciative public, why should he not put forth ridiculous analyses of entirely new phosphates with which chemists have long been familiar; and, jealous of the honour of his profession, why should he not lend himself to the grossest puffery by writing discreditable testimonials such as the one I enclose you, in which we are informed that so-and-so's pureé has been rigorously tested for everything hurtful under the sun?

So scrupulous in all his actions, so considerate of the feelings of others, why should not this immaculate Dr. Phipson complain piteously of the insinuations made against him? Why, I ask, should successive chemists have dared to asperse the scientific and social character of such an innocent?

I am, &c.
William Odling.

London, January 30, 1866.

Mercuric Methide and Iodide of Potassium.

To the Editor of the Chemical News.

Sir,—I have followed with some interest the discussion in your columns upon the poisoning by mercuric methide; I have also read the articles in the *Cosmos*, and have no hesitation in declaring that Dr. Phipson has done good service by bringing the matter so prominently forward. Although it is now nearly a year since the unfortunate occurrences, it was not until the appearance of Dr. Phipson's articles in the *Cosmos* that any attention was paid to the subject. At present both professors and assistants in England and abroad will have been amply forewarned, and the results cannot be other than beneficial.

In his letter, translated recently in the Chemical News, Dr. Hofmann has certainly not done justice to Dr. Phipson. Any one who compares this letter with what has appeared in the *Cosmos* cannot, I think, fail to be satisfied on this point.

The treatment by iodide of potassium recently again advocated by Melsens as a universal antidote for mercurial poisons, has in the present cases been found to fail. This I believe to be owing to the formation of an iodide of mercuric methide, which is not eliminated, but remains in the system. The action of the antidote is thus incomplete, and the same appears to happen with other compounds of mercury when treated with iodide of potassium. Amongst others I would mention "Belets' syrop," with which I experimented in Paris in 1849.

I am, &c. A. Schwarz, M.D.

Hammersmith, W., January 20, 1866.

The Illness of Dr. Ulrich.

To the Editor of the Chemical News.

Sir,—A few words from an intimate friend of the late Dr. Ulrich may, perhaps, be welcome to some of your readers.

The sad death of Dr. Ulrich must be considered an accidental one. Preparing a large quantity of the mercuric methide in the midst of January, 1865, he met with an accident, breaking one of the tubes which contained the preparation. According to his own statement, he inhaled a great portion, having not taken the necessary precautions. I saw him the following day, and, finding that his countenance had attained a dull, anxious, and confused expression, I advised him to consult a medical man at once. However, on February 1st he got worse. On the 2nd his gait was unsteady, and questions were answered slowly and difficultly, but rationally. He suffered also from extreme debility.

Through the kindness and immediate exertion of Dr. Odling, I was able to enter him at once into the hospital.

Before leaving him, he burst into tears, uttering words of gratitude, and, no doubt, feeling, as I did myself, his dangerous condition.

I may state that Dr. Ulrich was of a strong and robust constitution, but not healthy. During the years 1863 and

1864 he had three or four fits, which no doubt indicated a chronic disorder of the brain.

I am, &c., E. Reichardt.

336, Oxford Street, W., January 29, 1866.

*** We can insert no more letters on this subject.

Composition of Rice.

To the Editor of the Chemical News.

Sir,—Your journal of December 22 contains an analysis of rice, by Mr. Ransford. Had that gentleman visited the Food Department of the South Kensington Museum he would have found the composition of that grain more fully represented than by the analysis given by him. It is as follows:—

Water	13·5
Gluten	6·5
Starch	74·1
Sugar	·4
Gum	1·0
Fat	·7
Cellulose, or woody fibre	3·3
Ash	·5
	100·0

I am, &c. F. C.

Umber.

To the Editor of the Chemical News.

Sir,—I have lately discovered a very extensive bed of umber on the estate of a friend of mine, but before setting to work upon it I should like to get a little information on the subject. All that books tell us is that it is hydrated oxide of iron and manganese.

The following questions will give you an idea of what sort of information I seek:—

1. Where is it mostly found?
2. Are there any deposits in England? I hear of one at Truro and another in the Isle of Man.
3. What is it principally used for, and in what quantities?
4. What is its market price in London washed and dried?
5. What are the qualities of the best umber, and where does it come from?
6. Could any of your friends oblige me with a standard specimen, and the price and source of it?

I am, &c., Chemicus.

Depositing Copper on Solder.

To the Editor of the Chemical News.

Sir,—Will you, or any of your readers, kindly help me in the following:—

How can an electro-deposit of copper be made to adhere to solder? When I deposit copper on a clean surface of solder, it peels off under the scratch-brush. How will solder best and quickest take a fixed electro-deposit of silver? and how can I give an object, of which a part of the surface is copper and a part solder, an equal coat of silver at the same time, so that the silver shall not be thicker on the copper than on the solder?

I am, &c., C. B. W.

MISCELLANEOUS.

Royal Institution.—The following are the arrangements for the ensuing week:—Monday, February 5, at 2 o'clock, general monthly meeting. Tuesday, February 6, and Thursday, February 8, at 3 o'clock, Professor Tyndall "On Heat." Friday, February 9, at 8 o'clock, Archibald Smith, Esq., F.R.S., "On the Deviation of the Compass in Iron Ships." Saturday, February 10, at 3 o'clock, Professor Westmacott, R.A., "On Art Education, and How Works of Art should be Viewed."

Composition and Quality of the Metropolitan Waters in January, 1866.—The following are the Returns of the Metropolitan Association of Medical Officers of Health:—

Names of Water Companies.	Total solid matter per gallon.	Loss by ignition.*	Oxydisable organic matter.†	Hardness.	
				Before boiling.	After boiling.
Thames Water Companies.	Grains.	Grns.	Grains.	Degs.	Degs.
Grand Junction	20·95	1·57	0·76	13·6	4·0
West Middlesex	23·45	1·96	0·66	13·5	5·2
Southwark & Vauxhall	21·46	1·89	0·73	13·6	4·0
Chelsea	19·79	1·00	0·93	13·5	4·2
Lambeth	19·36	1·80	1·03	11·4	5·0
Other Companies.					
Kent	26·12	0·86	0·19	17·5	7·0
New River	21·05	1·00	0·35	16·2	4·9
East London	24·25	1·28	0·59	15·7	6·4

* The loss by ignition represents a variety of volatile matters, as well as organic matter, as ammoniacal salts, moisture, and the volatile constituents of nitrates and nitrites.

† The oxydisable organic matter is determined by a standard solution of permanganate of potash—the available oxygen of which is to the organic matter as 1 : 8; and the results are controlled by the examination of the colour of the water when seen through a glass tube two feet in length and two inches in diameter.

H. Letheby, M.B., &c.

"Chemical Rhymes."

"Now Brown's employer had a large collection
Of chemicals in every sort of phial,
And some he would employ in the detection
Of poisons when engaged upon trial;
Results were thus submitted to inspection
Which were beyond a shadow of denial;
Others had odours vile, and most injurious,
And nearly all had names both strange and curious.

"Among the acids there were Itaconic,
Oxalic, Cyanuric, and Phocenic,
With Parabanic, Gallic, and Euchronic,
Saccharic, Kakodylic, and Comenic,
Melanic, Citric, Kinic, and Myronic,
Sulphomethylic, Tannic, Sulphophenic,
Tartaric, Xanthic, Pectic, and Cerotic,
With Mucic, Malic, also Carbazotic."

—*From "Percy Villiers," a poem by John Newlands, F.C.S.*

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. XII. 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. XIII. commenced on January 5, 1866, and will be complete in 26 numbers.

T. H.—We are informed that the book will probably be issued this year.

B.—1. Try a saturated aqueous solution of carbolic acid. 2. Sulphite of soda.

M. G.—Full information on the subject will be found in the last edition of Ure's Dictionary.

J. J.—Spon's, 16, Bucklersbury, is a likely place.

F. Maxwell Lyte, Esq.—Received, with thanks. Could the woodcut of instrument be sent for insertion?

A. B. C.—In a recent number of the *British Medical Journal.*

Excelsior.—The sample consists of china clay, chalk, and some colouring matter which can only be determined by a complete analysis.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Remarks on a Paper of E. J. Mills on Nitro-Compounds,[*] (Part II.), *by* F. Beilstein, *Professor at the G. A. University, Göttingen.*

In an investigation conducted by E. Reichenbach and myself we showed[†] that the acid $C_7H_6O_2$ obtained from nitrodracylic acid was in every respect identical with common benzoic acid. Mr. E. J. Mills has not read this publication, but only the first published in common with J. Wilbrand,[‡] and, therefore, believes the question of isomerism to be still open. He has made an investigation for the purpose of comparing the two acids, and comes to the conclusion that there are two benzoic acids. Before proceeding to explain this difference, let me remark that the name "nitrodracylic acid" was not introduced by us, but by Glénard and Boudault, by whom, in 1843, this body was discovered and obtained pure.[§] They obtained it by boiling toluol (at that time called "dracyl") with fuming nitric acid, and it was only owing to a mistake in the estimation of the carbon that they gave the wrong formula $C_8H_6(NO_2)O_2$, which has found its way into all compendiums.[||] Abel afterwards, in 1847,[¶] obtained an acid $C_7H_5(NO_2)O_2$ by treating cumol with fuming nitric acid, which was probably only nitrobenzoic acid.

Our observations are entirely opposed to those of Mr. Mills. We have shown (l. c.) that the acid obtained from nitrodracylic acid comports itself with a mixture of nitric and sulphuric acid exactly like common benzoic acid; nitrobenzoic acid is the product. We analysed the acid, and found that all its properties and salts corresponded exactly to those of the acid obtained from α-nitrobenzoic acid. In these experiments a great deal depends on the purity of the substance worked on. In a separate paper (*Ann. Chem. Pharm.*, 132, 509) we have shown the extraordinary influence which even a minute impurity may exert on the nature of the acid obtained. We found in particular that in the action of nitrous acid on a hot solution of amidobenzoic acid in alcohol it is almost impossible to prevent the formation of other products, from which benzoic acid can only be freed with difficulty.

The preparation of nitrobenzoic acid from benzoic acid by means of nitric acid is very inconvenient, and simply washing the product by no means insufficient for purification. As Naumann found (*Ann. Chem. Pharm.*, 133, 208) the melting point of pure nitrobenzoic acid is not 128°, but 141 to 142°—a statement which we can in every respect confirm. The smallest impurity is sufficient to lower the melting point of nitrobenzoic acid.

According to Mr. Mills, nitrodracylic acid, on being heated with nitric and sulphuric acid, is converted into dinitrobenzoic acid. This statement, too, we must contradict. We have boiled nitrodracylic acid with a mixture of fuming nitric acid and sulphuric acid some days without the slightest change taking place, even when heated with most concentrated nitric acid in sealed tubes. Nitrodracylic acid remained unchanged. So great is the stability of this acid that it can be boiled without decomposition with a solution of chloride of lime, by which nearly all nitro-compounds are decomposed. This comportment may be conveniently used to obtain nitrodracylic acid of a dazzling white colour. Only an acid containing as impurities a considerable quantity of benzoic and nitrobenzoic acids could, owing to this impurity, yield dinitrobenzoic acid. The best way for obtaining pure nitrodracylic acid consists in oxidising nitrotoluol with a mixture of bichromate of potash and sulphuric acid, diluted with twice its bulk of water.

The investigation of isomerism in the aromatic series is connected with much trouble and difficulty. A great deal of practice and experience is necessary to take all the circumstances into account. If Mr. Mills had read all our publications he would certainly have been more careful while studying these reactions.

Göttingen, January 30.

On Biracemate of Potash as an After Deposit in Red Wine, by Dr. T. L. Phipson, *F.C.S., &c.*[**]

In 1858 and 1859 I noticed in the red wine of Meudon, near Paris, and also in some Bordeaux wines of those years, the presence of innumerable brilliant crystals which floated in the bottles and sparkled like diamonds in the wine-glass when illuminated by the direct rays of the sun. In a few minutes these crystals were mostly deposited at the bottom of the glass. They did not appear to affect the quality of the wine to any sensible extent, either in taste, bouquet, or limpidity. I collected a small quantity of this deposit, but had no leisure to examine it completely. It was supposed to be principally composed of bitartrate of potash.

I did not meet with these floating crystals again until the month of May, 1865, when I was informed by the manager of the Cadiz, Oporto, and Light Wine Association that 600 dozen of Bordeaux wines in their stores were affected with a peculiar deposit, which I was requested to examine. I soon recognised the same crystalline production which I had formerly noticed in Paris, and was glad to have this opportunity of analysing it.

The wine was filtered and the crystalline deposit collected, dried in the air, and was found to consist entirely of brilliant crystals, tinged with the colouring matter of the wine, having an agreeably mottled appearance. The original deposit contained 62·5 per cent. of moisture and 37·5 of dry residue (dried at 110° Centigrade). The dry substance was submitted to analysis, and proved to be principally formed of what was at first taken to be bitartrate of potash, with a little tartrate of lime, colouring matter, &c.

But the microscopic examination of the deposit showed that the crystals were octagonal tables, and that they manifested no signs of hemihedry; they were then dissolved and their acid precipitated as a lime salt; this proved to be insoluble in acetic acid, either cold or hot, and when examined under the microscope showed rhombic prisms modified with the faces of the octahedron (and a good number of perfect octahedra); moreover, no signs of hemihedry were manifested in these modified rhombic prisms. There was then no doubt left in my mind that the deposit was formed principally of biracemate of potash.

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[*] *Journal of the Chem. Soc.* [2], 3, 319.

[†] *Ann. Chem. Pharm.*, 132, 137.

[‡] *Ibid*, 128, 257.

[§] *Berzelius Jahresb*, 24, 623; 25. 859; *Journ. de Pharm. Chim.* [3], 6, 250.

[||] Gerhardt, iv., 392; Gmelin, vi., 39.

[¶] *Ann. Chem. Pharm.*, 63, 313.

[**] Abstract of a paper communicated to the Academy of Sciences of Paris.

Vol. XIII. No. 323.—February 9, 1866.

The analysis gave—

Biracemate of potash	88·8
Tartrate of lime	6·2
Red colouring matter, ferment, and other organic matters . . .	5·0
	100·0

This is, I believe, the first time that biracemate of potash has been found to constitute a separate, or after, deposit in wine. Its presence is, in my opinion, a proof of the genuineness of red wine; but why it is not always present I am not, at this moment, prepared to examine. It may probably be the result of the decomposition of tartaric ether.

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

PART II.

THEORY OF TYPES AND ATOMICITY.

SECTION II.—*Application of the Theory of Types.*

(*Continued from page 50.*)

The preceding examples will give a condensed, but, I think, sufficient idea of the theory which was first suggested by Dr. Williamson, and of which Gerhardt has been the chief promoter. But the work of Gerhardt has been extended. Dr. Odling and M. Kekulé have added some important developments, and I think I may be allowed to state that my experiments on glycol and the interpretation I have given of the valuable researches of M. Berthelot on glycerine, have given a solid basis of the theory of condensed types, making evident the action of the polyatomic radicals in complex molecules. My experiments and researches had reference to the water type. Dr. Hofmann, in his classical investigations of the polyamines, has extended them in the most skilful and complete manner to the ammonia type. Thus, the theory has grown with the riches of science itself. New facts, far from being a hindrance, have given it increased force. And if these discoveries have formed in a manner the completion of the theory, has not the latter in its turn originated experiments, corrected views, established relationships, supplied deficiencies? In organic chemistry it has brought into the interpretation of reactions a clearness and simplicity before unknown. Let us refer back to the time when Gerhardt, in his earlier method, rejected all the rational formulæ which had nevertheless been so happily introduced into the science by the classic labours of MM. Dumas and Boullay on ethers, and of MM. Liebig and Wöhler on the benzoyle compounds. In conformity with the unitary idea, compound bodies were represented by a single expression, the crude formula. Formulæ of this kind expressed only the atomic composition and the size of the molecule. They neither represented the mode of generation nor the ties of relationship. They gave no account of the properties, and only an insufficient one of the reactions. When I adopt for the principal derivatives of acetic acid the formulæ,

$\left.\begin{array}{r}C_2H_3\Theta\\H\end{array}\right\}\Theta$	$\left.\begin{array}{r}C_2H_3\Theta\\K\end{array}\right\}\Theta$	$\left.\begin{array}{r}C_2H_3\Theta\\C_2H_5\end{array}\right\}\Theta$	$\left.\begin{array}{r}C_3H_3\Theta\\C_2H_3\Theta\end{array}\right\}\Theta$
Acetic acid.	Acetate of potassium.	Acetic ether.	Anhydrous acetic acid.
$\left.\begin{array}{r}C_2H_3\Theta\\H\end{array}\right\}S$	$\left.\begin{array}{r}C_2H_3\Theta\\CH_3\end{array}\right\}$	$\left.\begin{array}{r}C_2H_3\Theta\\Cl\end{array}\right\}$	$\left.\begin{array}{r}C_2H_3\Theta\\H\\H\end{array}\right\}N$
Thiacetic acid.	Acetone.	Chloride of acetyle.	Acetamide.

first observe that they all contain a common element: the acetyle radical $C_2H_3\Theta$. That is the connexion which unites all these bodies; it discloses relationships between them as close as those which are shown in the copper compounds by the existence of the copper radical.

The formula

$$\left.\begin{array}{r}C_2H_3\Theta\\H\end{array}\right\}\Theta$$

in which one atom of the hydrogen is not confounded with the three others, reminds me next of this fact, that of the four atoms of hydrogen in the acetic acid, one only is easily replaced by metals or organic groups; that acetic acid is monobasic, that it forms only one ether, one chloride, and one amide; only one ether because only one atom of hydrogen is capable of being replaced by an alcoholic group; only one chloride, because only one group $H\Theta$ is capable of being replaced by chlorine, &c.

If we take a bibasic acid—succinic acid, for example—the formula

$$\left.\begin{array}{r}C_4H_4\Theta_2\\H_2\end{array}\right\}\Theta_2$$

shows us that this acid contains two equivalents of hydrogen capable of being replaced by a metal or organic group; that it is bibasic—that it can form two ethers, two chlorides, and two amides: two ethers because each of the two equivalents of hydrogen can be replaced by an alcoholic group; two chlorides—

$$\left.\begin{array}{r}C_4H_4\Theta_2\\H\end{array}\right\}\begin{array}{l}\Theta\\Cl\end{array}\text{ and }C_4H_4\Theta_2Cl_2$$

because each of the two groups $H\Theta$ can be replaced by an atom of chlorine; lastly, two amides, because each of these two groups can be replaced by a group NH_2.

If we next pass to a compound of a higher order—glycerine, for example, the formula

$$\left.\begin{array}{r}(C_3H_5)'''\\H_3\end{array}\right\}\Theta_3$$

shows us immediately the triatomic nature of this combination; it reminds us that three atoms of its hydrogen may each be replaced by a radical of acid, that the three groups (or typical residues) $H\Theta$ which it contains may be replaced by chlorine, bromine, or by groups of NH_2, and that three series of combinations may occur in consequence of these substitutions.

What can be more convincing, or more simple, than the way in which the theory explains all these exchanges? What clearness it gives to the generating equations which we have already mentioned in the preceding pages, and which we might multiply indefinitely! But for what purpose, since the question is evident almost *à priori*. The theory of types takes its origin from a sounder interpretation of an immense number of reactions which it regards as double decompositions. It is their symbolic representation. It is quite natural, then, that it should account in a satisfactory manner for these same properties which M. Kekulé has called typical,* and which have reference to the very exchanges under discussion.

In place of all this, what do we see in the original formulæ? Nothing but the relative size of the molecules.

What do the formulæ

$$C_2H_4\Theta_2 \text{ and } C_4H_8\Theta_2$$

tell us concerning the relationship between acetic acid and acetic ether, and how would the second allow us to distinguish between acetic ether and the isometric methylpropionic ether, propylformic ether, and butyric acid? These formulæ are absolutely useless for this object, and to avoid such confusion we must return to the generating equations

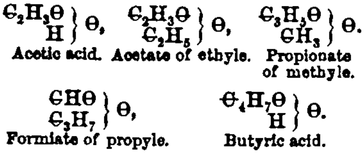
$$\underset{\text{Alcohol.}}{C_2H_6\Theta} + \underset{\text{Acetic acid.}}{C_2H_4\Theta_2} = \underset{\text{Acetic ether.}}{C_4H_8\Theta_2} + H_2\Theta$$

---

* *Lehrbuch der Organischen Chemie*, t. I., p. 124.

Gerhardt did so at the time that he defended the unitary system in the strict sense of the word. But it was an evasion, an inconvenient and even insufficient expedient, for the formulæ and the typical equations which Gerhardt afterwards employed are more explicit than the generating equations in question.

The following are the formulæ :—



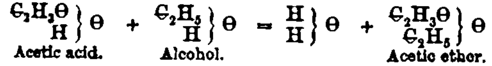
$$\left.\begin{matrix}C_2H_3\Theta\\H\end{matrix}\right\}\Theta,\quad \left.\begin{matrix}C_2H_3\Theta\\C_2H_5\end{matrix}\right\}\Theta,\quad \left.\begin{matrix}C_3H_5\Theta\\CH_3\end{matrix}\right\}\Theta.$$

Acetic acid. Acetate of ethyle. Propionate of methyle.

$$\left.\begin{matrix}CH\Theta\\C_3H_7\end{matrix}\right\}\Theta,\qquad \left.\begin{matrix}\Theta_4H_7\Theta\\H\end{matrix}\right\}\Theta.$$

Formiate of propyle. Butyric acid.

Here is one of the typical equations,—



$$\left.\begin{matrix}C_2H_3\Theta\\H\end{matrix}\right\}\Theta + \left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}\Theta = \left.\begin{matrix}H\\H\end{matrix}\right\}\Theta + \left.\begin{matrix}C_2H_3\Theta\\C_2H_5\end{matrix}\right\}\Theta$$

Acetic acid. Alcohol. Acetic ether.

Is it possible to express in a clearer and more simple manner this fact,—that the reaction of acetic acid on alcohol consists of an exchange of elements, and that the formation of acetic ether is necessarily connected with that of water? Certainly the typical equation gives account of the essential conditions, and, in a manner, of the mechanism of the reaction. There is a singular difference of opinion among some chemists on this subject. Among the detractors of the typical notation, some affirm that it says too much, others regret that it does not say enough. Admitting, say the former, these exchanges of simple bodies for groups in the systems which it considers as typical, the theory implies hypotheses on the molecular grouping. It does not confine itself to representing facts, it goes beyond them.

It is true, say the others, that it perfectly interprets certain reactions, but it is powerless to express them all. For after all these molecular changes, these double decompositions which it depicts so well are not the only reactions; there are molecular additions and subtractions; and when it becomes necessary to account for those more or less profound changes, which attack not only the external scaffolding, but the very substance of the molecule, the typical formulæ afford very slight, if any, assistance.

The following considerations will reduce these objections to their proper value.

(To be continued.)

Researches on the Volatile Hydrocarbons,
by C. M. Warren.

(Continued from page 51.)

The method just described differs in some respects from that of Kopp. He objects to the practice of taking boiling points with the thermometer bulb immersed in the liquid, on the ground that the thermometer in this condition hardly ever indicates a constant temperature, the end of the mercurial column being in a state of motion. He states that a boiling point taken in this manner may lie several degrees above that found with the thermometer bulb in the vapour. As bearing on this point, I propose, a little further on, to give the results of a few experiments and observations, which, with others of a similar character, have induced me to depart from the now more common custom of taking boiling points with the thermometer bulb in the vapour.

Under normal conditions, the temperature of the boiling liquid and that of the vapour evolved should be the same. The only disturbing influence which appears to have been specially dwelt upon as likely to alter these conditions in the taking of boiling points is the liability of some liquids to adhere to the surface of the glass in such a manner as to produce abnormal elevation of temperature, generally attended with irregular ebullition, and consequent fluctuation of the thermometer. To remedy this it is usual to introduce pieces of platinum; iron filings, coal, &c., have also been employed. As above remarked, pieces of coke—or, when admissible, sodium —are found to be more effectual with hydrocarbons than platinum. Indeed, during more than three years of experience and careful observation upon a large number of hydrocarbons, I have not yet met with a single instance in which irregular ebullition and its consequent disturbing influence upon the boiling point might not be completely prevented by these means. Although I cannot, of course, go so far as to say that equally satisfactory results would be obtained with other liquids by the use of coke, it is nevertheless my belief that in a majority of instances such would be the case.

I have dwelt upon this point for the reason that the objections to the custom of taking boiling points with the bulb in the vapour appear to be even greater than those which Kopp has raised against the opposite course of placing the bulb in the liquid, as I shall proceed to show. It therefore becomes a matter of some importance that the objections to one or the other custom should be removed; and I think it will be found easier to overcome the objections to placing the bulb in the liquid, as I have done in the case of many hydrocarbons, even if coke shall not be found equally efficient with most other liquids.

My experience has shown that, when irregular ebullition is effectually prevented, the temperature of the vapour from a boiling liquid is more liable to an erroneous determination of the boiling point, than the temperature of the liquid itself. The reasons for this are, first, that the vapour is liable to become superheated by the hot air from the flame coming in contact with the sides of the retort above the surface of the liquid; second, that, with the bulb in the vapour, the thermometer is more liable to sudden depression from the currents of cool air passing over the retort. If the bulb be in the vapour, the occurrence of either of these disturbing influences would then affect the principal mass of the mercury in the thermometer; while, on the contrary, if the bulb were in the liquid, only the small quantity of mercury in the stem of the thermometer would be subjected to these influences; the liquid then serving as a regulator, and reducing the error from these sources to a minimum. Fluctuations from currents of cold air are comparatively slight, and more easily prevented than those from overheating the vapour. The latter will be more likely to occur the lower the boiling point of the liquid, or when the quantity of liquid in the retort is small. I have, however, observed from this cause an elevation of 3° to 4° in distilling a body boiling as high as 98° C., without an unnecessarily large flame. But the liquid in this instance was pretty low in the retort.

In the case of liquids boiling below the common temperature, it seems indispensable that the bulb of the thermometer should be placed in the liquid. As evidence of this I will here state the results of observations made while occupied in fractioning some exceedingly volatile products from American petroleum.

Experiment 1.—The liquid operated upon boiled at so low a temperature that the distillation was effected by the heat of the surrounding atmosphere. The distillation was conducted in a flask, and the bulb of the thermometer placed in the vapour. The flask was attached to my condensing apparatus, including the "refrigerator

B, Fig. 2."* The temperature of the condensing worm contained in the "elevated bath, *aa*, Fig. 2,"* and also that of the "first receiver, *k*, Fig. 2,"* was 11°·5. The temperature of the "cold bath, *ii*, Fig. 2,"* was 11°. The condenser in "the refrigerator, B," and the "second receiver," were cooled in a mixture of ice and salt. With the liquid boiling steadily from several points on the bottom of the flask, and the condensed product from the distillation running well from the refrigerator into the "second receiver," not a drop was condensed in any of the apparatus intervening between the flask and the "second receiver," although this part of the apparatus was cooled, as already stated, to about 11°. The temperature of the vapour in the flask at this time was 18·5°, or only 2·5° below the temperature of the laboratory. These observations show that the liquid was boiling at a temperature considerably below that indicated by the thermometer in the vapour. Additional evidence of this was furnished by the fact that, during the distillation, the exterior of the flask, from the bottom to about one-quarter of an inch above the surface of the liquid, was thickly covered with water condensed from the atmosphere, resembling heavy dew; while above the sides of the flask were perfectly dry. It was these observations which first directed my attention to the fact that the temperature of the vapour could not in all cases be depended upon for the true boiling point of a liquid, and naturally led me to make other experiments with special reference to this question.

Experiment 2.—The conditions of this experiment were somewhat different from those of the first. The liquid operated upon was the extremely volatile product collected in the "second receiver" of experiment 1. The flask employed was smaller, and provided with two thermometers: the bulb of one of these was placed in the liquid and that of the other in the vapour. The flask stood in a water bath containing ice water; this bath was also provided with a thermometer. The tempeature of the ice-water bath was very gradually raised by means of a small flame from a Bunsen's burner. Temperature of the laboratory, 20° C. Observations during the distillation :—

		Degs.
1.	Temperature of the water bath	10
	„ „ boiling liquid	8
	„ „ vapour	18·5
2.	Temperature of the water bath	12
	„ „ boiling liquid	9
	„ „ vapour	18
15 minutes later 3.	Temperature of the water bath.	18
	„ „ boiling liquid	10
	„ „ vapour	14
10 minutes later. 4.	Temperature of the water bath	20
	„ „ boiling liquid	12
	„ „ vapour	19
20 minutes later. 5.	Temperature of the water bath	23
	„ „ boiling liquid	15
	„ „ vapour	19

Experiment 3.—The subject of this experiment was a liquid which I had separated from the most volatile product of the redistillation, on a manufacturing scale, of the crude benzole obtained in the distillation of coal tar. The apparatus employed was essentially the same as that used in experiment 1, with the addition of the extra thermometers, as in experiment 2. The condensing worm in the "elevated bath," and that in the "cold bath," and also the "first receiver," were all cooled in pounded ice. The condenser in the "refrigerator," and also the "second receiver," were both cooled in a mixture of ice and salt. The retort which stood in a small copper bath containing pounded ice, was charged with about 250 c.c. of the liquid, which had been previously cooled in a mixture of ice and salt. Temperature of the laboratory, 16° C. Observations during the distillation :—

		Degs.
1.	Temperature of the retort bath	0
	„ „ boiling liquid	0·6
	„ „ vapour	13·5
45 minutes later† 2.	Temperature of the retort bath	0
	„ „ boiling liquid	1·3
	„ „ vapour	12·2
15 minutes later 3.	Temperature of the retort bath	6
	„ „ boiling liquid	1·8
	„ „ vapour	12·6
30 minutes later 4.	Temperature of the retort bath	11
	„ „ boiling liquid	3·8
	„ „ vapour	12·4
30 minutes later 5.	Temperature of the retort bath	14·5
	„ „ boiling liquid	7·3
	„ „ vapour	13·8

The apparent inconsistency that the temperature of the boiling liquid should be above that of the heating medium—viz., an ice-bath—which continued during the first forty-five minutes of the experiment, is to be explained by the fact that there was a long column of mercury, above the surface of the liquid, which was subjected to the heating influence of the vapour. I would further remark that the gradual elevation of the boiling point, as indicated by the thermometer in the liquid, is also only apparent, and is due to the gradual uncovering of the bulb as the liquid was distilled off. At the close of the experiment only about one-fifth of the bulb, which unfortunately was a long one, was under the surface of the liquid. That this is the true explanation is evinced by the fact that during the experiment not a drop of liquid was observed to fall back into the retort from the "elevated condenser," although this was a tube ten feet in length, and cooled to the temperature of 0°.

(To be continued.)

TECHNICAL CHEMISTRY.

Purification of Nitrate of Sodium,

by F. MAXWELL LYTE, *Esq.*

A VERY convenient mode of obtaining nitrate of sodium free from all impurities, and fit for use as a reagent, is as follows :—

The impure article of commerce is first of all purified by one, or at most two, crystallisations, and dissolved to saturation in boiling water, and to the solution is added about 0·1 of ordinary commercial nitric acid of sp. gr. 1·35 (the pure acid is not necessary), the liquid being continually stirred, and the stirring kept up till cold. The crystalline powder thus formed is now washed on a strainer with dilute nitric acid of commerce (a 10 per cent. solution) and lastly with a little of a solution of similar strength of pure nitric acid.

The above method, which depends on the sparing solubility of nitrate of sodium in dilute nitric acid, is far more economical than the ordinary mode of preparing that salt, and the nitrate of sodium is obtained in the form of a beautiful white crystalline powder fit for use. The free acid which the salt is liable to contain may of course be expelled by heat.

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* See memoir "On Process of Fractional Condensation." *Memoirs of the American Academy*, 1864, and this journal, last vol., pp. 98, 99.

† From this point the temperature of the retort bath was gradually raised by means of a small gas-flame.

The addition of nitric acid to the nitrates of potassium and of barium, as well as to an infinity of other nitrates, is a considerable economy in their preparation, and greatly facilitates the separation of chlorides and other impurities during crystallisation.

Bagneres de Bigarre, January 16.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 1.

Professor W. A. MILLER, *M.D., F.R.S., President, in the Chair.*

THE business of the evening was commenced, as usual, by reading the minutes of the previous meeting, and by announcing the gifts to the library. The President then read for the second time the resolution of the council proposing the expulsion of some fourteen members of the Society who had allowed their subscriptions to lapse for upwards of three years, the ballot upon which will be taken at the next meeting. Mr. R. H. Smith was formally admitted a Fellow of the Society, and the following gentlemen were duly elected, viz.:—Mr. Arthur E. Davies, Surgeons' Hall, Edinburgh; Mr. Franklin Epps, Great Russell Street; Mr. Edward Purser, jun., 116, Fenchurch Street; and Mr. William Thorpe, 13, York Terrace, Kingsland Road. The names of the candidates proposed for the first time were—Mr. W. H. Cawfield, Pembroke College, Oxford; Mr. Robert Bell, Professor of Chemistry in the Queen's College, Kingston, Upper Canada; and Mr. G. W. Webster, Bridge Street, Warrington. For the second time were read the names of Mr. G. B. Ferguson, B.A., Magdalen Hall, Oxford; Mr. Benjamin Nickels, Making Place Hall, Ripponden, near Halifax; and Mr. W. H. Walenn, Talbot Road, Tufnell Park West. The name of Mr. Samuel Crawley, Training College, York, was withdrawn.

Dr. GILBERT then delivered a most interesting lecture "*On the Composition, Value, and Utilisation of Town Sewage,*" which was illustrated by a series of tables showing in detail the analytical results obtained by himself and previous observers. The author commenced with an historical account of the sanitary arrangements put in practice throughout Europe, particularly in England, Belgium, and Prussia, and stated that the primitive (dry) system had almost universally given way, in large cities at least, to the introduction of the modern system of water drainage, which had, however, the disadvantages of polluting the rivers, and of being wasteful. Within the present century the value of the manurial constituents had awakened much inquiry and research as to the best modes of utilising the ammonia, phosphates, &c., thus washed away continually into the sea and rivers; but the demands of civilisation requiring their rapid removal from our dwellings, the question resolved itself into the least objectionable means of disposing of town sewage, and its application to the land manifestly offered the greatest advantages. The analytical results of Mr. Way, Dr. Letheby, and of Dr. Hofmann and Mr. Witt were quoted as affording evidence of the very variable quality of the London sewage flowing through the same channels at different times and seasons, which discrepancies induced Dr. Gilbert, when experimenting at Rugby, to take samples every two hours, and mix them for the purpose of obtaining a fair average for analysis. After adopting these precautions, the results were so much disturbed by rainfall that the amount of ammonia varied between the limits of 2½ and 15½ grains in the gallon of sewage, or in value from ⅔d. to nearly 4d. per ton. With regard to the composition of the Rugby sewage, it was found that most of the organic matter remained in suspension, whilst the greater part of the mineral constituents existed in solution, and that the ratio of the organic to the inorganic was usually about 1 : 2. The mean result adopted by the author after collecting 93 samples at regular intervals within a period of nearly three years was thus expressed:—

	Grains per gallon.
Total solid matter	87·6
Ammonia	6.5

From which it is estimated, at 60 tons dilution per head per annum, that the sewage would yield 12½ lbs. of ammonia, equivalent to ⅔ cwt. of guano, and be worth 8s. 4d. per annum, or 1⅔d. per ton; Mr. Way's and Mr. Ellis's estimates for the metropolis were 2d., and Dr. Hofmann's and Mr. Witt's 2⅙d. per ton. The author remarked that a 10-lb. or 6s. 8d. standard for a mixed population per annum was arrived at twelve months ago by Mr. Lawes and himself, and it now appeared from recent experiments of Mr. Way and Dr. Odling, made upon the outfall of the great sewers north of the Thames, that 10½ lbs. of ammonia was a correct result, the value of which would be 7s. per head per annum. Baron Liebig took originally an exaggerated estimate of the value of London sewage, which he considered to be worth 4d. per ton; but in the year 1863 he reduced his standard from 18 grains to 7·2 grains of ammonia per gallon, and the price in proportion. Dr. Gilbert proceeded in the next place to compare the amounts of phosphoric acid and potash in the sewage with those required by various crops, and showed that the relation of 27 : 42 in the former would leave an excess of phosphoric acid in the soil if grass be cultivated, whilst if corn were grown a contrary result would occur. During the seasons 1861-62-63 two fields, of five and ten acres respectively, were laid out with grass at Rugby, and divided into four plots, three of which were irrigated with different proportions of sewage, one being left in the ordinary condition. The quantity of green grass raised upon an average of the two fields during three years proved as follows:—

	Tons.	Cwts.
I. Not watered	9	6
II. Sewage, 3000 tons . . .	22	5
III. do. 6000 tons . . .	30	6
IV. do. 9000 tons . . .	32	12

In the year 1864 the same meadows were left without any further application of sewage, and it was found that the plots II., III., and IV. still retained their luxuriance, and continued to give a greater yield. Several tables were devoted to the statement in detail of the composition of sewage before and after being used for the irrigation of land, as ascertained by experiments at Rugby, Croydon, &c., and from which it appeared that only small quantities of ammonia escaped absorption by the soil by becoming converted into nitric acid; there was, however, some nitrogen in the form of nitrates in sewage, the utilisation of which seemed to be difficult or incomplete. The bases, lime and magnesia, were sometimes removed from the soil in the process of irrigation, but the phosphoric acid was mostly retained. Croydon sewage contained 6·7 grs. of ammonia per gallon, of which only ·21 gr. escaped with the surplus water after irrigation, and the river Wandle contained no more than ·18 gr. of ammonia per gallon. The lecturer then gave some interesting facts relative to the application of sewage to the Edinburgh meadows, which owed much of their success to the geographical circumstance that the excess of fluids could run down directly into the sea, and thus large amounts of sewage, even to 100,000 tons per acre, could be safely applied without endangering the health of the surrounding neighbourhood by river pollution or otherwise. The results at Lochend and Craigentinny had the practical effect of raising the rental to an average of 22*l.* per acre, whilst the most successful instance of the benefits of sewage irrigation might, in the author's opinion, be seen on the eight acres of meadow land known as "Quarry

Holes," which took in all 500,000 tons of liquid sewage per annum, and was let for 32*l.* per acre. Other results were quoted by Dr. Gilbert, as referring to the produce of meadow and rye-grass at Alnwick, Carlisle, Malvern, Tavistock, and the Earl of Essex's estate at Watford. The system of sewage utilisation was also being tried at Worthing. The lecturer concluded his discourse by advancing the following propositions:—

1st. It is only by the liberal use of water that the refuse matters of large populations can be removed from their dwellings without nuisance and injury to health.

2nd. That the discharge of town sewage into rivers renders them unfit as a water-supply to other towns, is destructive to fish, causes deposits which injure the channel, and emanations which are injurious to health; is a great waste of manurial matter, and should not be permitted.

3rd. That the proper mode of both purifying and utilising sewage-water is to apply it to land.

4th. That considering the great dilution of town sewage, its constant daily supply at all seasons, its greater amount in wet weather, when the land can least bear, or least requires more water, and the cost of distribution, it is best fitted for application to grass, which alone can receive it the year round, though it may be occasionally applied with advantage to other crops within easy reach of the the line or area laid down for the continuous application to grass.

5th. That the direct result of the general application of town sewage to grass land would be an enormous increase in the production of milk (butter and cheese) and meat, whilst by the consumption of the grass a large amount of solid manure, applicable to arable land and crops generally, would be produced.

6th. That the cost or profit to a town of arrangements for the removal and utilisation of its sewage must vary very greatly according to its position and to the character of the land to be irrigated; where the sewage can be conveyed by gravitation, and a sufficient tract of suitable land is available, the town may realise a profit, but under contrary conditions it may have to submit to a pecuniary loss to secure the necessary sanitary advantages.

In the discussion which followed the reading of the paper,

Dr. **Voelcker** said that the conclusions arrived at by Dr. Gilbert will receive the hearty consent of all who have interested themselves in the practical application of sewage to land. It would be necessary to take the sewage matters a considerable distance out of the towns in order to avoid the annoyance from exhalations, which must always be given off until more perfect systems of deodorisation have been invented; and it is clear that grass would be the best crop, and both corn and roots exceptional. With respect to the purely chemical aspect of the subject, he was much interested in Dr. Gilbert's remarks about the conversion of the ammonia into nitric acid, for he felt convinced that, inasmuch as nitrates are invariably present in the juice of plants, the nitrogen can only be taken up in that form. From the tendency of lime and potash to be washed out of the soil, the speaker conceived that the use of highly dilute sewage should be avoided as far as possible. He was convinced that plants absorbed their food in the state of solution, and not, as Baron Liebig had suggested, in an intermediate form, neither liquid nor solid.

Dr. **Smee** related the particulars of his contest with the Croydon Board of Works respecting the disposal of the town sewage, and asserted that there was no better test of quality than by taking a sample of the water and placing a bottle of it on the mantelpiece, when organic matters would, if present, soon begin to decompose and emit a powerful odour. Impure water was distinguished by the rapidity with which weeds, especially the large American species, took root and flourished so as almost to choke the stream; it likewise prevented the deposition of fish spawn by covering all the loose stones with a vegetable growth. The American water-weed was about as rich in nitrogen as clover, and might possibly be used as cattle food. When sewage was applied to land it was important to ascertain the nature of the subsoil; if this was sand or a drift bed, the conditions were favourable for the oxidation of the animal matters. At Worthing, where an outbreak of fever was reported, the sewage operations had, he believed, impregnated the subsoil by leakage, and the water drawn from the chalk, formerly bright and clear, was now slightly turbid. At Weybridge and Woking, which stand on alternate beds of clay and sand, several cases of diphtheria had occurred; and the speaker considered that Croydon was unsafe since the irrigation with sewage. If, however, a dry sandy soil or other suitable foundation permitted the advantageous use of town sewage it was then desirable to employ the manurial matters in as concentrated a state as possible. In the Tyrol the farmers owed everything to the system of irrigation, which enabled them to get a third or fourth crop of hay during their short summer.

Dr. **Gilbert**, in reply to Mr. Newlands, said that the *whole* of the nitrogen in guano was included in the calculation of his estimate; he admitted the subsoil question and the desirability of deodorising sewage, but could not find time to discuss these points in his lecture. Some of these matters would be treated of in the report of the Rivers Commission, which was expected to appear in a very few weeks.

The **President** moved a vote of thanks to Dr. Gilbert for his entertaining and instructive lecture, and then adjourned the meeting until the 15th inst., when a paper "*On the Action of Nitrous Acid upon Naphthylamine*" will be read. The subject of Professor G. C. Foster's lecture on the 19th April was announced—"*On the Thermal Phenomena accompanying Chemical Action.*"

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 5.

Tuesday, May 9, 1865.

On the Discoveries in the Chemistry of Rocks and Minerals.

Although the title of this lecture appears to have some reference to the lectures recently delivered by my learned predecessor, Professor Ansted, still the study of geology and mineralogy is so vast that different men may lecture on them without interfering with one another's views, or in the slightest degree with the special branch of that science that each one has chosen for his discourse.

The first subject to which I should wish to draw your attention is the origin of colour in minerals. Up to a very recent period it was generally believed that their colour was due to a minute quantity of certain metallic oxides diffused through the mass; thus the red colour of the garnet was attributed to sesquioxide of iron; ultramarine to oxide of cobalt; emerald to sesquioxide of chromium; and amethyst to oxide of manganese.

The first researches which were published, according to my knowledge, on the fact that organic matters might exist in minerals, are due to Sir David Brewster, who discovered in one of the most compact and hard minerals known—viz., topaz—exceedingly volatile hydrocarbons, which were so volatile that the simple heat of the hand, when brought to bear upon this mineral, proved sufficient to transform them into gaseous matters, which would recondense on the hand being removed. Sir David Brewster ascertained that the fluids were confined in small apertures, or cells, existing in the mineral, and calculated there were 3000 cavities in one-seventh of an inch of topaz. In 1857 Lewy ascertained that the green colour of the emeralds of Muso, New Grenada, was not due to sesquioxide of chromium, but to an organic substance, for not only did they yield water and carbonic acid when heated in a close vessel, but on calcining a small quantity of the mineral it became colourless, and did not again resume its primitive colour, which probably would have been the case if the colour of the mineral had been due to sesquioxide of chromium. Notwithstanding this, Mitscherlich and Rose published, in 1864, a paper in which they showed that the colour of a certain class of emeralds was due in their opinion to the presence of this oxide.

Knox also demonstrated the fact that smoked quartz became colourless when heated; and Kuhlmann, in researches recently published, has shown that smoked quartz will lose its colour under the influence of heat, and that the bluish black colour of flint may be traced to the same cause.

Wolf proved some time since that the various colours which fluor-spar assumes are also due to organic substances; and his researches leave no doubt that the colour of green fluor-spar can be traced to a hydro-carbon. But one of the most interesting papers published of late on this subject is that of Professor Fournet, of Lyons, in which he shows that the reddish, yellowish, or greenish colour which some clays assume is not due, as was formerly believed, to metallic oxides, but may clearly be traced, in many instances, to the presence of organic substances.

Amongst numerous instances that he cites in his memoirs, the most curious one is the molecular change of certain clays into a mineral called jasper, "a double silicate of alumina and protoxide of iron," and which conversion could not be attributed to the action of heat, but to the slow dehydration of the clay and to pressure, for he was able to trace in those splendid veins of jasper existing in the province of Constantine, Algeria, the gradual passage of certain beds of clay into corresponding ones of jasper, and this mineral, as well as the clay from which it was produced, became not only colourless under the influence of heat, but gave off vapours which had a strong empyreumatic or organic odour. Mr. F. Kuhlmann, whose name I have often had the pleasure of citing in this course of lectures, has published of late in the *Comptes Rendus* of the Academy of Sciences of Paris, several papers on the interesting subject as to what the colouration of minerals is attributable to, and this gentleman has not only proved that in many instances the colouration of certain minerals and gems may be traced to the presence of organic matters, but he has succeeded in colouring certain colourless minerals; thus, for example, by plunging into melted pitch topaz, rock crystal, and opal, and allowing a sufficient quantity of pitch to penetrate, he has given a yellow colour to the topaz and opal, and transformed white rock crystal into the smoky variety. This fact is not only interesting to a geologist, but must prove so to every reflecting mind, for it is difficult to conceive how substances so hard and compact can prove sufficiently porous to admit the vapours of volatile bodies. His researches have also for chemists a marked interest, for he has made the following curious observation—viz., that if he took plaster of Paris, mixed with a sufficient proportion of water to convert it into a solid mass (the composition of which is equal to $SO_3CaO + 2HO$, or sulphate of lime, with two equivalents of water), and plunged it into a bath of melted pitch, the two equivalents of water would be replaced by an equal weight of pitch, converting the whole into a solid mass susceptible of taking a high polish, and therefore applicable to many ornamental purposes. He also proposes what I believe has been in practice now in England for some time—viz., dipping bricks and other building materials into melted pitch, and cementing them with that substance in all cases where an impermeable wall or surface is required.

Without entering into the numerous applications of Mr. Kuhlmann's researches, I cannot part with them without citing a simple method which he proposes to determine whether the colouration of a mineral or a gem is due to an organic or to an inorganic substance. To effect this he places a small quantity of the mineral in a small platinum tube, and passes over it hydrofluoric acid, which does not affect the colour of the gem if it is due to an organic substance—for example, those of the amethyst, ruby, black diamond, or yellow quartz—but discolours at once cornelian stones, their colouring substance being sesquioxide of iron or a silicate of it.

Allow me to mention a most interesting, and as yet little known, class of minerals, the composition of which is not only interesting to chemists, but also to astronomers, mineralogists, and natural philosophers: I mean aerolites. Notwithstanding the careful analyses that have been made of these meteoric stones, the presence of no new metal has been discovered in them, or of any which chemists have not found upon our own planet; but they have been able to ascertain that some of these aerolites contain, or are composed in some instances of, metals in a native state, which are never found in that condition upon our planet; thus it has been proved that some of them contain metallic nickel, cobalt, and even iron; in fact, in some instances the volume of some of these aerolites that have fallen on our planet, which are composed of iron, has been sufficient to allow man to work them directly into implements. Such was the case with an aerolite found in Mexico, which had the following composition:—

Iron	96·50
Nickel	3·50
	100·00

What in a scientific point of view enhances the value of this peculiar class of meteoric stones is the presence in some of them of a peculiar yellow mineral, having a great resemblance to pyrites, but still differing entirely from it in composition, as proved by the analysis of Mr. Lawrence Smyth, who found it to be composed of four equivalents of iron, two equivalents of nickel, and one equivalent of phosphorus, and to it he gave the name of "Schreibersite." It has lately been artificially produced by Mr. Faye, under the able guidance of Henry St. Claire Deville, by melting together in a crucible a mixture of oxides of iron and nickel, phosphate of soda, silica, and charcoal, allowing the whole to cool, when in the fused mass were found well-defined crystals, having a yellow colour, and identical in composition to the "schreibersite" analysed by Mr. Lawrence Smyth—a triumph of science, for it is the first example of the artificial production of a mineral substance found in an aerolite. The presence of a large proportion of metallic iron, and especially of phosphorus, in this class of aerolites, proves that they must have a cosmical origin, and that they must have been formed, or rather the mass from which they have been detached, must have been produced and existed where there was no atmosphere similar to that which surrounds our planet—viz., one containing oxygen. What tends to confirm this view is that many of the meteoric stones analysed by chemists contain a large quantity of carbonaceous matters. The most complete analysis of this class of meteoric stones is that made by Mr. Cloez of one which fell in June, 1864, at Orgueil, in the south of France, and which drew the attention of many scientific men at the time, owing to its fall being clearly traced, and specimens carefully secured; it had the following composition.

Composition of the Orgueil Aerolite.

Hygrometric water	5·975
Silicic acid	24·475
Sulphuric acid	2·195
Sulphur	4·369
Chlorine	0·073
Phosphorus	traces.
Alumina	1·175
Oxide of chromium	0·025
Peroxide of iron	13·324
Protoxide of iron	17·924
Oxide of nickel	2·450
Oxide of cobalt	0·085
Oxide of manganese	1·805
Magnesia	1·163
Lime	2·183
Soda	1·244
Potash	0·307
Ammonia	0·098
Humin	6·027
Combined water	7·345
	96·442

This analysis of Mr. Cloez is not only interesting as showing the numerous substances which enter into the composition of one of these meteoric stones, but especially owing to the fact that he demonstrated in it the presence of an organic substance similar to coal, and also water. Chemists have also ascertained that many meteoric stones are highly siliceous, or composed almost entirely of silica or silicates of various metals. Mr. Charles Sorby, of the Royal Society, has recently published, in the *Proceedings* of that Society, some interesting papers on the microscopic differences which exist between the general texture or appearance presented by meteoric stones and the lava of volcanoes; also between the native meteoric iron and the commercial kind. There can be no doubt that these researches will throw much light on the circumstances that have attended the formation of aerolites in general. At all events, there can be no doubt that fire-balls, falling stars, and meteoric stones have a cosmical origin, and that they fall on the surface of our planet whenever they come within the earth's attraction, or that this force overpowers that of the sun. It is easy to explain, knowing, as we now do, their composition, why they appear luminous when they arrive near the earth's surface, for they have to traverse an oxidising atmosphere, or one containing oxygen, and as they travel through the space heat is generated by the friction of the particles composing them with those of the atmosphere, and the heat thus produced becomes sufficient for the combustible matters which enter into their composition, viz., carbon, iron, nickel, &c., being burnt or oxidised by the oxygen of the atmosphere. It is the knowledge of this fact which, no doubt, has suggested to Professor William Thomson his theory—that the high temperature of the sun is due to, and maintained by, the heat generated by cosmical matter falling on its surface, as I had the pleasure of explaining to you more fully in my first lecture.

I shall now examine with you the artificial formation of certain minerals and gems. Some of the earliest and most successful attempts in this line of researches are those of that talented chemist, Ebelmen, who made the curious observation that certain bodies or compounds, which chemists had considered as fixed or non-volatile, were susceptible of being volatilised if they were kept at a very high temperature for a long period, and also that bodies might be made to combine together and form certain minerals which existed already in nature. The fusible and volatile substance which he especially used was boracic acid; thus he mixed with a large quantity of this substance small amounts, but in equivalent proportions, of alumina and magnesia, and introduced the whole into a crucible which was placed in a porcelain kiln, and submitted to an intense heat for several days, when the greatest part of the boracic acid was volatilised; on allowing the fused mass to cool, well-defined crystals were found which, on examination, proved to be identical with the mineral called spinelle ruby, and by substituting the earth called glucina for magnesia, he obtained another gem called "cymophane." Without adverting to the various minerals and gems that he produced, I may state that his researches attracted much attention at the time they were published.

M. Daubrée has also succeeded in producing artificially various minerals by submitting, in a boiler containing water, divers amorphous mineral matters to an extremely high pressure, and consequently to a comparatively elevated temperature, thus converting them into crystalline ones. By this means he succeeded in producing, among other minerals, crystallised quartz.

But certainly the most interesting papers that have been published in this line of investigation are those due to a gentleman whose name I have often cited in these lectures, I mean Henry St. Claire Deville. This gentleman has succeeded in converting amorphous bodies into well-known crystalline minerals by submitting them to the influence of minute quantities of another substance under circumstances quite novel in themselves; and what enhances the value of his researches is, that the methods he has employed are similar to those which must have taken place in nature, and also the fact that the substance which he has employed to effect the change of an amorphous substance into a crystalline one, does not itself undergo any molecular change or decomposition. For example, he has transferred the red, amorphous, sesquioxide of iron into the crystalline variety called "oligist iron ore," identical with that found in the Isle of Elba, or into specular iron ore, similar to that observed in the craters of volcanoes. To obtain these results he places the sesquioxide of iron in a porcelain tube, and whilst the whole is heated to dull redness, he passes over it a slow current of hydrochloric acid gas. This result explains how specular iron is found in volcanoes, for his brother and Dr. Daubeny have proved the existence of hydrochloric acid among the gaseous products escaping from these great natural furnaces, in which violent chemical reactions take place. M. H. Deville has also succeeded in converting a mixture of sesquioxide of iron and magnesia by means of a small quantity of hydrochloric acid, or what he calls his "mineralisator," into a substance called "periclase," also found on Mount Vesuvius. These results are certainly extraordinary in a chemical point of view, if we remember with what facility these oxides dissolve in hydrochloric acid when brought into contact with an excess of that gas, even when operating under the circumstances in which he did, or when these oxides are placed in contact with a solution of the same acid. Mr. H. Deville also succeeded in producing "Hausmannite," or the crystallised sesquioxide of manganese, by substituting this oxide for sesquioxide of iron in the tube in which he operated. He further observed that if he employed binoxide of manganese instead of sesquioxide of manganese, he obtained, strange to say, beautiful green crystals of protoxide of manganese. But, certainly, the most important result arrived at was the artificial formation of a mineral called "staurotide," a silicate of alumina, a mineral that exists abundantly in nature. To effect this he introduced into a porcelain tube, placed vertically, first, a layer of alumina, then a layer of silica, over this a layer of alumina, and again a layer of silica, and so on until he filled his tube, ending with silica; he then applied a gentle heat to the tube, and passed through it a slow current of fluoride of silicon, which, on coming in contact with the alumina, gave rise to silicate of alumina, and fluoride of aluminium, which, in its turn, coming in contact with silica gave rise again to silicate of alumina and fluoride of silicon, and this chemical reaction continued from layer to layer until the whole mass in the tube was transformed into "staurotide," the same mineralising substances escaping from the tube as had entered it, although during its passage it had converted the amorphous alumina and silica into the well-defined mineral called "staurotide."

Mr. Deville calls the attention of mineralogists as well as chemists to the probability that such similar actions have no doubt taken place in nature, and so gives an easy explanation of many of the facts observed by geologists.

In conclusion, I may state that Messrs. Deville and Daubrée have succeeded by the same method in producing anatase, rutile, and brookite.

(To be continued.)

ACADEMY OF SCIENCES.

January 29, 1866.

M. Daubrée presented the first part of a memoir entitled "*Synthetical Researches relative to Meteorites.*" The object of the researches appears to be an explanation of the mode of formation of these bodies. The author's first experiments were made with ferruginous meteorites, which he divides into three classes—1, native iron alone; 2, iron with globules of peridote; 3, iron associated with silicates, perodite, and pyroxene. All meteorites are covered with a black crystalline crust, formed, no doubt, by the fusion of the exterior layer in the passage of the stone through the atmosphere. All the components of stone are also of an eminently crystallisable nature. It might have been expected, therefore, that, after fusing a meteorite, a crystalline surface would have been obtained on cooling. Nothing of the sort, however, happens. When a meteorite is fused the mass separates into two parts very different from each other; the earthy substances and the metallic part solidify separately. The manner in which these residues crystallise is altogether different, owing probably to the rapidity of cooling. The crystals obtained by the fusion of meteorites remind us of the long needles water forms on freezing slowly, while the granular semi-crystalline structure of natural meteorites resembles hoar-frost or snow formed, as we know, by the sudden passage of water from the state of vapour to the solid state. M. Daubrée proceeds to point out the analogies, chemical and mineralogical, of meteorites with terrestrial rocks, reminding us that as yet nothing has been found in those bodies which is not a common constituent of the surface of our globe. He remarks, however, that one essential chemical difference is the state of oxidation of the iron, stating that the protoxide so common in our basic silicate rocks is almost entirely wanting in meteoric stone, being apparently replaced by native iron. The masses, therefore, he believes to have been originally identical, but have been modified by different actions, which he hopes to imitate.

M. Sedillot communicated a memoir "*On the superiority of Chloroform as an Anæsthetic Agent.*" The author, after a short review of the whole subject, repeats the usual arguments in favour of chloroform—viz., the rapidity with which chloroformic anæthesia is produced and its persistence, the slow and gradual awakening, &c. He quotes also the experience of a surgeon with the French army in Turkey (1855), who states that he chloroformed numerous wounded soldiers exhausted with scurvy, diarrhœa, traumatic fever, and Hospital gangrene without any accident which could be attributed to chloroform. These were all put under the influence of chloroform in bed before they were removed to the operating table.

M. Mallard presented a communication "*On the Stanniferous Deposits of Limousin and La Marche.*" There is nothing in this communication beyond the announcement of the author's belief that mines in these neighbourhoods were worked by the Gauls in ante-historic times, and that gold besides tin was extracted.

M. Duchemin announced that he had discovered that bees are affected by two parasites, the one he described lately as always hatched on sunflowers, and another which has been already described by Reaumur. He also gave a short description of a phosphorescent marine worm.

Dr. Phipson sent a note "*On a Deposit of Biracemate of Potash in Red Wine,*" which will be found in another place.

M. E. Pelikan forwarded from St. Petersburg some "*New Researches on the Poison of Nerium Oleander.*" The author confirms the observations of Orfila as to the effects of an alcoholic-aqueous extract of the leaves of the common oleander. He finds that it paralyses the heart; and suggests that the leaves might be employed in medicine in the same cases and with the same precautions as digitalis.

NOTICES OF BOOKS.

Report on Water for Locomotives and Boiler Incrustations, made to the President and Directors of the New York Central Railroad. By Charles F. Chandler, Ph.D., Professor of Chemistry in the School of Mines, Columbia College, New York. J. F. Trow and Co. 1865.

(Continued from page 57.)

After describing the results obtained by the chemical analysis of a number of samples of water drawn from the hydrants along the line of railway, and representing the supplies available for use in the locomotives, and also the composition of some typical specimens of boiler incrustation, Dr. Chandler proceeds to discuss the causes of corrosion in the following terms:—The only substances contained in the water which can be supposed to act upon the iron are the alkaline salts (the sulphates and chlorides of potassium and sodium), and chloride of magnesium. That these substances do affect iron is shown by introducing slips of iron and copper connected with a galvanometer into their solutions, when a galvanic current is produced indicative of chemical action. The copper and brass tubes, used in locomotive boilers on account of the rapidity with which they "make steam," must greatly facilitate the corrosion of the iron, by throwing the last-named metal into the electro-positive condition. The plates which suffer most are those in the lower part of the boiler, and upon which the incrustations most rapidly accumulate. The author then recommends the trial of an arrangement by which the water entering the boiler could be made to produce currents in those parts not directly over the flues or fire-box, for the purpose of diminishing both the deposits and the consequent corrosion. The use of rain or remarkably soft waters is condemned on account of their greater disposition to induce corrosion by direct oxidation of the metal composing the boiler-plates, aided by the high temperature of the water. The effects of incrustation in inducing a great loss of heat are estimated at 20 per cent., and in exceptional cases even double that amount of fuel wasted. Thin scales, from their low conducting power, have a decided influence upon the steam-generating capacity of the boiler, and for the same reason cause an overheating of the boiler-plates to the extent of becoming nearly, if not quite, red hot; and should the expansion of the metal loosen and detach the scale, an explosion may result. The rapid destruction of the metal, as a consequence of such over-heating, leads to the necessity for frequent repairs and temporary loss of service.

Means of Preventing Incrustations and Corrosion.—Under this head the author enumerates several methods of "softening" the water, such as the liming process and the use of an alkaline carbonate. It is proposed to conduct the operation in the tanks or reservoirs at the station, so that the precipitated lime salts may not be carried into the engine; but if this cannot be done, it is advisable to mix the alkali with the water in the boiler. "Carbonate of soda is preferable to the other substances of this class from its low price, but it may be advisable to employ caustic soda in some cases, on account of its superior efficacy in loosening hard scales." The author speaks favourably of chloride of ammonium, and says that "when it is desired to loosen a considerable deposit, hydrochloric acid may be cautiously added at the same time." The proposition to include this acid amongst the store of engineer's chemicals is, we think, likely to be condemned; and for similar reasons the use of certain metallic salts, such as those of lead and tin (the protochloride of tin having been employed in France), if not from the consideration of cost alone. But all accounts agree in attaching great value to the use of spelter or of rolled zinc, which has proved very efficacious in preventing the corrosion of the iron when this, the more electro-positive metal, is placed in actual contact with the boiler plates. Bonsfield's patent insulating packing (India-rubber washers) and Parry's electro-magnetic inductors are briefly described, but no evidence is furnished respecting their merits. A wire gauze lining is stated to be a protection when applied to cylindrical boilers, but cannot be adapted to locomotives. A little clay introduced into the water serves to keep the lime deposits in a fine state of division, but it was found that the hard and gritty particles of sand always present in the clay were sure to get into the cylinders and scratch their internal surfaces. The silicate, phosphate, and arseniate of soda have all been tried, but neither of them was found to answer. Hyposulphite of soda would be too expensive in practice, and was no better than brown sugar, molasses, &c., which form soluble compounds with lime and its salts. The "lacquering" of the insides of boilers with whale oil, coal tar, tallow and graphite, or tallow in conjunction with soap and charcoal, have been favourably reported of for cylinder boilers, but cannot be used in locomotives. Glutinous or mucilaginous substances, such as linseed meal, bran, glue, and potatoes, are deemed effective agents in preventing the hardening of the calcareous deposits. The first-named substance has been used for some time on a German railway, and the potato remedy is well known and often practised. The organic matters of this class are said to cause frothing in the boiler, but the author considers this objection over-ruled by other counter-balancing advantages. Somewhat similar effects are attributed to oak-bark, tormentilla root, nutgalls, logwood, &c., which contain tannin, associated with soluble extractive or colouring matters; all of these have been employed with good results, but it is necessary to attend to a precaution—that of preventing the chips and woody fibres from stopping up the pipes, valves, and other fittings. The author concludes by advising the frequent use of the "blow-off cock," and the practice of repeatedly washing out, also that the boilers should never be emptied while there is fire enough to harden the deposits. To these recommendations are appended an inventory of the most promising of the various remedial agents mentioned in the text of the report.

Annales de Chimie et de Physique. December, 1865, and January, 1866.

These two numbers contain for the most part only papers which have been communicated to the Academy of Sciences, and call for no further notice here. The December number contains in addition the valuable review of papers in other than French journals by M. Wurtz, which makes the number peculiarly interesting. The January number, we ought to say, contains the full paper by M. Kopp "*On the Utilisation of Soda Waste and Chlorine Residues*" (an abridgement of which we are publishing) accompanied by a drawing of the arrangements for carrying out the processes.

Annalen der Chemie und Pharmacie. December, 1865.

Together with some papers which have already appeared in our pages, this number of the *Annalen* contains articles by A. Bayer "*On Hydantoinic Acid and Allantoin;*" by Herzog "*On Hydantoinic Acid;*" by Glinzer and Fittig "*On Monobromated Toluol,*" and also "*On Methyl and Ethyl Toluol,*" in which latter paper we have some interesting remarks on the constitution of the hydrocarbons of the benzole series. There are also papers by Carius; the first a continuation of his researches on sugar and sugar-resembling bodies, in which he describes a body resembling sugar obtained from benzole, and which he names *Phenose* ($Ȼ_6H_{12}O_6$), a paper of great interest, to which we shall return. The second article is "*On a New Homologue of Benzoic Acid,*" which the author names *Benzenic Acid*, and which has the formula $Ȼ_6H_4Θ_2$. There is another paper from Carius' laboratory, by Dr. Neuhoff, "*On a New Tetratomic Alcohol, Naphtenalcohol,*" obtained from naphthalic dichlorhydrine by the action of potassic hydrate. These are three important contributions from the Heidelberg School.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

3262. W. E. Dobson, Nottingham, "The conversion of the refuse of starch and gumaline into useful gumaline."—Petition recorded December 18, 1865.

3378. A. Knowles, J. Knowles, and J. Barraclough, Birstal, near Leeds, "Improvements in means or apparatus for extracting wool from cotton and other vegetable substances contained in mixed fabrics."—Dec. 30, 1865.

35. W. Clark, Chancery Lane, "Improvements in preparing and treating wood and wood pulp for the manufacture of paper." A communication from J. B. Neyret, L. G. Alexander, N. P. Orioli, and A. A. Fredet, Boulevart St. Martin, Paris."—January 4, 1866.

66. J. Skinner, Glasgow, "An improved mode of preparing albumenised paper, and the process connected therewith."—January 9, 1866.

124. A. Prince, Trafalgar Square, Middlesex, "Improvements in the means of preserving timber from decay." A communication from G. P. Ball, New York, U.S.A.—January 13, 1866.

138. Don F. Lecocq, Monte Video, South America, "Improvements in the means or method of preserving in a fresh condition animal and vegetable substances, and in the apparatus to be employed therein."—Jan. 15, 1866.

225. G. J. Bensen, Christian Street, St. George's-in-the-East, "Improvements in the manufacture of beetroot sugar."—January 23, 1866.

235. J. M. Watt, Glasgow, "An improved composition for coating materials and structures."—January 24, 1866.

Notices to Proceed.

2377. O. W. Jeyes, Leyton, Essex, "An improved method of making effervescing drinks."—Petition recorded September 18, 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.—September 23, 1865.

2456. N. Korshunoff, Birmingham, "Improvements in the manufacture of cast iron, malleable iron, and steel."—September 26, 1865.

2472. G. Eveleigh, Southampton, "Improvements in the manufacture of paper by the introduction therein of a new vegetable fibrous substance."

2477. W. Morgans, Brindon Hills, Somersetshire, "Improvements in coke and charcoal ovens, and in the manufacture of coke, parts of which are applicable to bread, biscuit, and pastry ovens."

2480. J. Boffey, Sheerness, Kent, and C. W. Smith, Buckingham Street, Strand, "Improvements in compositions used for coating metallic surfaces."—Sept. 27, 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."

2528. S. C. Salisbury, New York, U.S.A., "Improvements in blast furnaces."—October 2, 1865.

2719. I. Baggs, Chancery Lane, "Improvements in the manufacture of inflammable gases, and in their application to useful purposes."—October 21, 1865.

2835. H. Bessemer, Queen Street Place, Cannon Street, London, "Improvements in the manufacture of iron and steel, and in apparatus employed in such manufactures."—November 3, 1865.

3163. A. Parkes, Birmingham, "Improvements in preparing compounds of xylodine or gun cotton, and in apparatus employed."—December 8, 1865.

3383. W. E. Newton, Chancery Lane, "Improvements in friction matches, in apparatus for using them, and in adapting them for lighting lamps." A communication from P. B. Tyler, Springfield, Mass., U.S.A.—December 30, 1865..

CORRESPONDENCE.

Continental Science.

PARIS, February 7.

You will have read, I dare say, that M. Wurtz has been appointed Dean of the Faculty of Medicine, *vice* M. Tardieu, who made himself very unpopular with the students, and has resigned. The appointment of the eminent chemist has been hailed with great delight. He is universally popular, an eloquent speaker, and has other recommendations for a post to occupy which satisfactorily requires the exercise of some hospitality. Although a doctor of medicine, M. Wurtz is only known in the profession by his toxicological researches, and a few contributions to physiological chemistry. He has devoted himself almost all his life to chemistry, for the progress of which he has done so much.

Mentioning this appointment reminds me that there is some talk of establishing schools of medicine in some of our large cities at present without them, and, indeed, of establishing distinct universities in different cities. Lyons and Marseilles, for example, have no schools, while less important places, like Montpelier and Strasburgh, possess Faculties. Some other cities, the names of which I forget, have been named for similar institutions.

I read in *Les Mondes* that at the glass foundry of MM. Monnin Japy, in this city, the crucibles are heated by gas produced by the combustion of turf. The arrangements are not described. The enterprising proprietors showed the Council of the Société d'Encouragement at their visit some marvellously cheap watches. A silver one to be sold for 14 francs, and a gold one for 37 to 40 francs, the case of which alone has 20 francs' worth of gold in it. What will Mr. Bennett and Clerkenwell say to these? And what will become of Geneva?

I will extract from the same journal a very interesting experiment described by M. Cauderay. He introduces an electro-magnet into the circuit of a galvanic pile, and, breaking the circuit at any point, places the ends of the two conducting wires, separated one from the other, in a box containing metallic filings, such as silver, copper brass, or iron. The metallic particles will of course complete the circuit. If, now, one of the conducting wires be slowly raised, a small chain, formed by the juxtaposition of the metallic particles, will be drawn out, and if the experiment be made with great care, every particle in the box can be drawn out in one long chain. The author states his opinion that the adhesion of the particles is not due to magnetisation, but is the result of a sort of autogenous soldering by a superficial fusion of the metallic particles. The same author has shown that metallic filings offer very great resistance to currents of dynamic electricity, and upon this principle constructs a new and very cheap rheostat.

Dr. Phipson.

To the Editor of the CHEMICAL NEWS.

SIR,—I call upon you to insert these few lines in reply to an intemperate letter by Mr. Odling. The facts of the case which have induced his anger, as stated in my first notice of the affair, have never been, and cannot be, confuted, with the sole exception of my having introduced the name of Dr. Frankland instead of Mr. Odling, an error which was immediately acknowledged. It is quite true that some of my papers have been returned to me by the secretary of the Chemical Society, whose animus I now perceive; for instance, that "*On the Influence of Silicium in Iron upon the Production of Bessemer Steel,*" which will be found in the *Comptes Rendus* of the Academy of Sciences of Paris (May 15, 1865). Something similar occurred for my paper "*On Vanadium Ochre and other Sources of Vanadic Acid*" (*Journal of the Chemical Society,* 1863), which, much to my annoyance, I was requested to abridge, &c.

That your correspondent's letter was refused insertion in the *Cosmos* is not true; it will be found as it was written in the number for November 29, 1865; and that my analyses of the new phosphatic rock, calctriplite, are "ridiculous" remains to be proved, and if your correspondent will undertake to prove it, I will make it a pleasure to furnish him with specimens of this rock, which he certainly has never seen.—I am, &c.,

T. L. PHIPSON, Ph.D., F.C.S., Professor of
Analytical Chemistry, Member of the
Chemical Society of Paris, &c.

London, February 5, 1866.

[We reluctantly give insertion to this letter, which must finally close all correspondence on the subject in our pages.—ED. C. N.]

Purification of Gas.

To the Editor of the CHEMICAL NEWS.

SIR,—I have to-day seen on your advertisement sheet a letter from Mr. C. H. Wood, recently an assistant of Dr. Letheby, on the subject of the Purification of Coal Gas by the use of soda-waste and other alkaline agents. In the course of the argument Mr. Wood makes the following statement:—

"I ought to add that these experiments by Mr. Hawksley are the Nottingham experiments which Dr. Letheby says I knew of. Beyond the statement in Mr. Hawksley's published letter, however, I never heard and do not now know anything of the results. I understood that Dr. Letheby was engaged to examine the products chemically, but it was not till last autumn that I had any liquids to test. The results indicated five or six times more sulphur than is present in London gas!"

I, therefore, take the liberty of informing you that the liquids obtained from Nottingham were the result of the combustion of "crude" gas—*i.e., unpurified gas,* and not of the gas supplied to the town, as in the case of the London gas, with which Mr. Wood, in his ignorance of the circumstances or the object of the experiment, by mistake compares it.

The results of the experiments referred to were as follows, viz.:—

Sulphur in 100 Cubic Feet of Gas.

	Grains.
1. Crude state	158
2. After purification by lime	13
3. After purification by lime and a previous washing with a copious douche of ammonical liquor	9

I may, in conclusion, add that by a further progress of purification, with lime only, the quantity of sulphur has been reduced to 4 grains, and this whether the gas had been previously washed or not.

I am, &c., T. Hawksley.

30, Great George Street, Westminster, S.W., February 2, 1866.

P.S.—The experiments and chemical determinations in question were of a confidential nature, and were entrusted to myself and Dr. Letheby by certain of our clients. It is as fortunate for the reputation of the Nottingham Gas Company as it is unfortunate for the reputation of Mr. Wood that that gentleman should have committed so great an error.

MISCELLANEOUS.

Royal Institution.—The following are the arrangements for the ensuing week:—Tuesday, Feb. 13, and Thursday, Feb. 15, at 3 o'clock, Professor Tyndall, LL.D., F.R.S., "On Heat." Friday, Feb. 16, at 8 o'clock, Colonel Sir H. James, F.R.S., "On the Ordnance Survey of Jerusalem." Saturday, Feb. 17, at 3 o'clock, Professor Westmacott, R.A., "On Art Education, and how Works of Art should be Viewed."

Analysis of the Metropolitan Waters in Jan., 1866, 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	30·12	1·44	·1184	5·5	15·9	21·4
West Middlesex . . .	32·02	1·80	·0336	6·7	14·7	21·4
Southwark and Vauxhall .	29·90	1·85	·0568	6·2	14·0	20·2
Grand Junction . . .	30·70	1·65	·0627	5·7	15·4	31·1
Lambeth	27·10	1·94	·1288	6·4	9·0	15·4
Other Companies.						
Kent	37·70	1·26	·0096	9·2	17·3	26·5
New River	29·92	1·30	·0152	5·7	18·0	23·7
East London . . .	35·15	2·24	·0291	6·1	18·7	24·8
South Essex . . .	40·59	1·69	·0096	7·8	17·9	25·7

The table may be read thus:—100,000 lbs. of the Chelsea water contained 30·12 lbs. of solid matter, of which 1·44 lbs. of organic and other matters were driven off by incineration. ·1184 lbs. of oxygen were required to destroy organic matter in the said quantity of Chelsea water. Of the solid matter 21·4 lbs. are carbonate of lime or its equivalent; of which 15·9 lbs. are got rid of by boiling, and 5·5 lbs. remain. The second column of this table contains the amount of solid matter left on evaporation and desiccation at 120° C.—130° C. (248° F. 266° F.) The results are recorded in 100,000 parts. By moving the decimal point one place to the right, the above figures express in milligrammes the quantities contained in one kilogramme of the several waters. The majority of the waters contain a larger quantity of solid impurity than in the preceding month; the three exceptions to this rule are in the waters supplied by the Southwark, Lambeth, and New River Companies. The organic and other volatile matters have slightly decreased in the case of the waters supplied by the Chelsea, Southwark and Vauxhall, and Grand Junction Companies; the rest of the waters exhibit an increase in these ingredients over December, 1865. A comparison of the above table with that of last month will show a very remarkable diminution in the majority of cases, with respect to the oxygen required to oxidise the organic matters. The waters of the Chelsea, Southwark and Vauxhall, and Lambeth Companies were turbid when drawn from the companies' mains.

On Aniline Orange.—Mr. Jacobsen gives the following method of obtaining an orange-coloured dye from aniline. Red aniline is made in the usual way by the action of nitrate of mercury on aniline. The residue is then purified by boiling the resinous deposit and crystallising the solution. The mother liquor of the crystals contains small quantities of dyes of different colours, and a large proportion of orange dye. The orange is isolated by means of common salt, which precipitates the other colours and leaves the orange in solution. The dye is afterwards extracted with alcohol. The colour is a golden orange, which readily dyes silk and wool, and M. Jacobsen speaks of using it as a sort of varnish for optical instruments and on tin foil.—*Cosmos.*

Chloroform for Removing Stains of Dry Paint.—An accident, involving the loss of several ounces of chloroform at a time when in consequence of a sudden and unprecedented demand, it was peculiarly valuable, introduced me to the knowledge of a fact I was previously unaware of—viz., that chloroform is capable of exerting a powerful solvent action on dry white-lead paint. The accident happened in this way. The four ounce measure I was using had been broken, and afterwards carefully mended with white lead, several months being allowed for it to become thoroughly hard. In that state it was, as I imagined, capable of resisting for at least a short time the action of any of the more powerful solvents to be found in a chemist's shop. On pouring chloroform into it, however, I was at once undeceived, for the bottom fell out immediately, without sufficient warning to enable me to save one drop of the liquid. Had it been mended with barley sugar, and water then poured into it, the effect would not have been more sudden. To turn this loss to some account, I then tried comparatively the respective effects on old paintwork of ether, benzol, bisulphide of carbon, and chloroform. I found that the last, applied on wadding with gentle friction, speedily exposed the clean surface of the wood, whilst the ether and benzol removed the more recent only of the layers of paint. Bisulphide of carbon apparently was without action. Query, then, would it not be advisable in cases where valuable dresses have been to all appearance spoilt, by paint being allowed to dry upon them, to try the effect of chloroform before giving up all hope? At any rate I shall try it on the first case I meet with. I have already discounted the smiles of the fair ones, whose gratitude I intend to deserve. By Thomas B. Groves, F.C.S., Weymouth.—*The Chemist and Druggist.*

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.

Onwards.—The best is made with magenta dye.

Received.—C. T. E.; C. H. B. L.; N. S. Maskelyne; Recent Subscriber.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Action of Sulphuric Acid on the more Volatile Portion of Coal Naphtha, by C. Greville Williams, *F.R.S.*

PRELIMINARY NOTICE.

In the course of my researches on isoprene and caoutchene I found that cymene, prepared either from caoutchene or from oil of turpentine, was susceptible of polymerisation. I was thus led, incidentally, to study the action of sulphuric acid on the more volatile portion of coal naphtha. The results have proved so remarkable that I am induced to communicate some of the facts which I have already observed.

When commercial benzole is rectified in quantities of 200 or 300 gallons, and the first portion is received separately, a very volatile fluid is obtained, boiling chiefly below 70°, and containing large quantities of benzole. On heating this liquid with a considerable excess of sulphuric acid—ten times its volume, for instance, a variable portion, amounting generally to about one-eighth, refused to dissolve. This portion after two or three fresh treatments with acid, was washed with solution of hydrate of potassium, and dried by digestion over sticks of the hydrate; it was then rectified over sodium.

On being submitted to distillation it gave ten degree fractions from about 70° to temperatures above the range of the mercurial thermometer, the largest portions were those obtained about 215°. The relative bulks of the fluids at given boiling-points were, however, found to be greatly modified by systematic fractionation.

The following were the results of the analyses of the largest fractions:—

	I.	II.	III.	Mean.
Carbon . .	88·45	88·49	88·98	88·64
Hydrogen . .	11·18	11·23	11·12	11·18

The first and second analyses were made on a fluid boiling between 210° and 220°, the third on an entirely fresh preparation boiling between 215° and 220°.*

The above numbers would nearly agree with those required for the formulæ of several homologous mixed radicals, namely—

Phenyl-amyl, $C_{11}H_{16}$
Phenyl-hexyl, $C_{12}H_{18}$
Phenyl-heptyl, $C_{13}H_{20}$.

The following percentages are required to satisfy the above expressions:—

	$C_{11}H_{16}$	$C_{12}H_{18}$	$C_{13}H_{20}$
Carbon . .	89·19	88·89	88·63
Hydrogen . .	10·81	11·11	11·37

It is evident that with substances approximating so nearly in composition, the vapour density is the most reliable means of deciding between these formulæ. The following are the values required:—

$C_{11}H_{16}$	$C_{12}H_{18}$	$C_{13}H_{20}$
5·121	5·605	6·089

The experimental vapour density, in an operation conducted with great care, gave the number 5·78. I have, consequently, no hesitation in selecting the expression—

$$C_{12}H_{18}$$

as representing the hydrocarbon analysed.

The substance appears therefore to be the mixed radical phenyl-hexyl, and to be produced by the union of benzole with hexylene. We may represent the constitution as being—

$$\left\{\begin{matrix} C_6H_6 \\ C_6H_{12} \end{matrix}\right\} \quad \text{or,} \quad \left\{\begin{matrix} C_6H_5 \\ C_6H_{13} \end{matrix}\right\}$$

Recent investigations tend to indicate that substances constituted according to either of the above methods would have nearly, if not identically, the same properties.

There would be several other modes of representing the constitution of the hydrocarbon were it not for the fact of its having been prepared from a fluid boiling below 70°, and which could therefore only contain fluids distilling within a limited range.

The substance described is homologous with the phenyl-amyl obtained by Tollens and Fittig by acting with sodium on a mixture of bromide of phenyl and bromide of amyl.† As phenyl-amyl was found to boil at 195°, the boiling point of the hydrocarbon above described agrees sufficiently with the number required by the theory, assuming 24° as the difference for an increment of CH_2, that being about the number of degrees usually found between the boiling points of two homologues in the benzole series and the alcohol radical series, the two classes of which the constitutions approximate most nearly to the substance under consideration.

Phenyl-hexyl is colourless, transparent, and but little prone to oxidise on exposure to the air. The fluid condensed in the balloon after a determination of the vapour density is perfectly colourless. The odour is peculiar and characteristic.

The specific gravity of the liquid at 13° was found to be 0·8731.

I believe I shall be able to show that several mixed radicals, including phenyl-amyl, phenyl-hexyl, and phenyl-heptyl, exist in the fluid prepared as described.

An oily alkaloid of excessively high boiling point is formed by reducing a nitro-compound of phenyl-hexyl with acetic acid and iron. I hope in a short time to be able to give an account of its constitution and properties.

On the Analysis of Volcanic Ash and Fossil Wood from Arran, by J. Wallace Young.

Some time since Mr. Wünsch, Vice-President of the Geological Society of Glasgow, made a most interesting discovery of fossil trees, &c., imbedded in volcanic ash in the island of Arran.‡ The ash-beds which until then had been considered by geologists of eminence to be regular outbursts of trap, occur on the north-eastern shores of Arran, regularly interstratified with seams of coal and shale, and at a highly-inclined angle. As many as eleven different beds of ash have been observed between high and low-water mark.

The trunks of trees found in the ash appear to belong to the genera Sigillaria, Lepidodendron, &c., and are clearly in the position in which they grew. The larger branches are perfectly round, and the pith and cellular structure beautifully preserved. Mr. Wünsch kindly supplied me with large specimens for analysis.

The ash is of a dark-grey colour, hard and compact; some portions being much finer grained than others. It is intersected by numerous veins of common and fibrous carbonate of lime, quartz, and small bright particles of iron pyrites occur disseminated throughout the mass. Small portions placed in hydrochloric acid for an hour

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* The details of the analyses will be given in the complete memoir.

† *Ann. Chem. Pharm.*, cxxxi., 313. Watt's Dict. Chem., Art. "Phenyl-amyl."

‡ *Geological Magazine*, October, 1865.

or two disintegrate and fall to pieces. It appears to consist of five portions—viz.:

1. Carbonates.
2. Soluble silicates.
3. Insoluble silicates.
4. Quartz.
5. Small quantities of iron pyrites.

The results of the analysis of the ash after drying at 100° C. are as follows:—

Sp. gr. at 15·5° C. 2·790.

		1.	2.	3.
A	Silicic acid	13·20	18·71	
	Alumina	8·13	11·52	
	Protoxide of iron	18·26	25·88	
	Oxide of manganese	·78	1·10	
	Lime	13·47	19·09	
	Magnesia	5·06	7·17	
	Carbonic acid	8·40	11·90	
	Water	3·23	4·57	
		70·53		
B	Silicic acid	23·49		81·70
	Alumina	4·14		14·40
	Lime	·46		1·60
	Magnesia	·20		·73
	Potass and soda	·45		1·57
	Iron pyrites	·70		
		99·97		

A. Portion decomposable by HCl.
B. Portion undecomposable by HCl.
No. 1. Composition of the ash as a whole.
No. 2. Percentage composition of the portion decomposable by HCl.
No. 3. Percentage composition of the insoluble silicates.

Dilute acetic acid removes the carbonates, consisting principally of carbonate of lime with a very little carbonate of iron and carbonate of magnesia. The rock appears to me to have resulted from the cementing together of volcanic scoriæ, partly by a re-arrangement of its constituents, and partly by the carbonate of lime undoubtedly added.

The various plant-remains imbedded in the ash may be divided into two classes,—

1st. Those in which the woody tissue has been replaced by carbonate of lime.

2nd. Those in which the lapidifying substance is silica.

Composition of a Specimen of the Calcified Wood dried at 100° C.

Sp. gr. at 15·5° C. 2·611.

Carbonate of lime	89·16
,, magnesia	1·26
,, iron	1·06
,, manganese	2·22
Ferric oxide	1·39
Insoluble	2·24
Carbon	2·44
	99·77

Composition of the Silicified Wood dried at 100° C.

Sp. gr. at 15·5° C. 2·600.

Silicic acid	95·30
Alumina and ferric oxide	1·00
Lime	·73
Magnesia	trace
Loss on ignition	2·35
	99·38

Colour blue black; the powdered mineral on ignition becomes of a light-grey tint, thus showing the presence of organic matter.

The quartz and silicified wood in the ash shows that the silica must either have been derived from water percolating the rock, or is the result of decompositions in which it has been set free.

Glasgow.

Researches on the Volatile Hydrocarbons,
by C. M. Warren.

(Continued from page 64.)

I will now proceed to give my determinations of the boiling points of various hydrocarbons, and of some of their derivatives, and then pass directly to consider the bearing of these results on the question concerning the increment of boiling point for the addition of C_2H_2 in homologous series.* The data for these considerations may be more conveniently arranged in tabular form, exhibiting at once, in serial order, the formulæ, boiling points, elementary difference, and the corresponding difference of boiling point.

1. *On the Hydrocarbons Obtained from Pennsylvanian Petroleum.*

1st Series.

Formula.	Boiling-point.	Elementary Difference.	Difference of boiling-point found.	Range of Temperature within which the Substance would all Distil.†
	Degs.		Degs.	Degs.
C_8H_{10}	0·0 (?)			
$C_{10}H_{12}$	50·2	C_2H_2	30·2	1·5
$C_{12}H_{14}$	61·3	C_2H_2	31·1	0·8
$C_{14}H_{16}$	90·4	C_2H_2	29·1	1·0
$C_{16}H_{18}$	119·5	C_2H_2	29·1	1·0
$C_{18}H_{20}$	150 8	C_2H_2	31·3	0·8
			150·8÷5=30·°16	

Average increment of boiling-point for the addition of C_2H_2=30·16°.

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* In considering this question I shall include the boiling points of the substances which I have separated from Pennsylvanian petroleum, and the oil distilled from Albert coal; reserving for a subsequent memoir all other facts which have been derived from the study of these bodies.

† The ranges of temperature given in this and in the corresponding columns of the following tables are for the purpose of showing the impossibility of there having been any essential error in the determinations of the boiling points; as is evinced by the fact, in each case, that the whole product was found to distil without residue within such narrow limits. With so small a range of temperature, it is evident that it would make no practical difference whether either extreme or the mean of the observations be taken for the boiling point.

The fact that these substances distil without residue within so short a range of temperature is also of much value as proof of the existence of the two parallel series in petroleum and in coal oil, with boiling points so near together [as shown by comparison of the boiling points of the first with the second series from petroleum; and also of the two corresponding series from Albert coal oil]; especially i this is considered in connection with the fact, so far as my experience goes, that the quantities of material in one series are generally about equal to those in the other.

That no erroneous conception may be formed as to the degree of purity of the substances treated of in this and the following tables, from a mere inspection of the *ranges* of temperature here given; and in order that the almost absolute constancy of the boiling points, in most cases, may not be overlooked, I would refer to the preceding memoir for further details concerning the boiling points of such of these bodies as are therein treated of. For example, it will be found under the head of "Determination of boiling point" of benzole that in the distillation it required twenty minutes for the temperature to rise 0·2°; while in one of the following tables it will be seen that the *range* of temperature within which the benzole distilled to dryness was found to be 0·8°. Likewise, by reference to the "Determination of boiling point" of toluole, it will be observed that it was found to boil absolutely constant forty-eight minutes; while the *range* of temperature given in the table referred to is 0·7°. In such cases as these the slight rise of temperature which takes place just before going to dryness is doubtless to be attributed to superheating of the vapour, in consequence of there being so small a quantity of liquid in the retort. Similar instances of absolute constancy of boiling point to those just cited might be given from among the products in either series from petroleum and Albert coal; which the *ranges* o temperature given in these tables do not indicate.

2nd Series.[‡]

Formula (?)	Boiling-point.	Elementary Difference.	Difference of boiling-point found.	Range of Temperature within which the Substance would all Distil.
	Degs.		Degs.	Degs.
C_8H_{10}	8·9			
$C_{10}H_{12}$	37·0	C_2H_2	29·0	0·4
$C_{12}H_{14}$	68·5	C_2H_2	31·5	0·6
$C_{14}H_{16}$	98·1	C_2H_2	29·6	1·2
$C_{16}H_{18}$	127·6	C_2H_2	29·5	1·5
			119·6 + 4 = 29°·9	

Average increment of boiling-point for the addition of C_2H_2 = 29°·9.

3rd Series (not completed).

Formula.	Boiling-point.	Elementary Difference.	Difference of boiling-point found.	Range of Temperature within which the Substance would all Distil.
	Degs.		Degs.	Degs.
$C_{20}H_{20}$	174·9			1·7
$C_{22}H_{22}$	195·8	C_2H_2	20·9	1·5
$C_{24}H_{24}$	216·2	C_2H_2	20·3	2·2
			41·2 + 2 = 20°·6	

Average increment of boiling-point for the addition of C_2H_2 = 20°·6.

2. *Of the Hydrocarbons obtained from Albert Coal.*

1st Series (not completed).

Formula.	Boiling-point.	Elementary Difference.	Difference of boiling-point found.	Range of Temperature within which the Substance would all Distil.
	Degs.		Degs.	Degs.
$C_{10}H_{12}$				
$C_{12}H_{14}$	59·9	C_2H_2		1·5
$C_{14}H_{16}$	90·6	C_2H_2	30·7	0·5
$C_{16}H_{18}$	119·7	C_2H_2	29·1	0·5
			59·8 ÷ 2 = 29°·9	

The average boiling-point difference in this series for the addition of C_2H_2 is therefore 29°·9.

2nd Series (not completed).[‡]

Formula (?)	Boiling-point.	Elementary Difference.	Difference of boiling-point found.	Range of Temperature within which the Substance would all Distil.
	Degs.		Degs.	Degs.
$C_{10}H_{12}$				
$C_{12}H_{14}$	68·0	C_2H_2		1·0
$C_{14}H_{16}$	98·5	C_2H_2	30·5	0·6
$C_{16}H_{18}$	125·1	C_2H_2	26·6	
			57·1 + 2 = 28°·6	

Average boiling-point difference = 28°·6.

3. *Of Hydrocarbons obtained from Coal Tar Naphtha.*

Name of Substance.	Formula.	Boiling-point.	Elementary Difference.	Difference of Boiling-point found.	Range of Temperature within which the Substance would all Distil.
		Degs.		Degs.	Degs.
Benzole .	$C_{12}H_6$	80·0			0·8
Toluole .	$C_{14}H_8$	110·3	C_2H_2	30·3	0·7
Xylole .	$C_{16}H_{10}$	139·8	C_2H_2	29·5	0·4
Isocumole	$C_{18}H_{12}$	169·9	C_2H_2	30·1	1·0
				89·9	

Average increment of boiling-point for the addition of C_2H_2 = 89·9 + 3 = 29°·97.

4. *Of Cumole from Cuminic Acid and Cymole from Oil of Cumin.*

Name of Substance.	Formula.	Boiling-point.	Elementary Difference.	Difference of Boiling-point found.	Range of Temperature within which the Substance would all Distil.
		Degs.		Degs.	Degs.
Cumole .	$C_{18}H_{12}$	151·1			3·6
Cymole .	$C_{20}H_{14}$	179·6	C_2H_2	28·5	1·2

With only a single exception, the results presented in the above tables point clearly to 30° as the common increment for the addition of C_2H_2 in homologous series of hydrocarbons. Indeed, leaving out of the calculation the third series from petroleum (having the general formula CnHn)—which must remain anomalous—and also the products from oil of cumin, the average of all the other boiling point differences is 29·75°. The few individual variations from the number 30°, rarely exceeding a single degree, may reasonably be attributed to errors of the thermometer (especially in case of temperatures above 100°), or in some instances to a want of purity of one of the compared substances; which latter cause I doubt not is the case with the body from petroleum boiling at 37°, as upon this body I had bestowed less labour in fractioning than upon most of the others, on account of the extreme volatility and consequent loss of the substance, by which the quantity had become so much reduced that I could ill afford further loss. In the case also of cymole from oil of cumin, and cumole from cuminic acid, in which the boiling point difference varies only 1·5° from the common differences of 30°, the want of perfect agreement may be fairly accounted for by the fact that the quantity of cumole at command was too small to admit of continuing the process of fractioning far enough to obtain perfect constancy of boiling point. In consequence also of the quantity being so small, the determination of the boiling point of cumole is less reliable, as this had to be conducted in a test-tube. It came into full ebullition at 148·4°, the temperature rising gradually to 151·6° (observed temperatures), at which latter temperature it had distilled nearly to dryness. The distillation occupied thirteen minutes in passing over the range of three degrees. The average of the extremes, with the usual corrections for pressure, &c., was taken for the boiling point. Abel,[§] who probably operated on a larger quantity, found the boiling point of cumole to be 148°. It does not appear that he applied the corrections for pressure and the upper column of mercury. I do not doubt that the true boiling point of this body will be found to be 150°, which would establish the difference of 30° between it and cymole.

I would here remark that this difference of 30° for

[‡] I am somewhat in doubt whether the bodies composing this series and the second series from Albert coal have the formula C_nH_{n+2} as here represented, there being some indication that they contain less of hydrogen. For the purpose for which they are now presented it is immaterial which formula is employed, as the common elementary difference and the boiling-point differences would remain the same. The solution of this question is therefore deferred for a subsequent memoir.

[§] *Annalen der Chemie und Pharmacie*, 1847, lxiii., 308.

the addition of C_2H_2 was first observed while engaged in fractioning Pennsylvania petroleum, and the oil from Albert coal—substances the most difficult to separate, on account of the presence in each of two parallel series of constituents, whose boiling points lie so near together.

(To be continued.)

Notes on Sulphocyanide of Ammonium,
by Frank Clowes.

Whilst engaged in purifying the above-named salt by several crystallisations from its aqueous solution, I happened to observe that some water hanging in drops from the bottom of the vessel, froze; on applying my hand to the vessel I found it to be intensely cold, and in a short time the atmospheric moisture was deposited like hoar frost on the sides of the vessel.

This led me to try a few experiments with weighed quantities of water and of the salt; from a few trials with different proportions, it appeared that the mixture of equal parts by weight gave the most intense cold. By mixing 1386 grains of the salt with its weight of water at 17° C., a cold of (—12°) C. was obtained; the temperature of the atmosphere at the time of the experiment was the same as that of the water employed.

This method of producing cold could hardly be advantageous in a practical point of view, on account of the somewhat costly nature of the sulphocyanide; but it may be interesting to the scientific chemist as another example of a property which is known to be possessed by several other saline bodies.

Museum of Irish Industry, January 26.

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

Part II.

Theory of Types and Atomicity.

Section II.—*Application of the Theory of Types.*

(*Continued from page 63.*)

The molecules of compound bodies consist of an aggregation of atoms, which occupy a definite position in space. It is impossible to represent this arrangement by a formula or a plane figure, and the typical formulæ have no such pretension.* But experience and reason teach us that in a molecular system the atoms do not exercise the same attractions upon each other. According to their nature, their number, and their position, some are united closer to each other than they are to their neighbouring atoms. When therefore, the equilibrium being disturbed, the molecule breaks in certain directions, there may be found among the fragments groups where the stronger attractions are predominant. We call them compound radicals, and we represent them as separate and distinct members in the typical formulæ. Are we to say, then, that this graphic disposition indicates the real position of the atoms, that these members thus separated represent actual groups, occupying the place assigned to them in the formula? By no means. They recall the fact that certain aggregations of atoms are capable of resisting shocks which break up the rest of the molecule; or, if you like, they mark certain directions in which the molecule can separate. In a word, this artificial arrangement of the formula only gives those instructions on the real constitution of the molecule which we could gather from the reactions themselves.

When I compare the composition of ethylamine with that of ammonia, I observe that the former contains $Ȼ_2H_4$ more than the latter. That is the fact. When I say that ethylamine is ammonia in which 1 atom of hydrogen is replaced by the ethyle group, I, in truth, pass the limit which separates fact from hypothesis; but my hypothesis is only the interpretation of experiment, and the typical formula

$$\left.\begin{matrix}Ȼ_2H_5\\H\\H\end{matrix}\right\}N$$

shows the constitution of ethylamine only to the same extent that the reaction of bromide of ethyle with ammonia itself discloses.

$$\left.\begin{matrix}H\\H\\H\end{matrix}\right\}N + Ȼ_2H_5Br = HBr + \left.\begin{matrix}Ȼ_2H_5\\H\\H\end{matrix}\right\}N$$

It tells me that in this complex molecule 5 atoms of hydrogen are more closely united to the carbon than the two others; and in this it leads me into no error, for we know that the two atoms of typical hydrogen may easily be replaced by another group (Hofmann), whilst it is not the same with the other atoms of hydrogen.

It may be seen, then, that this formula is only the expression of certain facts. It does not go beyond them; it only recalls the conclusions that we may draw from experiment, if not on the exact position of all the atoms, at least on the mutual relations, and the functions of some of them.

Can such a formula express all the facts? Evidently not. When I write acetic acid

$$\left.\begin{matrix}Ȼ_2H_3Θ\\H\end{matrix}\right\}Θ$$

I recall its formation by chloride of acetyle and water, by the action of oxygen on aldehyde; but I do not foresee the possibility of forming acetate of sodium with carbonic acid and sodium methyle (Wanklyn),†

$$\underset{\text{Carbonic acid.}}{ȻΘ.Θ} + \underset{\text{Sodium methyle.}}{\left.\begin{matrix}ȻH_3\\Na\end{matrix}\right\}} = \underset{\text{Acetate of sodium.}}{\left.\begin{matrix}ȻΘ.ȻH_3\\Na\end{matrix}\right\}Θ}$$

or the action of soda on cyanide of methyle (Dumas, Malaguti, and Le Blanc). I neither give account of the electrolytic decomposition of acetate of soda nor of the formation of acetone. All these reactions disclose a certain grouping of the atoms in the acetyle radical, which is not indicated by the term $Ȼ_2H_3Θ$, which is represented as a whole in the typical formula

$$\left.\begin{matrix}Ȼ_2H_3Θ\\H\end{matrix}\right\}Θ$$

But in the case of acetic acid nothing is easier than to make the formula agree with the facts just mentioned. To do so it is sufficient to decompose the radical into two groups—$ȻH_3$ and $ȻΘ$—and to write this formula

$$\left.\begin{matrix}ȻΘ.ȻH_3\\H\end{matrix}\right\}Θ$$

In truth, it is now less simple, but it represents a greater number of facts. This methyle group which is shown there existed in the cyanide of methyle, in the sodium methyle, and it passes into acetone

$$\left.\begin{matrix}ȻΘ.ȻH_3\\ȻH_3\end{matrix}\right\}$$

We must remark that the molecule of acetic acid only contained two atoms of carbon, and that the groups $ȻΘ$ and $ȻH_3$ each contain one. This formula then can hardly be further decomposed. It is on that account that, without ceasing to be simple, it explains so well all the reactions. By means of similar processes we can

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* Kekulé, Lehrbuch, t. i., p. 158.

† *Annales de Chimie et de Physique*, 3rd series, t. lvii., p. 358.

perfect the typical formulæ, by decomposing the terms expressing the radicals into a certain number of factors. Thus nothing prevents us from representing the bodies homologous with acetic acid by the formulæ

$$\left.\begin{matrix}ȻΘ.C_2H_5\\ H\end{matrix}\right\}\Theta,\quad \left.\begin{matrix}ȻΘ.Ȼ_3H_7\\ H\end{matrix}\right\}\Theta,\quad \left.\begin{matrix}ȻΘ.Ȼ_4H_9\\ H\end{matrix}\right\}\Theta,$$

Propionic acid. Butyric acid, &c. Valeric acid, &c.

nor from giving analogous formulæ to the acetones derived from these acids. It is unnecessary to insist on this point, which is generally admitted. But we must not forget that such changes introduced into the typical formulæ must represent facts without ever going beyond them for fear of becoming arbitrary; in the next place that in these decompositions of formulæ there is a limit which must be respected for fear of taking from the typical notation its principal advantage that of simplicity. It seems to me that some chemists have been unable to avoid this latter danger, and that in their desire to be complete and profound on the subject, they have submitted to become obscure. How could it be otherwise, since it was attempted to decompose the formulæ of complex bodies? In such a proceeding, supposing every error to be avoided, we should certainly not escape the embarrassment of a complicated, if not confused, notation. I insist upon this consideration, and I will strengthen it by an example which offers a particular interest. I formerly represented the composition of lactic acid by the formula

$$\left.\begin{matrix}(Ȼ_3H_4\Theta)''\\ H_2\end{matrix}\right\}\Theta_2$$

to show that this acid is derived from propylglycol,

$$\left.\begin{matrix}(Ȼ_3H_6)''\\ H_2\end{matrix}\right\}\Theta_2$$

that it is diatomic, and capable of forming a dichloride, $Ȼ_3H_4\Theta.Cl_2$, and an anhydride $Ȼ_3H_4\Theta.\Theta$. This formula, then, represents a certain number of the reactions of this acid. It is far from representing them all. In fact, in the same way that dicyanhydric glycol, or dicyanide of ethylene divide under the influence of caustic potash into ammonia and succinic acid,[‡] so monocyanhydric glycol by the action of alkalies gives lactic acid.[§]

Quite lately Mr. A. R. Catton has obtained lactic acid by passing a current of carbonic acid into alcohol in which he at the same time dissolved sodium.[‖]

The formula

$$\left.\begin{matrix}Ȼ_3H_4\Theta\\ H_2\end{matrix}\right\}\Theta_2$$

does not account in a satisfactory manner for these new cases of the formation of lactic acid; for it does not show that the radical $Ȼ_3H_4\Theta$ is composed, according to every appearance, of two terms, as the two preceding experiments indicate. But it is both easy and allowable to give satisfaction on this point by introducing into the formula of lactic acid a change analogous to that made in acetic acid. The formula

$$\left.\begin{matrix}[ȻΘ.Ȼ_2H_4]''\\ H,H\end{matrix}\right\}\Theta_2$$

expresses in a satisfactory manner these new reactions.

I have often insisted on the different functions which, in lactic acid, are fulfilled by the two atoms of hydrogen which we look upon as typical, and which I have separated in the preceding formula. Mr. Perkin,[¶] has very cleverly expressed this idea, by saying that lactic acid is at once acid and alcohol. M. Wislicenus[**] has recently even tried to translate it into the notation, by writing the formula in question—

$$\left.\begin{matrix}\left.\begin{matrix}(ȻΘ)''\\ (Ȼ_2H_4)''\\ H\end{matrix}\right\}\Theta\ \Big]\\ H\end{matrix}\right\}\Theta$$

The two atoms of hydrogen here occupy perfectly distinct positions; one forms part of the group

$$\left.\begin{matrix}Ȼ_2H_4\\ H\end{matrix}\right\}\Theta$$

and cannot be replaced by an electro-positive metal; the other, the basic hydrogen, is outside the group.

By introducing into the formula of lactic acid the group, or typical residue as he calls it,

$$\left.\begin{matrix}Ȼ_2H_4\\ H\end{matrix}\right\}\Theta$$

M. Wislicenus explains the experiment of the decomposition of monocyanhydric glycol.[††] He founds his formula upon a fact; he is in the right. But I question if this formula expresses as clearly as the more simple one the relationship of lactic acid to propoglycol, or the formation of chloride of lactyle and of the polylactic compounds, and whether the inconvenience caused by a complicated form is compensated by the advantages the formula offers in the interpretation of other reactions. We may be allowed to doubt it, and to prefer for ordinary use the simpler formulæ

$$\left.\begin{matrix}(ȻΘ.Ȼ_2H_4)''\\ H.H\end{matrix}\right\}\Theta_2 \text{ and } \left.\begin{matrix}Ȼ_3H_4\Theta\\ H.H\end{matrix}\right\}\Theta_2$$

in which the two typical residues $H\Theta$ are placed together.

(To be continued.)

The Formation of Acetylene in Incomplete Combustions,[‡‡]
by M. Berthelot.

Acetylene is formed, as I have already proved, at the expense of most organic compounds when submitted to the prolonged influence of a red heat. I now purpose showing the formation of this same carbide under a condition not less general—namely, incomplete combustion.

The following is a general experiment proving this fact either with gas or with very volatile liquids:—

Take a gas, such as ethylene, C_4H_4; hydrochloric ether, C_4H_5Cl; propylene, C_6H_6; methylic ether, C_2H_2 $(C_2H_4O_2)$; marsh gas, C_2H_4, &c.; or, better still, a very volatile liquid, such as ordinary ether, C_4H_4 $(C_4H_6O_2)$; amylene, $C_{10}H_{10}$; hydride of amylene, $C_{10}H_{12}$; and even benzole, $C_{12}H_6$; acetone, $C_6H_6O_2$; methylformic ether, $C_2H_2(C_2H_2O_4)$, &c.

Fill a test-tube of 300 cubic centimetres capacity with gas, or pour into it a few drops of volatile liquid; then add a few cubic centimetres of ammoniacal cuprous

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[‡] Maxwell Simpson, *Annales de Chimie et de Physique*, 3rd series, vol. lxi., p. 224.

[§] Wislicenus, *Annalen der Chemie und Pharmacie*, vol. cxxviii., p. 9:

$$\left.\begin{matrix}Ȼ_2H_4\\ H\end{matrix}\right\}\begin{matrix}ȻN\\ \Theta\end{matrix} + 2H_2\Theta \qquad \left.\begin{matrix}\left.\begin{matrix}ȻΘ.Ȼ_2H_4\\ H\end{matrix}\right\}\Theta\ \Big]\\ H\end{matrix}\right\}\Theta + NH_3$$

Monocyanhydric glycol. Lactic acid.

the lactic acid thus formed is identical with the paralactic acid extracted from meat. The synthesis of ordinary lactic acid has since been accomplished by M. Strecker by means of alanine obtained by the action of cyanhydric acid on aldehyde. M. Wislicenus has arrived at the same result by starting from aldehyde.

[‖]
$$\left.\begin{matrix}Ȼ_2H_5\\ Na\end{matrix}\right\}\Theta \quad + ȻΘ.\Theta = ȻΘ. \quad \left.\begin{matrix}Ȼ_3H_4\\ Na,H\end{matrix}\right\}\Theta_2$$

Ethylate of sodium. Carbonic acid. Lactate of sodium.

[¶] Chemical News, 1861, p. 82.

[**] *Annalen der Chemie und Pharmacie*, vol. cxxv., p. 41, and vol. cxxviii., p. 1.

[††] See note § in preceding column.

[‡‡] *Comptes Rendus*, lxii., 94.

chloride, set fire to the combustible vapour, and incline the tube almost horizontally, rolling it about, so as to spread the cuprous reagent over all the interior; cuprous acetylide will speedily be produced. It is produced by the contact of the flame from beneath, and is seen in the form of a characteristic red precipitate.

This experiment answers especially well with ordinary ether and hydride of amylene.

The amount of acetylene produced under these circumstances in the form of acetylide is evidently larger than that produced under the influence of heat alone, acting on the same compounds. The quantity of acetylene actually produced is, moreover, much greater than that which takes the form of acetylide, because the greater part of the acetylene burns almost as soon as formed, and without coming in contact with the reagent. I think it possible to deduce from this experiment, conveniently modified, a method of preparing acetylene more advantageous than those hitherto in use.

Coal gas is no exception to this general rule, as may be easily ascertained by observing the traces of acetylene it contains in its normal state.

I have, on the contrary, obtained no result, either with a mixture of oxide of carbon and hydrogen or with hydrogen charged with pure carbon dust, or directed in a jet on a stick of retort coke.

Not only is acetylene formed during combustion, in a half covered vessel of hydrocarbonated compounds, but it is produced and discharged into the atmosphere whenever an organic conpound burns in contact with the air with formation of lamp-black.

This may be seen by placing the mouth of a tube over the flame, far enough off not to interfere with the combustion, and by drawing away the gases produced by the aid of a slow flow of water (one or two litres per minute). A dry, empty flask, of about a litre, is thus filled by displacement with the gases of the combustion. After several minutes, put into the flask a few drops of ammoniacal cuprous chloride, and the characteristic precipitate will be produced, though much less abundantly than in a half covered vessel. I have especially obtained this result by burning the following bodies in a small capsule:—Ordinary ether; benzole, $C_{12}H_6$; oil of turpentine, $C_{20}H_{16}$: petroleum; vegetable oil; stearic acid naphthaline, $C_{20}H_8$.

The results given by benzole and naphthaline merit attention from the fact that I have hitherto failed to transform these carbides into acetylene by heat alone. This is another proof of the extreme stability of acetylene, particularly when mixed with a certain proportion of foreign gases.

The same observations are applicable to the combustion of coal gas. The gases discharged into the air whether by the flame of a burner known as the bat's-wing, or by the smoky flame of one of Bunsen's burners, contain a notable proportion of acteylene.

These observations will explain the odour observable in rooms where gas is burnt. However, acetylene in the air exercises, by itself, no specially pernicious physiological action; for I have ascertained, by an experi- in which M. Arm. Moreau was kind enough to join me, that its poisonous action is not more marked than that of ordinary carbides of hydrogen. But its presence is an evidence of incomplete combustion; such a combustion should produce a considerable proportion of carbonic oxide, to the injurious properties of which M. Leblanc has testified.

From the point of view of the theory of combustion, the general formation is not without interest. In the first place it is contrary to the positive axiom that the whole amount of the hydrogen of hydrocarbons is completely burned during incomplete combustion, leaving free carbon.

Now in the imperfect combustion of naphthaline, a body much less hydrogenised than the acetylene C_4H_2, which it engenders, it must be admitted that a portion at least of the original carbide loses its carbon before its hydrogen—$C_{20}H_8 = 4C_4H_2 + C_4$.

In fact, the combustion of hydrocarbonated bodies is not effected at once, but by a series of decompositions. The first of these decompositions causes the formation of special products, depending on the particular nature of the combustible bodies; the first product of the incomplete combustion of alcohol, for instance, is aldehyde. Then come the general products, formed during all combustions and preceding the water and carbonic acid. Carbon and carbonic oxide are the only two general products of this nature hitherto known; to these my experiments have added acetylene.

PHOTOGRAPHY.

*On the Simultaneous Action of Light and Oxygenated Salts on Violet Subchloride of Silver, and the Possibility of Producing by Photography Natural Colours on Paper,** *by M.* L. A. POITEVIN.

THE researches of M. Edm. Becquerel in 1848 on the production of colours by the chemical action of light are well known, and how he obtained on the surface of silver plates the violet subchloride of silver capable of receiving colours.†

The magnificent images of the spectrum he has obtained, as well as the pictures reproduced with their natural colours in the focus of the camera, have never been surpassed, and no improvements have been made in M. Edm. Becquerel's processes.

In studying the same question with a view to the production of colours on paper by photography, I tried to ascertain whether the action of the sun on the violet subchloride would not be facilitated and rendered more complete by the presence of various substances themselves capable of being modified by light. Reducing bodies—that is to say, those which absorb and combine chemically with the chlorine—produced no effects; but with the bodies furnishing oxygen, chlorine, &c., I was more successful, provided always that they did not act spontaneously on the violet subchloride of silver. Alkaline bichromates, free chromic acid, as well as nitrate of uranium, have furnished excellent results; nitrate of silver acted in the same way, but on decomposing it turned black, and prevented the appearance of the picture.

After lengthened trials I succeeded in producing a reaction which I believe to be capable of certain applications. The violet subchloride, which, on paper, becomes coloured very slowly, and incompletely by the rays of the sun traversing a transparent coloured screen or design, is, on the contrary, modified, even in diffused light, where it has been previously covered with a solution of alkaline bichromate, &c.; so that in white light it becomes white, and takes colours analogous to those of the various rays acting upon it.

Wishing to call attention to what I believe to be a new fact—that is to say, the simultaneous action of oxygenated salts and light on violet subchloride and

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* *Comptes Rendus*, lxi., 1111.

† *Annales de Chimie et de Physique*, 3rd series, vol. xxii., p. 451 vol. xxv., p. 447, and vol. xlii., p. 81.

its application to the reproduction of colours by photography, I will here merely describe the process which has furnished the coloured proofs I have now the honour of laying before the Academy.

Some photographic paper having been previously covered with a coating of violet subchloride of silver, obtained by the reduction by light of white chloride in the presence of a reducing salt, I applied to its surface a liquid formed by mixing one volume of saturated solution of bichromate of potash, one volume of saturated solution of sulphate of copper, and one volume of solution at 5 per cent. of chloride of potassium. I allowed this paper to dry, and kept it in the dark; it kept several days fit for use. In this case the bichromate of potash was the principal agent; it may be replaced, but with no advantage, by chromic acid, &c., &c.; sulphate of copper facilitated the reaction, and the chloride of potassium preserved the whites which were formed.

Through paintings on glass the exposure to direct light lasted only from five to ten minutes, being in proportion to the degree of transparency of the negative plates.

This paper was not yet sufficiently sensitive to be used in the camera, but such as it was coloured pictures were obtained upon it in the enlarging apparatus or solar megascope.

To preserve these images in an album it is only necessary to wash them with water acidulated by chromic acid, then to treat them with water containing bichloride of mercury, to wash them in water charged with nitrate of lead, and finally with water. They will then remain unaltered in the dark, but become brown in the direct rays of the sun.

I intend to return to this subject, and to the special preparation of paper with subchloride of silver which I employ.

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 5.

Tuesday, May 9, 1865.

On the Discoveries in the Chemistry of Rocks and Minerals.

(Continued from page 69.)

M. Kuhlmann has also published in the *Comptes Rendus* of the Academy of Sciences of Paris several papers on the artificial formation of minerals, and although I drew your attention on several occasions to instances of their being produced under what he calls the crystallogenic force, in my first lecture, still I cannot refrain from adverting to another example—viz., that if gummy matter be mixed with syrup of sugar, and the whole dried rather rapidly, an amorphous varnish is left, say on the surface of a glass plate, but if then it is exposed to a damp atmosphere, after a few days the whole of the surface becomes covered with well-defined crystals of sugar.

Mr. Faraday and M. Becquerel, sen., published many years ago some valuable papers, in which they showed that, by submitting proper metallic solutions to the influence of slow currents of electricity, slowly, but surely, well defined mineralogical specimens would be produced, such as gypsum, pyrites, blende, galena, and several metallic oxides.

These researches present a peculiar interest when we consider the formation of the metallic veins or lodes on our planet, the more so that M. Becquerel employed moistened clay to separate the two different fluids in his tubes as a substitute for porous cells in ordinary galvanic batteries, thereby imitating nature in many instances where metallic lodes are found; thus in Cornwall, often a clay slate called killas is found to accompany or to line the lodes of tin and copper, which no doubt fulfils, as in the experiments of M. Becquerel, the functions which a porous cell does in ordinary batteries.

That electricity must play an important part in the formation of metallic veins or lodes there can be no doubt, if we reflect on the advantage taken by telegraphic engineers of the earth as a conducting medium for the return current of electricity, for, as you are aware, there is no necessity to employ more than one wire, since the earth completes the circuit, thus dispensing with the use of a second one, as it brings back the current to the instrument from which it has been emitted.

Further, many practical mining engineers have observed that the veins or lodes of tin and copper run or strike in Cornwall in an easterly and westerly direction, whilst those of lead, called "cross-courses," have a bearing nearly at right angles. I am aware that there are exceptions to this rule, but they are rare. A further proof that natural electricity must play an important part in the formation of veins or lodes, is that the largest deposits are generally found near the junction of two veins. Also that metallic veins are generally mixed with mineral matters differing entirely in composition from the rocks in which they are imbedded; this mixture of minerals bears in Cornwall the name of "gossan;" thus, for copper ores, the mixture is more or less rich in ochre, friable quartz, &c., and this "gossan" plays such an important part in the formation of veins that it is the surest guide that a Cornish miner can have to direct him towards the mineral lode he is seeking for. In the case of copper, this "gossan" is generally above the lode; in tin, generally below, although often stream tin or peroxide of tin is found in the "gossan" itself. For lead ores in Cornwall the gang is generally a soft blue or dark clay-slate, containing large quantities of alumina and carbonate of lime. In Derbyshire and other parts the gang is generally heavy spar or sulphate of baryta. As to gold, its matrix is quartz, and in North Wales nearly all the veins run in the same direction—viz., from east to west; whilst the iron veins, especially those which are magnetic, run from north to south, and in some instances exactly in the direction of the magnetic poles.

Allow me to draw your attention for a few minutes to a most important discovery which has been made within the last few months, by Bunsen, Edmond Becquerel, and Marcus, of an unforeseen adaptation of terrestrial electricity which results from a slight change of temperature between the various geological beds composing the crust of our planet, and which has received the name of thermo-electricity; up to this period it was admitted that all natural currents of electricity (or dynamic electricity) on the surface of our planet were due to chemical action or molecular changes which were constantly taking place between the various mineral matters composing its surface.

Before attempting to impress your minds with the important part which thermo-electricity must play in the production of the natural electrical currents of the earth, and therefore in the formation of metallic lodes or veins, as above stated, it is necessary that I should say a few words on thermo-electricity itself. If two metallic bars be so soldered together that they compose a closed circuit, a more or less intense current will be produced as often as the temperature varies at the places of junction, the current continuing as long as the difference of temperature is maintained; and this fact can be easily demonstrated if a bar of bismuth and one of copper be soldered together, and their other ends be connected with a copper wire made to pass over a suspended magnetised needle. As long as the temperature of the junction remains unchanged, no current is produced; but as soon as any slight change of temperature occurs at the point of junction, a current of electricity is produced, and the needle is deflected. All metals do not yield the same marked results as bismuth and copper, and investigations have shown that, as with dynamic electricity, metals have different degrees of conductibility; that some may be classed under the name of negative metals, whilst others may be ranged under the head of positive. As the quantity of electricity produced by this means is exceedingly feeble, Nobili conceived the idea of soldering together a number of thermo-electric pairs of copper and bismuth; thus composing a thermo-electric battery, or pile; and Melloni further multiplied the intensity of these currents by an instrument which he called a "thermo-multiplicator;" but, notwithstanding this, the quantity of electricity produced by a change of temperature in this manner was so feeble that these currents were considered too insignificant to participate in any way in the production of the natural electricity which was known to exist.

In November last Professor Bunsen published in the *Poggendorff's Annalen* a paper in which he showed that thermo-electricity was produced when blades of natural copper pyrites and of pyrolusite (a peroxide of manganese) were heated at their point of junction.

This publication induced M. Becquerel to publish a paper in the *Comptes-Rendus* of the Academy of Sciences of Paris of last February, in which he showed that sulphur modified in a remarkable degree the thermo-electric power of metals; thus, that sulphide of bismuth was negative to bismuth itself; whilst proto-sulphide of copper was positive with respect to copper, and that the natural copper pyrites was negative to the same metal. Further, he showed that a thermo-electric pair, composed of a bar of copper, and one of protosulphide of copper, would produce, when heated between 32° and 212°, a current ten times as strong as that which would be produced by heating between the same temperatures equal surfaces of copper and bismuth soldered together, and that a more powerful pile still could be produced by forming a pair of proto- and bi-sulphides of copper.

Without entering here into the numerous experiments and deductions which Edmond Becquerel draws from his researches, let me at once call your attention to some most valuable results obtained by S. Marcus, of Berlin, who has succeeded in constructing thermo-electrical batteries having a force far exceeding anything that could have been anticipated from thermo electricity; thus he formed a battery of twenty-five elements capable of disengaging in a minute twenty-five cubic inches of hydrogen and oxygen, and of melting a platinum wire one millimetre in diameter when placed in the circuit. A battery of thirty elements produced a quantity of electricity sufficient to communicate to an electro-magnet the power of sustaining a weight of 150 lbs.

M. Marcus arrives at these results by soldering together long bars of metallic alloys, composed as follows:—

For the positive metal:—

Copper	10 parts.
Zinc	6 "
Nickel	6 "

For the negative metal:—

Antimony	12 parts.
Zinc	5 "
Bismuth	1 "

These alloys not only give rise to most powerful thermo-electric currents when soldered together, and their point of junction heated, but they are preferable to copper and bismuth, owing to the fact that they undergo no change at a comparatively high temperature as copper does, and do not melt like bismuth. Further, he increased in a marked manner the power of his battery by plunging one end of his soldered bars into cold water whilst their other end was heated by a gas flame, and as no solder could be found capable of resisting such a high temperature, the two bars composing the elements of his battery were united by means of screws.

These facts, together with some others which you will find published in the *Philosophical Magazine* of this year, must give you some idea of the enormous quantity of electricity that must be produced in the crust of our planet by means of thermo-electricity, for we all know the large amount of sulphurets of various metals that enter into the composition of that crust, and there can be no doubt, from the facts above stated, that the electricity so produced must, and does, contribute, in a marked degree, to the formation of veins and lodes.

My wish was to have drawn your attention to the variety of gases which escape from the craters of volcanoes when in activity, as well as from the secondary outlets, called "fumerolles," as much information has been added to our knowledge on these phenomena of late years by M. Charles St. Claire Deville and M. Fouqué since the valuable researches of Professor Daubeny on these phenomena; still, I cannot refrain from calling your attention to several tables which I have hung round this room, and which illustrate the great variety of gases that escape from the crater, as well as from the fumerolles, which surround it. From the crater escapes hydrochloric and sulphurous acid, volatile chlorides, and aqueous vapour; at a short distance from it hydrochloric acid appears to cease, and sulphurous acid to predominate; thus in 100 parts of gas he found—

Sulphurous acid	24·5
Oxygen	14·5
Nitrogen	61·0
	100·0

At a further distance he found sulphuretted hydrogen and carbonic acid, varying from 0·8 per cent. to 28 per cent.; oxygen, 8·2 per cent.; and nitrogen, 90 per cent. In another case, 14·9 per cent. of oxygen, and 56·9 per cent. of nitrogen; and as he still proceeded further from the centre of activity, the sulphuretted hydrogen and sulphurous acid disappeared, and were replaced by carbonic acid, and lastly by a mixture of light carburetted hydrogen and carbonic acid, as this table illustrates:—

	Santa Venerina.	San Biagio.	Paterno.	Valica.	Girgenti.
Carbonic acid .	3·13	74·99	95·35	93·49	1·65
Oxygen . .	1·18	2·78	0·58	0·68	0·69
Nitrogen . .	22·15	19·47	2·94	5·14	3·74
Carb. hydrogen .	71·76	3·77	1·12	1·45	87·23
Hydrogen . .	3·70	0·99	0·50	0·43	5·74
Sulphuretted hydrogen . .	traces.	—	—	—	—

PHARMACEUTICAL SOCIETY.

Wednesday, January 7.

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

DR. ATTFIELD exhibited a specimen of "*Mannite*," presented to the Society by Professor De Luca. It was obtained from the olive plant, in the leaves and fruit of which it is found at different stages of growth.

Mr. HANBURY remarked that a saccharine exudation from the olive tree is occasionally found, and asked whether the specimen of mannite shown was obtained from this or procured from the plant by a chemical process.

Dr. ATTFIELD explained that the specimen was obtained by a chemical process.*

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* A paper on the subject, by Professor De Luca, will be found in the *Comptes Rendus* of the Academy of Sciences, vol. liii., p. 3[illegible], a short notice of which appeared in this journal, vol. iv., p. 334 (1861).

A Visitor exhibited to the meeting "*A New Leech Cage.*" It consisted of a glass jar, in which were three perforated diaphragms of galvanised iron, fitting the jar, and fixed upon a vertical axis, so that all could be lifted together. The perforations of the bottom diaphragm are too small to allow the leeches to pass through; the larger holes in the upper afford the animals the means of cleansing themselves. A metal cover, with small perforations, admits air, and allows the water to be changed with facility.

The Chairman called the attention of the meeting to a specimen of "*Port Royal Senna,*" brought to England by Dr. Bowerbank; and Dr. Tilbury Fox stated that Dr. Bowerbank had used the senna in his practice for thirty years, and found it preferable to East Indian and Alexandrian sennas. It was less disagreeable to the palate, excited no nausea, and produced no griping. The infusion tasted something like tea, and children drank it readily.

Professor Bentley said that the specimen consisted of leaves of *Cassia obovata*, a cultivated variety of the plant, which was originally introduced from Africa. It was mentioned by several writers on West Indian plants, under the names of Italian Senna and Cassia Portugalia. It was said by Sloane to produce much griping. He believed that it was less active than East Indian and Alexandrian senna.

Mr. Cook stated that the plant grew wild in the hedges in the West Indies.

Two papers of more than usual practical interest were afterwards read, the report of which we defer until next week.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

January 23, 1866.

R. Angus Smith, *Ph.D., F.R.S., &c., President, in the Chair.*

M. le Marquis Anatole de Caligny, of Versailles, Civil Engineer, was elected a Corresponding Member of the Society.

Thomas Graham, F.R.S., &c., Master of the Mint: A. W. Hofmann, F.R.S., &c.; Joseph Prestwich, F.R.S., &c.; and Andrew Crombie Ramsay, F.R.S., &c., were elected Honorary Members of the Society.

A conversation took place respecting the cattle plague, in the course of which Mr. Baxendell stated that the results of inquiries he had made had led him to believe that the total mortality among cattle from plague and all other diseases, during the past year, had been very little, if at all, above the average rate of the last ten years; thus indicating that the plague had, to a great extent, displaced pleuro-pneumonia and other dangerous diseases, and that therefore no just cause at present existed for the feeling of alarm which prevailed throughout the country.

A paper was read entitled "*Notes on a Section of Chat Moss, near Ashley Station,*" by W. Brockbank, Esq.

PHOTOGRAPHIC SECTION.

January 11.

Dr. J. P. Joule, *F.R.S., &c., Vice-President of the Section, in the Chair.*

A note from Mr. Joseph Sidebotham was read, regretting his inability to attend the meeting, and giving particulars respecting some photographs which he had recently taken with Dallmeyer's new wide-angle lenses of five and seven inches focus. These prints were exhibited, and also one taken with an ordinary lens from the same spot, a comparison of the two showing the great advantage of the new over the old form of lens. The time of exposure was stated to be from two minutes to thirty seconds for collodio-albumen plates at this season of the year.

Professor Roscoe explained the method of meteorological registration of the chemical action of light, as described in his paper in the *Philosophical Transactions* of the Royal Society, which has been chosen as the Bakerian lecture for 1865. Dr. Roscoe exhibited the apparatus needed, and showed the method of manipulation adopted in order to obtain curves of daily chemical intensity. He also detailed the results which have been obtained by the employment of his method at the British Association's observatory at Kew, during nine months of the year 1865, under the superintendence of the Director, Dr. Balfour Stewart, F.R.S.

Dr. Joule observed that he considered Dr. Roscoe's investigations on this subject to be equal in importance to the systematic registration of the variations of temperature, as the growth of corn, &c., depended as much on the chemical effect of light as on the temperature of the air.

Mr. Baxendell regarded the subject as a new department in meteorology, and one likely to yield results of considerable interest and importance.

Mr. Parry suggested that it was desirable to have observations made at more than one station, and at a distance from Kew.

Dr. Roscoe stated that he hoped in a short time to perfect apparatus for effecting the registration of the chemical changes in the light by means of self-acting apparatus, so as to lessen the labour of making the observations.

It was suggested that a simple photometer would be useful to photographers working with dry plates, and Dr. Roscoe said he would endeavour to carry out the idea.

ACADEMY OF SCIENCES.

February 5, 1866.

M. Payen made a communication "*On Iodide of Potassium,*" in which he showed that a cold saturated solution, to which but a very minute quantity (0·005) of acetic, nitric, or oxalic acid had been added, gradually decomposed in contact with air, iodine being liberated; but when the same mixture was kept sheltered from the air no decomposition took place. The author attributes the result to the double influence of the oxygen tending to oxidise the potassium, and the acid exerting its affinity for the potash. The results, he adds, have a particular interest, since they serve to explain the difference of opinion expressed by chemists, some having asserted that dilute acids decompose the iodide, while others have denied that any decomposition takes place.

M. P. W. Hofmann contributed a note entitled "*Experiments Relating to Oxysulphide of Calcium.*" The author states that a simple mixture of two equivalents of sulphide of calcium with one equivalent of lime does not form the oxysulphide without calcination; but the same mixture when strongly heated does form oxysulphide. The composition of the oxysulphide he states is $2CaS,CaO$, because when a larger proportion of lime is present it does not combine with the CaS, but acts as free lime. The author also confirms the statement of M. Kopp that the oxysulphide $2CaS,CaO$ exists in fresh soda waste, the reactions of the waste with a solution of chloride of manganese being precisely the same as the reactions of the oxysulphide prepared by calcining the mixture of its components.

Experiments on a large scale, M. Hofmann adds, have shown that in the manufacture of soda when less than the normal proportion of chalk is used (equal weights of sulphate of soda and chalk) a crude soda is obtained, which on lixiviation gives a solution containing too much sulphide of calcium to be employed industrially.

The author also remarks that the sulphide of manganese (MnS) is very unstable in the air. In a very short time it parts with two-thirds of its sulphur, there being formed, at the same time, sulphate of manganese and the oxide Mn_3O .

M. H. Caron made a communication "*On the Blisters in Steel,*" in which he showed that when steel or iron is melted in crucibles made of lime or magnesia no blisters are formed.

M. Balard suggested that the floors of puddling furnaces might be made of magnesian bricks, which would last much longer than the bricks usually employed; and further, that sea-water was an excellent source from which to obtain the magnesia.

M. H. St. Claire Deville said that crucibles of magnesia made on M. Caron's principle (*by pressure*) were in daily use in his laboratory, and were found extremely useful.

M. Regnault ended the conversation by stating that Thilorier used crucibles of magnesia for melting platinum twenty years ago.

MM. Tessie du Mothay and Maréchal contributed a note "*On the Chemical Production of Dead Engravings on Glass.*" An aqueous solution of hydrofluoric acid, as our readers know, gives a half transparent etching on glass, while the action of the gaseous acid is very unequal. The authors have succeeded in obtaining an uniformly ground appearance by the use of the following solution:—They take 1000 grammes of water and dissolve therein 250 grammes of crystallised fluorhydrate of fluoride of potassium and 140 grammes of sulphate of potash, and add 250 grammes of commercial hydrochloric acid. This solution is quite inoffensive, and its use has in several workshops superseded that of the wheel and hydrofluoric acid in the production of ground glass. Beautiful specimens of engravings procured with the solution were exhibited to the Academy.

M. Terreil contributed a note "*On the Crystallised Oxides of Antimony and the Antimonites.*" The author proposed to himself to discover under what conditions the two forms of oxide of antimony are produced, and his experiments have led him to the following conclusions:—

1. That when antimony is burned, or sulphide of antimony is roasted, in contact with air, it is always the prismatic oxide that is formed.

2. That the octahedric form is only produced when the prismatic form is slowly sublimed in the presence of non-oxidizing gases.

3. The prismatic oxide has more strongly pronounced chemical affinities than the octahedric, which latter is ordinarily the more stable oxide. Sulphide of ammonium immediately colours the prismatic crystals, and then dissolves them, but has no action on the octahedric crystals.

4. The densities of the two oxides differ considerably; that of the prismatic is 3.72, that of the octahedric 5·11.

5. The densities of the natural and artificial oxides are the same for the same form.

6. The crystalline compounds deposited in alkaline solutions containing protoxide of antimony are definite hydrated antimonites of soda, having the formulæ

$NaOSb_2O_3,6HO$ (neutral antimonite), and
$NaO,3(Sb_2O_3),2HO$ (triantimonite).

7. Both antimonites crystallise in small octahedric crystals, apparently belonging to the rectangular system.

8. The neutral antimonite is not changed by sulphide of ammonium, while the triantimonite is decomposed and dissolved. This reaction distinguishes the latter from the octahedric oxide, with which it might be confounded.

9. The solution of antimonite of soda precipitates nitrate of silver white; the precipitate is soluble in dilute nitric acid; ammonia colours it deep brown, and then dissolves it. The last reaction is characteristic. Sulphuretted hydrogen and sulphide of ammonium do not precipitate this solution unless previously acidified. Antimonite of soda precipitates peroxide of iron yellowish white; the acetates of lead white; sulphate of copper bluish white; and nitrate of peroxide of mercury white. All these precipitates are soluble in nitric acid.

The last paper we may quote is one by M. Tripier, who tells us that small doses of "grog" are better for the whooping-cough, and also for phthisis, than the usual tisanes. A glass the last thing at night, he states, will generally procure a good night for the patient.

NOTICES OF BOOKS.

Photographic Mosaics. Edited by M. Carey Lea and Edward L. Wilson. Philadelphia: Benerman and Wilson. 1866.

This is for the most part a reprint of papers published in the *Philadelphia Photographer*, and, it is needless to add, mostly derived from English photographic journals. There are, however, a few original papers by Mr. Carey Lea. To these we give every welcome; but we cannot help thinking it a little too bad to send to the English market a volume consisting mainly of articles from English journals.

Among the papers by Mr. Lea is one "On the Management of Waste Nitrate of Silver," a matter of interest to all photographers, so we extract a portion:—

"I do not expect in these paragraphs to develope anything in the least new. For all the methods rest upon a few principles, well understood amongst all chemists and assayers. But it is convenient to have a few simple rules with respect to the carrying out of these principles, so as to accomplish that saving with as little trouble as possible. Some will not take any trouble, and waste all their silver, probably not knowing how easy it is to save it.

"The directions which I am now about to give are applicable rather to the operations of amateurs who work upon a moderate scale, than to professional workers, and it is to the former that they are addressed.

"Divide your waste solutions into three classes—viz.:

"1. Solutions containing hyposulphite.
"2. Weak solutions free from hyposulphite.
"3. Strong solutions free from hyposulphite.

"The first of these of course includes solutions used for fixing both positives and negatives.

The second consists of the first washings of printed proofs. It is scarcely necessary to say that the only proper way to treat proofs is to let them rest fifteen to twenty minutes in a very moderate quantity of water, which is to be saved; the further washings may be rejected.

"The third class consists of negative baths that can be no longer persuaded to work, of positive ammonia—nitrate baths that have become choked up with nitrate of ammonia and organic matter from the paper and albumen, and will no longer yield to the action of citric acid or kaolin, and of plain nitrate baths in a similar bad condition.

"Provide three capacious bottles to accommodate these different classes.

"1. In the first, place strips of sheet copper, and let the sediment of precipitated silver settle to the bottom. When your bottle has become full, and the last additions have remained twenty-four hours in contact with the copper, pour the liquid out and add new portions. When your silver has attained a quantity sufficient to make it worth while, you remove it and work it up with the rest. You may leave this as long as you like, only taking care always to have plenty of metallic copper present.

"2. The bottle into which you pour your weak solutions is to be managed differently. It will fill much faster than the other, perhaps daily, and is best regulated as follows:—Throw a tablespoonful of salt into the bottom of the bottle, pour in your waste, stir up, and in a few minutes the chloride of silver will settle. When you have more ready, and the bottle is full, pour it off, and add another spoonful of salt. Keep a few lumps of zinc in the bottle, and once in a while add a few drops (*very* little is sufficient) of sulphuric acid. This will save you from the trouble of working up your chloride as a separate operation. Instead of your silver accumulating in the form of chloride, you will have it ready in the form of 'revived silver,' as the assayers express it.

"3. The bottle containing the spent baths will accumulate more slowly, but be much richer in silver than the other solutions. It is not worth while to convert this into chloride at all. Keep some lumps of zinc in it, acidulate faintly, and the silver will all fall down.

"The object in the second instance, of converting into chloride is simply to save time, inasmuch as the silver is removed far more quickly in this way than the other. But if the photographer prints only once in a while, so that his spent solution has a chance to remain several days with the zinc, he may combine classes 2 and 3 and dispense with the salt altogether, reviving his silver directly, instead of first converting into chloride.

"The great advantage of converting into chloride lies in that the silver is thus purified from almost any admixture with other metals. There is scarcely any insoluble chloride, except those of lead and the protochloride of mercury (calomel). So that if the amateur is in the way of making original experiments in which his silver solutions become mixed up with a variety of other chemicals, a bottle for chloride is very convenient."

These will be very useful instructions to many photographers. We are bound to add that the compilation forms a very useful Year-book of Photography.

Bulletin Mensuel de la Société Chemique de Paris, &c. January, 1865.

The reports of the Chemical Society of Paris contain a short notice of a paper by M. Berthelot "*On the action of Carbonic Oxide on Alkaline Alcoholates.*" Dry carbonic oxide is slowly absorbed by a solution of alcoholate of baryta in absolute alcohol, and the result is ethyl-formiate of baryta $C_2O_2(C_4H_5BaO_2)$ isomeric with the propionate $C_6H_5BaO_4$, but soluble in perfectly absolute alcohol, and immediately decomposable by water into alcohol and formiate of baryta. Anhydrous alcoholate of soda also absorbs carbonic oxide, and forms an ethyl-formiate of soda, and at the same time a small proportion of propionate. The same alcoholates rapidly decompose well-dried formic ethers, reproducing the alcohols (without hydric or mixed ethers) and producing compounds which appear to be identical with the ethyl-formiates. Lastly the author has found that anhydrous baryta slowly decomposes well-dried formic ethers in the cold, producing a small amount of carbonic oxide, and a mass which, in contact with water, decomposes into alcohol and formiate, and which equally appears to contain an ethyl-formiate. M. Berthelot intends to return to this subject.

M. Maumené, at the same meeting, gave "*A New Explanation of the Theory of the Formation of Ether.*" The author of course admits the formation of sulphovinic acid in the first phase of the reaction. In the second phase he contends that, simultaneously with the destruction of the sulphovinic acid at first formed and the production of ether, there happens the reproduction of an equal amount of fresh sulphovinic acid.

Three papers of great theoretical interest were contributed from the laboratory of Kasan. The first was by Boutlerow "*On Tertiary Alcohols.*" The author, in a former communication, expressed an opinion that by the reaction of chlorides of different and radicals, $\Theta n\,H_2n-1\Theta Cl$, on zinc methyl, zinc ethyl, or zinc amyl, tertiary alcohols, $\Theta n\,H_2n+2\Theta$, of a higher molecular weight might be produced. He has partly succeeded in proving this by experiment. The action of chloride of acetyl on zinc ethyl, and that of chloride of butyryl on zinc methyl have furnished two tertiary *pseudo-hexylic alcohols* $\Theta_6H_{14}\Theta$ isomeric with each other; and by the reaction of chloride of butyryl on zinc ethyl he has obtained a tertiary pseudo-cylic alcohol $\Theta_8H_{18}\Theta$. The reaction of chloride of benzoyl on zinc methyl did not produce an alcohol, but a body which the author believes to be identical with the methyl-phenylic acetone obtained by Friedel. The author gives full details of his studies, and enters at length into the theoretical questions involved.

Another paper by the same author related to the "*Chlorinated Methylic Ethers,*" in which he shows the difficulties in the way of preparing these bodies in a state of purity.

From the same laboratory we have a paper "*On the Isomerism of Acetones,*" by A. Popoff.

A communication of more practical interest was by M. Perret "*On the Manufacture of Citric Acid by means of Citrate of Magnesia.*" The author appears to be working in Sicily, where he first makes a tribasic citrate of magnesia, which he afterwards heats with a fresh quantity of lemon juice, and so obtains a solution of bibasic citrate, which crystallises on evaporation, and which he proposes to export to England for the manufacture of citric acid. We shall give a longer abstract of this paper. The *Bulletin* contains the usual analysis of chemical papers published in France and abroad.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

2726. J. Wright, Throgmorton Street, London, "Improvements in the method of, and apparatus for utilising the liquors used in the treatment of straw or other fibrous materials for the manufacture of paper, which improvements are also applicable to the evaporation of liquids generally."—A communication from E. Porion, Rue St. Martin, Paris.—Petition recorded October 21, 1865.

34. F. Wright, High Street, Kensington, "A new preparation of fruit beverages of a stimulating character."—January 4, 1866.

98. D. Hall, Wharton, near Winsford, Cheshire, "Certain improvements in the construction of furnaces."—January 11, 1866.

202. W. Jeffries, West Bromwich, Staffordshire, "Improvements in puddling furnaces and heating furnaces, and other reverberatory furnaces used in the manufacture of iron and steel."

208. P. W. Bennitt and J. Meathews, Oldbury, Worcestershire, "An improvement or improvements in heating furnaces for smelting, puddling, melting, and annealing metals, or for the manufacture of glass."—January 22, 1866.

228. M. Silvester, Gilbert Road, Kennington Lane, Surrey, "An improved compound for removing and preventing incrustation in steam boilers."—January 23, 1866.

240. T. Spencer, Euston Square, Middlesex, "Improvements in the preparation of soils to promote general vegetation and prevent insalubrious or unhealthy exhalations from manures placed thereon."—January 24, 1866.

297. C. Doughty, Lincoln, "Improvements in apparatus for distilling the grease of cotton-seed oil and other fatty matters."—January 30, 1866.

Notices to Proceed.

2483. R. Reece, Llandilo, Carmarthenshire, "Improvements in obtaining and applying sulphurous acid, and in apparatus used therein."

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."—Petitions recorded September 28, 1865.

2507. J. Addenbrooke, G. Addenbrooke, and P. A. Millward, Darleston, Staffordshire, "Improvements in collecting or drawing off the gases from blast furnaces."—September 29, 1865.

CORRESPONDENCE.

New Cornish Minerals.

To the Editor of the Chemical News.

Sir,—Will you allow me to put on record in your journal that I received some little time ago from Mr. Talling, a small but very pretty specimen of a greenish-blue mineral in a state of finely granular aggregation; the granules being translucent, but under the microscope devoid of crystalline form. The analysis proved it to be a hydrated aluminic (with traces of calcic) silicate, tinted rather deeply with a cupric silicate. It is doubtless an opal allophane, the Saltzburg variety of which mineral it closely resembles. It is from Cornwall, but is not the first occurrence recorded of Cornish allophane. I have not enough, without destroying this specimen, for a quantitative analysis, but am not without hope of receiving further specimens from Mr. Talling.

That sagacious mineral-finder sent me also some time back, a curious variety of "pitchy copper ore," in what seem to be stalactitic incrustations.

It is, in fact, a mixture of native copper and a crysocolla with a hydrated ferric oxide, probably turgite, with which it presents great resemblance. I am, &c.

Nevil Story Maskelyne.

British Museum, February 7.

A Reply to Dr. Phipson.

To the Editor of the Chemical News.

Sir,—I am afraid that Dr. Phipson's habit of shiftiness, not to call it by an uglier name, is incurable.

Of course, I know perfectly well that my reply to his singularly temperate attack upon Dr. Frankland was inserted in *Cosmos* of November 29—not, indeed, "as it was written," but in a much garbled form; and, of course, he knows perfectly well, despite his apparent denial, that my other reply to his subsequent attack upon *me* was refused insertion altogether.

For his other ingenious statements and suggestions, the proverb must suffice—"*Ex uno disce omnes.*"

I am, &c., William Odling.

London, February 13.

[All correspondence on this subject must positively end with this letter.—Ed. C. N.]

A Reply to Mr. Hawksley.

To the Editor of the Chemical News.

Sir,—Allow me to say, in reply to Mr. Hawksley, that I had no wish to disparage the Nottingham gas, and that I am anxious to apologise to him if he considers my remarks had any such tendency. I did not for a moment suppose, nor did I think any one else would, that the gas tested had been purified, or was such as would be supplied to the town. I compared it to London gas simply to show that it must have been an impure gas, and that therefore the results could teach me nothing of the value of the processes under trial. I should have made no reference to those testings if Dr. Letheby had not asserted that I acquired special information from them. I have, therefore, to thank Mr. Hawksley for testifying to my ignorance regarding them. I am, &c. C. H. Wood.

5, Calthorpe Street, Gray's Inn Road, February 13.

MISCELLANEOUS.

Royal Institution of Great Britain.—The following are the arrangements for the week:— Tuesday and Thursday, at 3 o'clock, Professor Tyndall "On Heat." Friday, at 8 o'clock, William Pengelly, Esq., F.R.S., "On Kent's Cavern, Torquay." Saturday, at 3 o'clock, Professor Westmacott, R.A., "On Art Education," &c.

Death of Mr. Brande.—We regret to have to announce the death of this eminent chemist, which took place at Tunbridge Wells on the 11th inst. The deceased gentleman had arrived at the advanced age of 81. On a future occasion we hope to be able to give a short sketch of his life and labours.

Sale of Alcohol.—A question of importance to photographic and other chemists has just been decided. It seems that an excise officer bought some strong alcohol of Messrs. Horne and Thornthwaite, and then laid an information against the firm. Messrs. Horne and Thornthwaite thereupon wrote to the Commissioners of Inland Revenue, stating that in 1856, when supplying the photographic outfit to the Royal Engineers, they had, through the late Captain Fowke, inquired of the Board whether they were allowed to sell alcohol for photographic or scientific uses, and the reply given was to the effect that no notice would be taken of such sale. Messrs. Horne and Thornthwaite also urged that the spirit supplied by ordinary dealers was useless for scientific purposes. They stated, further, that they were of opinion that they were fully justified in selling an alcohol the strength of which is so high that it cannot be tested by Sikes' hydrometer, as such an article could not have been contemplated by the Act, which directs all spirits to be tested by Sikes' hydrometer; and they concluded by appealing to the Commissioners, on their own behalf and the many other establishments interested, to decide what they might legally sell. The reply of the Commissioners will be found below. We may add that Messrs. Horne and Thornthwaite have been advised not to sell alcohol under 60° over proof, and in quantities of not more than one gallon at a time.

"Inland Revenue, Somerset House, London, W.C.,
"30th January, 1866.

"Gentlemen,—The Board of Inland Revenue having had before them your application of the 17th instant, I am directed to state that the law absolutely prohibits the sale of any spirit without licence, but that this department is not in the habit of interfering with chemists who sell small quantities of highly rectified spirits, such as cannot be procured from ordinary spirit dealers, for medical or scientific purposes only.

"I am, Gentlemen, your obedient servant,
"Adam Young, Assistant-Secretary.

"Messrs. Horne and Thornthwaite."

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.

Mr. J. W. Gunning, Amsterdam.—The instruments are made by Mr. Ladd, Beak Street, Regent Street, London.

W. M.—Concentrate the solution very slowly. The crystallisation is favoured by suspending a wire in the liquor.

S. H.—No accounts have been received lately.

C. H. B. L.—At the Patent Office, Chancery Lane, price 3d.

Recent Subscriber.—Read Dr. C. Calvert's lectures, which will give the desired information.

M. N.—You can get it through a foreign bookseller. It is published by Voss, of Leipsic, once a week.

Mr. E. J. Mills's communication shall be inserted next week.

Pb. asks, "Can you inform me in your Notices to Correspondents of any soluble matter that will prevent paper saturated with sugar of lead burning like tinder when set on fire; it must not precipitate the lead?" Perhaps some correspondent can make a suggestion.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Type of the Chlorides of Antimony and Phosphorus, &c., by J. A. R. Newlands, *F.C.S.*

The existence of such bodies as the oxychloride, the chlorosulphide, and the pentachloride of phosphorus is sometimes explained by supposing them to be derived from three molecules of hydrochloric acid, in which the three atoms of hydrogen have been replaced by the trivalent acid-radicals-phosphoryl PO, sulphophosphoryl PS, and chlorophosphoryl PCl_2.

The terchlorides of phosphorus and antimony may, however, be looked upon as derivatives of ammonia, and as such would be named trichlorophosphine and trichlorostibine, analogous to triethylstibine, and, like that substance, bivalent.

The phosphorus compounds, for example, would be thus represented,—

PCl_3 trichlorophosphine.
PCl_3,O oxide of ditto.
PCl_3,S sulphide of ditto.
PCl_3,Cl_2 bichloride of ditto.

It will be observed that when viewing these bodies as constructed upon the ammonia type it is only necessary to consider them all as containing the terchloride of phosphorus; whereas, if we look upon them from the hydrochloric-acid point of view we must suppose a distinct radical as existing in every term of the series.

Laboratory, 19, Great St. Helen's, February 16.

Preliminary Notice of a New Cornish Mineral, by A. H. Church, *M.A., Professor of Chemistry, R. A. College, Cirencester.*

Mr. Talling, of Lostwithiel, found, not long ago, some greenish-blue crusts of a mineral which, when I first saw it, struck me as presenting some peculiar characters. I purchased a few specimens, and they have been submitted to analysis in my laboratory with a satisfactory result.

It occurs in minute botryoidal aggregations, which are occasionally arranged in a slightly foliated manner. Some portions of the crust are about one-sixth of an inch in thickness. It is tender, and falls into a coarse powder under slight pressure. The colour is uniform—a rather rich turquoise blue in some specimens; other less translucent pieces are pale, and slightly more greenish in hue. The darker masses are almost, if not quite, transparent, and resemble in appearance some specimens of hyalite very closely. The density of the mineral is about 2·38. It is soluble, with scarcely any residue, even in dilute acids.

As to the constituents of this mineral, I imagine that it might prove to be intermediate in composition between chrysocolla and allophane. But my assistant, Mr. R. Warington, soon found that silica was almost entirely wanting in the mineral; in fact, it consisted of oxide of copper, alumina, and sulphuric acid, water also being present in large proportion. Very minute traces of phosphoric acid, lime, and magnesia also exist in the substance; but they are scarcely in sufficient amount to be estimated, with the exception of the phosphoric acid.

This mineral, like many other uncrystallised species, is very hygroscopic; it was accordingly dried in vacuo till constant in weight before analysing it. The several analyses now completed are accordant and point to the formula—

$$2\overset{\prime\prime}{\mathrm{Cu}}\mathrm{SO_4},5\overset{\prime}{\mathrm{Cu}}\mathrm{H_2O_2},2\overset{\prime\prime\prime}{\mathrm{Al}}_2\mathrm{H_6O_6},\mathrm{H_2O}$$

for the mineral dried in vacuo. At 100° C. the substance loses 3·8 per cent. of water, and it then yields numbers closely according with the formula—

$$2\overset{\prime\prime}{\mathrm{Cu}}\mathrm{SO_4},5\overset{\prime\prime}{\mathrm{Cu}}\mathrm{H_2O_2},2\overset{\prime\prime\prime}{\mathrm{Al}}_2\mathrm{H_6O_6},$$

which may be written with the lower atomic weights in the following manner:—

$$2\dot{\mathrm{Cu}}\dddot{\mathrm{S}},5\dot{\mathrm{Cu}}\dot{\mathrm{H}},2(\dddot{\mathrm{Al}}_3\dot{\mathrm{H}}).$$

The following percentages have been deduced from the analytical results, the silica, about 1 per cent., having been first subtracted:—

	Vacuum-dried mineral.	Mineral dried at 100°.	
	R. W.	R. W.	A. H. C.
CuO .	46·80	48·67	48·34
Al_2O_3 .	17·93	18·64	17·97
SO_3 .	12·54	13·04	13·95
H_2O .	(22·73)	(19·65)	18·48
	100·00	100·00	98·74

The formula proposed for the vacuum-dried mineral, namely,—

$$2\overset{\prime\prime}{\mathrm{Cu}}\mathrm{SO_4},S\overset{\prime\prime}{\mathrm{Cu}}\mathrm{H_2O_2},2\overset{\prime\prime\prime}{\mathrm{Al}}_2\mathrm{H_6O_6},2\mathrm{H_2O},$$

demands the following percentages:—

$7\overset{\prime\prime}{\mathrm{Cu}}\mathrm{O}$	48·12
$2\overset{\prime\prime\prime}{\mathrm{Al}}_2\mathrm{O_3}$	17·82
$2SO_3$	13·83
$13H_2O$	20·23
	100·00

The formula proposed for the mineral when dried at 100°, namely,—

$$2\overset{\prime\prime}{\mathrm{Cu}}\mathrm{SO_4},5\overset{\prime\prime}{\mathrm{Cu}}\mathrm{H_2O_2},2\overset{\prime\prime\prime}{\mathrm{Al}}_2\mathrm{H_6O_6},$$

demands the following percentages:—

$7\overset{\prime\prime}{\mathrm{Cu}}\mathrm{O}$	49·65
$2\overset{\prime\prime\prime}{\mathrm{Al}}_2\mathrm{O_3}$	18·39
$2SO_3$	14·28
$11H_2O$	17·68
	100·00

It will be noticed that the sulphuric acid found is less than that required by theory. The phosphoric and silicic acids known to be present may account for this deficiency, however. The proportion of oxide of copper also is below that indicated by theory. It is possible that the undetermined lime and magnesia may have caused this difference between theory and experiment.

I shall shortly give full analytical details concerning this mineral, and in doing so I shall take occasion to point out its relationships to its nearest congener, lettsomite, and to brochantite, gibbsite, &c.

Cirencester, February 16.

Remarks on a Paper of F. Beilstein on Nitro-Compounds, by Edmund J. Mills, *D.Sc.*

In the last number of the Chemical News, Professor Beilstein, of Göttingen, published some observations on a paper which I recently communicated* to the Chemical Society. The paper in question was "chiefly devoted to the consideration of the two nitro-benzoic acids, and

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* *Journ. Chem. Soc.*, (2) iii., 319.

some general remarks" were "appended on the subject of isomerism itself." The results obtained, as well as the views advanced in connexion with them, have encountered strong opposition at the hands of Professor Beilstein. I take the present opportunity of replying.

At the commencement of my paper, when speaking of *beta*-nitro-benzoic acid, I remarked that Wilbrand and Beilstein had "distinguished" it as "nitro-dracylic" acid. Professor Beilstein observes, "the name 'nitro-dracylic acid' was not introduced by us, but by Glénard and Boudault," &c. I was quite aware of this; but, as Wilbrand and Beilstein were the first chemists to assign to the acid its true formula, and associate that formula with the name "nitro-dracylic" acid, they must be held responsible for having distinguished it as such. That they adopted the name after consideration may be seen by referring to their paper[†] on the acid; I never asserted that they had "introduced" it.

In his second paragraph, Professor Beilstein remarks, "that the acid obtained from nitro-dracylic acid comports itself with a mixture of nitric and sulphuric acid exactly like common benzoic acid; nitro-benzoic acid is the only product." A glance at my paper will show that I worked with nitric acid only. In the third place we are informed that "the preparation of nitro-benzoic acid from benzoic acid by means of nitric acid is very inconvenient, and simply washing the product by no means sufficient for purification." I had stated that my product yielded, on combustion, "the well-established numbers of recent observers." I thought it unnecessary, at the time, to print the analysis, but will now quote it—

0·3520 grm. substance, dried at 100°, gave 0·6492 grm. carbonic dioxide and 0·0949 grm. water.

The percentages are theoretically exact to two places of decimals.

With respect to the generally great stability of nitro-dracylic acid, I perfectly agree with Professor Beilstein. I cannot, however, admit that that body undergoes no change when boiled with mixed nitric and sulphuric acid. On the contrary, I find that, after heating for some time to 115°, cooling and adding water, a small precipitate falls, which has the composition of dinitro-benzoic acid,—and that there is a substance in the mother liquid having the same composition. My commentator does not mention having examined the mother liquid. Again, the statement that "nearly all nitro-compounds" are decomposed by chloride of lime, is apt to mislead any one who does not specially bear in mind the mode of formation of these bodies. Thus chloropicrin, a comparatively simple substance, which is easily decomposed, is generated in presence of chloride of lime.

Professor Beilstein lays exaggerated stress on small quantities of foreign bodies as means of altering fusion point and results of nitration. I am perfectly willing to allow a great deal of this; but not to the extent of admitting carelessness in purification and management,—that is to say, without proof. Naumann has not been guilty of such very extreme statements as to the influence of "the smallest impurity." This manner of treating the results of other chemists, though closely associated with Professor Beilstein's name, might be abandoned with advantage as a worthless expedient. The valuable experiments of Sokoloff on the two phenylic chlorides[‡] were set aside by Beilstein[§] to a great extent on this ground, in a note not very dissimilar in tone from his *critique* upon my own researches. Sokoloff found that there were two phenylic chlorides, differing in specific gravity and in aptitude for nitration. The latter observation exactly corroborates my own result with the benzoic acids, to which the phenylic chlorides can be referred by known reactions. Gregory[||] found two potassic benzoates. An anticipation, based on the difference I had remarked between the two acids, led to a satisfactory experimental result.[¶] I may add that I somewhat reluctantly admitted the existence of the two acids, having supposed that the difference between their "nitryls" would be sufficient to account for the isomerism. Very little "practice" or "experience" is necessary to enable one to perceive that Beilstein and his coadjutors have scarcely yet exhausted the means of comparison between these two acids, which are nevertheless asserted (not "shown") to be "in every respect identical."

The fusion point of nitro-benzoic acid has not hitherto been the subject of very satisfactory statements; some experiments in which I have been engaged for a short time will probably throw light on the matter. That Naumann has by no means cleared up the difficulty (as Beilstein supposes) may be seen by any one who will take the trouble to read his remarks[**] on the subject; when it will be obvious, I think, that Naumann concluded the fusion point of *a* nitro-benzoic acid, as given by Mulder, to be erroneous, chiefly because that chemist's carbon determination gave too high a number, and on account of the known difficulty of nitrating ordinary benzoic acid. My own determination, recorded above, may suffice to obviate those objections. As was the case with Naumann afterwards, I have also obtained a nitro-benzoic acid fusing at about 141°; but I have adduced proof that the acid fusing at 127°—8° has the same composition.

Lastly, I am reminded that "the investigation of isomerism in the aromatic series is connected with much trouble and difficulty." I believe this to be the character of all investigations worthy of the name. Different experimenters have often been at variance as to results; but to assert or insinuate that one of the parties is almost entirely wrong or unable, is legitimately considered premature and unwise. Neither is an open insinuation of this kind enhanced in value by proceeding from one to whom a style of patronage or contempt is too obviously familiar.[††]

Professor Beilstein may find this discussion continued as soon as my experiments are sufficiently advanced for publication. In the absence of new facts, I decline farther controversy on what that chemist has termed with some truth and despondency, "so feinen Versuchen, wie Isomerie in der organischen Chemie."

Behaviour of Turmeric Paper towards Boracic Acid and Zirconia.—Boracic acid and zirconia redden turmeric paper in a very similar way; but the paper reddened with boracic acid and dried at 100° becomes coloured a beautiful deep blue on being touched with a dilute solution of potash, while that reddened by zirconia is only affected as usual by an alkali. Fluoborate of potash after the addition reddens turmeric like other boron compounds; fluozirconate of potash subjected to the treatment reddens the paper very little, and only at the edges where it is in contact at once with the acid liquid and the air. Vogel and Ludwig have already remarked the action of an alkaline solution on paper reddened by boracic acid.—*Kraut. Zeitschrift für Analyt. Chem.*, p. 168.

[†] *Ann. Chem. Pharm.*, 128, 257.

[‡] *Zeitschr. f. Chemie*, 1865, p. 601.

[§] *Journ. cit*, p. 605.

[||] *Ann. Ch. Pharm.*, 87, 125.

[¶] See my paper referred to, p. 328.

[**] *Ann. Ch. Pharm.*, 133, 206.

[††] See, especially, *Zeitschr. f. Chemie*, 1865, p. 670.

Researches on the Volatile Hydrocarbons,
by C. M. WARREN.

(Continued from page 76.)

As no one had preceded me in the investigation of these substances, my mind was as far as possible unbiassed as to the boiling points of the constituents of these mixtures. I was, however, aware of the beautiful relation between elementary constitution and boiling point which Kopp had discovered, and familiar with the fact that the more recent investigations had shown the boiling point difference among homologous hydrocarbons to be about 22·5°. If there was any one thing which more than another tended to bias me, it was the recent work of Church* on the boiling points in the benzole series, in which he made the boiling point difference invariably 22° and a fraction, a number varying but 3° from the theory of Kopp. Soon after the publication of Church's results, however, Kopp† accepted the number 22·5° as about the boiling point difference in this series, therefore regarding it as one of the exceptional series in which the boiling point difference is greater than 19°. The work of Church had certainly the appearance of having been performed with great care, conducting to a beautiful harmony of results. My confidence in his determination of boiling points was increased not a little by his alleged discovery in coal naphtha of xylole, boiling at 126·2°, indicating a more thorough analysis of this naphtha than those which had been previously published. This body, the supposed middle member of the benzole series, had up to that time been regarded as wanting in coal tar naphtha, although all of the other members, above and below it, were found to be present—an anomaly not easily reconciled with any plausible theory in regard to the formation of these bodies. In view of these circumstances, therefore, I was naturally led, from analogy, to anticipate that the boiling point difference among the hydrocarbons from petroleum and Albert coal would not vary much from 20°. Not being able, however, to reconcile with previous facts and theories on this subject the indications which were being gradually unfolded by my seemingly unerring process of separation, I was compelled to lay aside all bias, and to regard these indications as pointing unmistakably to a much greater difference of boiling point for the addition of C_2H_2 than had previously been supposed to exist in this class of substances.

Having finally established beyond question the common difference of 30° for the addition of C_2H_2 among the hydrocarbons from Albert coal and petroleum (the third series from petroleum, with the difference of 20°, had not then been reached), I began to surmise that this difference might be found to be common among all other series of hydrocarbons. In this connexion my mind naturally reverted to the earlier determinations of the boiling points of the members of the benzole series, some of which, especially those of benzole and toluole, which had been more studied than the others, indicated strongly that 30° might prove to be the true difference for the addition of C_2H_2 in this series. My confidence in Church's determinations thus began to diminish, and finally I undertook to make a thorough analysis of coal tar naphtha, the results of which are given in Table 3. As there shown, the boiling point difference in the benzole series is also 30°, and the number of its members is reduced to four, in place of five, as alleged by Church.

This difference of 30° thus shown to be so common with the hydrocarbons, is so much larger than the difference of 19° which Kopp had found so frequent in other classes of substances, that the discrepancy cannot be regarded otherwise than as conclusive evidence, if such were wanting, that all liquid bodies do not obey the same law in this regard, but that there are unquestionably those series in which the boiling point difference for the elementary difference of C_2H_2 may be greater than 19°, of which Kopp has already furnished some examples.

That the difference may also be less than 19° in some series receives confirmation from the facts presented in the following tables:—

6. *Of the Nitro-Compounds derived from the Hydrocarbons of the Benzole Series.*

Name of Substance.	Formula.	Boiling-point. Degs.	Elementary Difference.	Difference of boiling-point. Degs.
Nitro-benzole .	$C_{12}H_5 NO_4$	212·1	C_2H_2	13·8
Nitro-toluole .	$C_{14}H_7 NO_4$	225·9	C_2H_2	13·4
Nitro-xylole .	$C_{16}H_9 NO_4$	239·3	C_2H_2	
Nitro-isocumole .	$C_{18}H_{11}NO_4$	..		

7. *Of the Alkaloids derived from the Hydrocarbons of the Benzole Series.*

Name of Substance.	Formula.	Boiling-point. Degs.	Elementary difference.	Difference of boiling-point. Degs.
Aniline .	$C_{12}H_7 N$	184·6	C_2H_2	17·1
Toluidine .	$C_{14}H_9 N$	201·7	C_2H_2	
Xylidine .	$C_{16}H_{11}N$	216·0*	C_2H_2	
Iso-cumidine	$C_{18}H_{13}N$	..		

* Not corrected.

In regard to the results presented in the last two tables, it may be remarked, first, that of the difference shown in the table of nitro-compounds—viz., an average of 13·6°, the discrepancy between this and the number 19°, being 5·6°, is so large as to leave no room for reasonable doubt that this is one of those exceptional series in which the boiling point difference is less than 19° for the elementary difference of C_2H_2. As this series does not appear to have been examined by Kopp, I have taken care to make as accurate a determination of the difference as circumstances would allow. The boiling points were corrected as usual for pressure and the upper mercurial column. The boiling points which have already been published of these bodies, so far as I have noticed, appear to have been given in the observed, *i.e.*, uncorrected temperatures. The quantities of nitro-benzole and nitro-toluole which I operated upon were sufficiently large, and of a high degree of purity, presenting perfectly constant boiling points. The quantity of nitro-xylole, however, was not so large as would have been desirable. Although the boiling point of this body is doubtless very nearly correct, those of nitro benzole and nitro-toluole are more to be relied upon; and omitting the fraction, the number 14° may, I think, be safely taken as the true boiling point difference in this series. Secondly, that the less striking difference presented in the series of alkaloids, being only 2° under the number 19°, cannot reasonably justify the assumption that this small discrepancy of 2° is attributable to impurity of the substances, or to inaccuracy in the determination of the boiling points, when it is considered that great care was taken to obtain a high degree of purity and accuracy, and when it is considered also that previous observers have made this discrepancy larger than mine. It was on account of the fact that so small a discrepancy would naturally raise a doubt as to the reliability of the determinations, and for the reason that Kopp has considered this series of alkaloids as agreeing tolerably well with his general law, that spe-

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* *Philosophical Magazine*, 1855, (4), ix., 256.

† *Annalen der Chemie und Pharmacie*, 1855, xcvi., 29.

cial care was taken on my part to arrive at a correct result. I am confident, therefore, that the boiling point difference here will not be found to vary more than a fraction from 17°. Of the absolute accuracy of the boiling points themselves I do not speak so confidently, since these depend so much on the accuracy of the thermometer at these high temperatures; but the correction of any errors which may have arisen from this source would not be likely to alter the relation, and the difference between the boiling points would still remain about the same. This remark applies with equal force as to the reliability of the other boiling points presented in this paper, especially of those of high temperatures.

It remains now to consider the foregoing facts with reference to the other theories mentioned.

(To be continued.)

On the Crystallisation of Sulphur, and upon the Reaction between Sulphide of Hydrogen, Ammonia, and Alcohol, by CHARLES M. WETHERILL, *Ph.D., M.D.*

SULPHUR, in three of its four allotropic conditions, has been well studied, notwithstanding the difficulties which the rapid passage of (γ S) through (β S) to (α S) presents to experiments upon the first two modifications.

The most reliable specific gravities which have been assigned to the different forms of sulphur are the following:—

	Marchand and Scheerer.	Deville.
Rhombic octahedral (α S)	2·045	2·07
Oblique prismatic (β S)	1·982	1·96
The red, amorphous (γ S)	1·957	1·91

Regnault found the specific heat of (α S) = 0·20259, and Marchand and Scheerer that of (β S) = 0·20684. During the passage (γ S) to (α S), a considerable amount of heat is evolved.

Hence in the red amorphous variety, the molecules are more widely separated, and are in a condition of unstable equilibrium. In satisfying their tendency to approach each other, they assume (by the fusion method) the beta form of prisms of the monoclinic system; but they soon pass into the condition of rest as rhombic octahedra (α S), of the trimetric system. This transformation takes place, as is well known, in the solid prism, which is, without change of form, converted into numerous smaller crystals of (α S).

According to Frankenheim, "gamma" sulphur, like other so-called amorphous bodies, possesses the property of crystallisation; but the manifestation of the phenomenon is prevented by the admixture of alpha and beta sulphur. Heat is the agent by which the (α) form is converted into the (β) and (γ) modifications, and has always been supposed to play an important part in the crystallisation of this element. The ordinary or alpha sulphur, when crystallised from its solvents, sulphide of carbon, or oil of turpentine, reappears as octahedral alpha sulphur.

Frankenheim, however, observed that when the body is precipitated from its solutions at a temperature approaching its point of fusion, it assumes the prismatic form of beta sulphur.

Mitscherlich has shown that crystals of (β S) are transformed immediately into (α S) when dipped into a solution of sulphur in sulphide of carbon.

According to Pasteur, both forms of the element may crystallise from the above solvent.

M. E. Royer determined the crystallisation from a turpentine solution, either in α or β crystals, according to the temperature. Thus, when fifteen grammes of sulphur were heated with two hundred and fifty grammes of oil of turpentine, the solution boiled at 158° C. Upon pouring one half of the liquid into a glass vessel, so that a rapid cooling was effected, prisms were deposited; while the remainder cooled slowly, yielded octahedrons, and not a single prism.

Such experiments would appear to present an analogous condition to the prismatic crystallisation by fusion, and subsequent change to the alpha form by rest. By the elevated temperature the molecules of sulphur are separated, and assume the relative positions required for (β S); while, during the slow refrigeration, they have time to arrange themselves into the rhombic octahedral form, in which they are in stable equilibrium.

Each of the allotropic conditions has probably a corresponding vapour density and its own chemical affinities. The only known vapour density is that of (γ S); the others not having been determined from their transformation to this modification by the heat required for the experiment.

Upon the assumption that sulphide of hydrogen has an atomic constitution analogous to that of water, the specific gravity of the vapour of the sulphur in the compound is (by calculation) 2·21126; but Dumas and Mitscherlich determined the density of the vapour of sulphur (γ S) itself to be three times this number, or 6·63378. It has hence been inferred that the hydrogen sulphide is not constituted like water; but is composed of one volume of hydrogen to one-sixth of a volume of sulphur.

If, however, we were acquainted with the true vapour density of (α S), it may be presumed that a calculation involving this element would establish an analogous constitution for sulphide of hydrogen and water, two bodies resembling each other so much in their chemical behaviour.

Otto supposes that sulphur occurs in HS and in most of its combination as (α S), and that perhaps in the persulphides of potassium, &c., and in the sulphur acids which contain two, three, and four atoms of that element, it exists in the condition of β or γ sulphur.

When sulphur is dissolved in the fat oils at a moderate temperature, a large portion of the element separates on cooling as a yellow powder (α S); but if the temperature be elevated, as in the preparation of *balsamum sulphuris*, the sulphur remains in solution, probably as (γ S), and a tenacious gelatinous mass is the result of the reaction (Otto).

This chemist infers that since the vapour density of (γ S) is thrice that of (α S), the specific gravity of the vapour of (β S) is probably double that of (α S). If this assumption be correct, we have in sulphur an allotropism like the polymerism of compound bodies.

From these considerations, the question of the crystalline form of sulphur in the act of separation from any of its compounds becomes one of great interest.

One of these instances, the subject of this article, has been presented accidentally to my notice.

An experiment was instituted to ascertain whether the presence of copper in alkaline solution (ammonia oxide of copper) would determine a decomposition of glucose different from that effected by the alkali alone. The ammonia copper was added to a boiling solution of glucose until the blue colour of the former was no longer discharged. Upon cooling, alcohol was added, and then sulphide of hydrogen was passed through the liquid to separate the copper. On the next morning the filtrate contained a quantity of beautiful prismatic crystals of sulphur, of which some exceeded an inch in length. When spread upon filter paper to dry they become opaque, and broke up readily into granules.

To ascertain whether the products of decomposition of the glucose effected the crystallisation, a litre of 94 p.c. alcohol was, on July 4, 1864, saturated first with ammonia, then with sulphide of hydrogen, and was placed in a loosely stoppered bottle upon a shelf in the laboratory of the Smithsonian Institution, where it remained undisturbed until May 26, 1865.

At this time the sides of the bottle were coated with white, slightly nacreous crystals, which were more numerous upon the part of the bottle most exposed to the light. The formation of these crystals commenced upon the day after the saturation with the hydrogen sulphide. The solution was of brownish deep red colour. The crystals measured one-eighth of an inch in diameter, and, under the microscope, had the appearance of scales or plates, with rounded, ill-defined contour. A few appeared to be hexagonal, and a very few were of spear shape. They were all completely soluble in water, more slowly so in alcohol, yielding a solution of faint acid reaction. They lost ammonia upon being heated with caustic potassa. Their solution treated with sulphuric acid evolved sulphurous acid and deposited sulphur. Heated upon platina foil they evaporated without previous fusion. Their taste was sharp and biting. Heated in a tube they yielded a deliquescent sublimate which contained sulphur. Their solution did not blacken acetate of lead, but gave a white precipitate with this reagent. With nitrate of baryta a white precipitate, insoluble in hydrochloric acid, fell after a short time. With nitrate of silver a precipitate was obtained which passed gradually from white through yellow and brown to black. It follows from these reactions that the crystals are hyposulphite of ammonia. Rammelsberg gives for the constitution of this salt the formula—

$$3(NH_4O,S_2O_2) + HO.$$

(To be continued.)

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

PART II.

THEORY OF TYPES AND ATOMICITY.

SECTION II.—*Application of the Theory of Types.*

(*Continued from page* 77.)

I THINK it should not be forgotten that the theory of types and the notation springing from it are marvellous instruments of explanation and classification, and that the services they have rendered to science arise greatly from the simplicity of the idea and the clearness of the form. These advantages have caused it to be adopted by the authors of the most valuable works on organic chemistry that have appeared within the last few years—viz., by Weltzein in his remarkable "Systematic Table of the Organic Combinations"[*] by Limpricht,[†] in his excellent "Treatise," and above all by Kekulé in his admirable "Treatise on Organic Chemistry."[‡] "But," it will be asked, "is this the only signification of the theory of types? Is it only a convenient expedient to explain reactions? Is it not subordinate to some general principle which is the cause of its existence?" These are important questions and require serious examination.

An eminent chemist some years ago made an attack upon the theory of types which was more serious than it might at first sight have appeared.[§]

"How can we admit," said M. Kolbe, "that nature could restrict herself to form all organic and inorganic combinations in the mould of four substances, chosen at hazard, hydrogen, hydrochloric acid, water, and ammonia, and to produce nothing but variations on these four themes?"

"Further, what natural connexion is there between the majority of organic compounds and water, hydrogen, or hydrochloric acid?"

According to Kolbe, these typical relationships are artificial and arbitrary, and he agrees to consider the organic combinations—that is to say, the combinations of carbon, as being derived from carbonic acid, which is the first source of them.

These objections are not without weight. I have replied to them [||] by showing that the types of hydrogen, water, and ammonia are not chosen at hazard, but represent three forms of combination, between which the theory can establish a connexion. We may in a manner reduce these three types to one, and refer them to hydrogen more or less condensed. Thus water appears as hydrogen doubly condensed in which the diatomic atom oxygen has taken the place of H_2. Ammonia appears as hydrogen condensed three times, in which the triatomic element nitrogen has taken the place of H_3. This idea is expressed by the following formulæ:—

$H\ H$	$H\ Cl$	Hydrochloric acid.
H_2H_2	$H_2\Theta''$	Water.
H_3H_3	H_3N'''	Ammonia.
H_4H_4	$H_4\Theta^{iv.}$	Marsh gas.
H_5H_5	$HCl_4P^{v.}$	Perchloride of phosphorus.
H_6H_6	$Cl_6(Al^{vi}{}_2)$	Chloride of aluminium.

Thus whilst chlorine only possesses the power of replacing one atom of hydrogen, oxygen can replace two, nitrogen three, &c., and these differences in the power of substitution are represented in the preceding formulæ by the accents ′ ″ ‴, &c.[¶]

But oxygen which can replace two atoms of hydrogen, can also combine with two atoms of hydrogen; its power of combination equal to its power of substitution, is double that of chlorine; it is diatomic. Similarly nitrogen which replaces three atoms of hydrogen can also combine with three atoms of hydrogen; its combining power is triple that of chlorine. It is triatomic. We may then say, by giving another and a clearer form to the idea above expressed, that a water type exists because there exists a diatomic element, oxygen, that we are justified in admitting an ammonia type because there exists a triatomic element, nitrogen.[**]

Thus the theory of types is subordinate to a fundamental principle which in a manner governs it, and upon which it depends. No, the types are not chosen at hazard, since they represent forms of combination deter-

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[*] "Systematische Zusammenstellung der organischen Verbindungen." By C. Weltzien. Brunswick. 1860.

[†] "Lehrbuch der organischen Chemie." By H. Limpricht. Brunswick. 1860.

[‡] "Lehrbuch der organischen Chemie oder Chemie der Cohlenstoff Verbindungen." By Dr. Aug. Kekulé. Vol. I. Erlangen. 1859.

[§] See chiefly Kolbe, "Ueber den natürlichen Zusammenhang der organischen mit den unorganischen Verbindungen," etc.—*Annalen der Chemie und Pharmacie*, vol. cxiii., p. 293.

[||] *Répertoire de Chimie Pure*, vol. ii., p. 354, and *Répertoire de Chimie Pure*, vol. iii., p. 418.

[¶] Since 1855 I have sought to point out and define the fundamental principle of the theory of types by showing that the tie which unites them consists in the different powers of substitution possessed by hydrogen, chlorine, oxygen, nitrogen, and phosphorus. I represented tribasic phosphorus by the formula $P\!=\!p_3$ (three small atoms triatomic).—*Annales de Chimie et de Physique*, 3rd series, vol. xliv., p. 305.

[**] Kekulé, "Lehrbuch," vol. i., p. 114. A. Wurtz, "Nouvelles Observations sur la Theorie des Types.—*Répertoire de Chimie Pure*, vol. iii., p. 419.

mined by a fundamental property of the elements; their power of substitution, their combining power, their atomicity. It is evident we might multiply them by following this train of ideas, and carry the number of fundamental types from three to five, as the following table shows:—

HH' Hydrogen.	$H_2\Theta''$ Water.	H_3N''' Ammonia.	$H_4\overset{iv}{C}$ Marsh gas.	$Cl_5\overset{v}{P}$ Perchloride of phosphorus.	$Cl_6\overset{vi}{Al}_2$ Chloride of aluminium.
HCl' Hydrochloric acid.	H_2S'' Sulphuretted hydrogen	H_3Ph''' Phosphuretted hydrogen.	$Cl_4\overset{iv}{C}$ Perchloride of carbon.	$ClH_4\overset{v}{N}$ Hydrochlorate of ammonia.	$\Theta_3\overset{vi}{Al}_2$ Oxide of aluminium.
HBr' Hydrobromic acid.	H_2Se'' Seleniuretted hydrogen	H_3As''' Arseniuretted hydrogen.	$\Theta''_2\overset{iv}{C}$ Carbonic acid.	$IH_4\overset{v}{P}$ Hydriodide of phosphuretted hydrogen.	$Cl_6\overset{vi}{Fe}_2$ Chloride of iron.
$K'Cl$ Chloride of potassium.	$HK\Theta''$ Hydrate of potassium.	Et_3N''' Triethylamine.	$S''_2\overset{iv}{C}$ Sulphide of carbon.	$Et_3Ph\overset{v}{S}$ Sulphide of triethyl phosphine.	$\Theta_3\overset{vi}{Fe}_2$ Oxide of iron.
$Ag'Cl$ Chloride of silver.	$Ag_2\Theta''$ Oxide of silver.	Et_3Ph''' Triethyl-phosphine.	$Cl_4\overset{iv}{Si}$ Chloride of silicium.	$Cl_5\overset{v}{Sb}$ Perchloride of antimony.	$Cl_6\overset{vi}{(C_6H_3)}$ Trichlorated trichloride of benzine.
HEt' Hydride of ethyle.	$HEt\Theta''$ Hydrate of ethyle.	Cl_3As''' Chloride of arsenic.	$\Theta_2\overset{iv}{Si}$ Silicic acid.	$I_2Et_3\overset{v}{Sb}$ Di-iodide of triethylstibine.	$Cl_6\overset{vi}{C}_2$ Sesquichloride of carbon.
$EtEt'$ Ethyle.	$Et_2\Theta''$ Oxide of ethyle.	Cl_3Sb''' Chloride of antimony.	$Et_4\overset{iv}{Si}$ Silicium-ethyle.	$ClEt_4\overset{v}{As}$ Chloride of tetriethylarsine	$H_6\overset{vi}{C}_2$ Hydride of ethyle.
$Et'Cl$ Chloride of ethyle.	Et_2S'' Sulphide of ethyle.	Cl_3Bo''' Chloride of boron.	$Cl_4\overset{iv}{Sn}$ Perchloride of tin.	$Cl_2Et_3\overset{v}{As}$ Dichloride of triethylarsine.	$\Theta''H_4\overset{vi}{C}_2$ Aldehyde.
	$Ca''\Theta''$ Oxide of calcium.	Cl_3Bi''' Chloride of bismuth.	$Et_4\overset{iv}{Sn}$ Stannethyle.	$Cl_3Et_2\overset{v}{As}$ Trichloride of diethylarsine.	
	$(C_2H_4)''\Theta''$ Oxide of ethylene.	Cl_3V''' Chloride of vanadium.	$Cl_4\overset{iv}{Ti}$ Chloride of titanium.	$Cl_4Et\overset{v}{As}$ Tetrachloride of monethylarsine.	
		$Cl_3(C_3H_5)'''$ Trichloride of allyle.	$Cl_4\overset{iv}{Zr}$ Chloride of zirconium.		
			$Br_4\overset{iv}{\begin{bmatrix} C_3H_5 \\ C_3H_5 \end{bmatrix}}$ Tetrabromide of allyle.		

Nothing would prevent us, moreover, from admitting types resulting from the condensation of the preceding, and to combine them to represent compounds of a higher order. Two atoms of aluminium, by joining or combining with each other, acquire a power of combination = 6. Hence the condensed type Al_2Cl6.

The organic combinations might all be derived from the type CH_4.††

But it must be remarked that this type might be referred to the doubly condensed water type.§§

As for the carbonic acid type, as adopted by M. Kolbe, it is confounded with the water type.‖‖

And it is evident that the water type $H_2\Theta$ has this advantage over the type $(C\Theta)'\Theta''$ that it permits the in-

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†† We should also have the following formulæ:—

$$C\left\{\begin{matrix}H\\H\\H\\H\end{matrix}\right. \qquad C\left\{\begin{matrix}H\\H\\H\\Cl\end{matrix}\right. \qquad C\left\{\begin{matrix}H\\Cl\\Cl\\Cl\end{matrix}\right. \qquad C\left\{\begin{matrix}H\\H\\H\\(H\Theta)'\end{matrix}\right.$$

Marsh gas. Chloride of methyle. Chloroform. Hydrate of methyle.

$$C\left\{\begin{matrix}H\\H\\H\\(CH_3.\Theta)'\end{matrix}\right. \qquad C\left\{\begin{matrix}H\\\Theta''\\(H\Theta)'\end{matrix}\right. \qquad C\left\{\begin{matrix}N'''\\H\end{matrix}\right. \qquad C\left\{\begin{matrix}N'''\\(H\Theta)'\end{matrix}\right. \&c$$

Oxide of methyle. Formic acid. Hydrocyanic acid. Cyanic acid.

$$C\left\{\begin{matrix}(CH_3)'\\H\\H\\H\end{matrix}\right. \qquad C\left\{\begin{matrix}(CH_3)'\\H\\H\\Cl\end{matrix}\right. \qquad C\left\{\begin{matrix}(CH_3)'\\\Theta\\H\end{matrix}\right. \qquad C\left\{\begin{matrix}(CH_3)'\\H\\H\\(H\Theta)'\end{matrix}\right.$$

Hydride of ethyle. Chloride of ethyle. Aldehyde. Hydrate of ethyle.

$$C\left\{\begin{matrix}CH_3\\H\\H\\(C_2H_5.\Theta)'\end{matrix}\right. \qquad C\left\{\begin{matrix}CH_3\\\Theta''\\(H\Theta)'\end{matrix}\right. \qquad C\left\{\begin{matrix}(H\Theta)'\\H\\(CH_3)'\\(H\Theta)'\end{matrix}\right. \qquad C\left\{\begin{matrix}(H\Theta)'\\H\\(CH\Theta)'\ \&c.\\(H\Theta)'\ \&c.\end{matrix}\right.$$

Oxyde of ethyle. Acetic acid. Glycol. Glycolic acid.

For the formulæ of the higher series it would be sufficient to replace the group (CH_3) by the more complicated alcoholic groups; and nothing prevents us from decomposing the latter, and from writing ethyle—

$$\begin{bmatrix}CH_2\\CH_3\end{bmatrix} = C_2H_6 - H, \&c.$$

The preceding compounds are saturated; they are derived from the saturated type CH_4. As for those that are not so, they may be referred to the type of carbonic oxide $C\Theta$, which is equal to CH_2.

$$C\Theta \text{ or } C\left\{\begin{matrix}H\\H\end{matrix}\right. \qquad C\left\{\begin{matrix}(CH)'\\H\end{matrix}\right. \qquad C\left\{\begin{matrix}(CH_3)'\\H\end{matrix}\right.$$

Type. Acetylene. Ethylene.‡‡

$$C\left\{\begin{matrix}(C_2H_3)'\\H\end{matrix}\right. \qquad C\left\{\begin{matrix}(C_2H_5)'\\H\end{matrix}\right.$$

Allylene. Propylene.

But it seems to me that such formulæ do not offer any advantage, at least for explanation, over the generally-used typical formulæ. They are less simple, and, after all, they differ less than might be thought. A distinguished chemist, M. Debus, has just proposed for acetic acid the formula given in this system. I may be allowed to remark that the two formulæ

$$\left.\begin{matrix}C\Theta,CH_3\\H\end{matrix}\right\}\Theta \text{ and } C\left\{\begin{matrix}CH_3\\\Theta\\H\Theta\end{matrix}\right.$$

do not differ essentially from each other; the group $H\Theta$, which is shown there (as in those which M. Kolbe employs), only represents the typical residue $H_2\Theta - H$. The group CH_3, exists in both; and the second atom of carbon is in direct connection with the atom of oxygen. Thus, whether acetic acid be referred to the type water or to the type CH_4, almost the same groups are admitted in it; and how could it be otherwise, since both formulæ are founded on the interpretation of the reactions of acetic acid.

‡‡ Formula of Kolbe.

§§ $\left.\begin{matrix}H_2\\H_2\end{matrix}\right\}\Theta_2 \quad \left.\begin{matrix}H_2\\H_2\end{matrix}\right\}C \quad \left.\begin{matrix}\Theta''\\\Theta''\end{matrix}\right\}C$; C^{iv} equals Θ_2, Θ_2 equal H_4

‖‖ $[C_2\Theta_2]\Theta_2$ or $C\Theta''.\Theta$ equal $H_2\Theta''$.

troduction of a single monoatomic group in place of an atom of hydrogen: H_2 is divisible, $(Є\Theta)''$ is not.

However this may be, what we have sought to establish seems to us to be proved—viz., that the principle of the atomicity of the elements forms a natural connexion between the types.

In the following pages we shall seek to define this principle and to show its importance in reference to the general theories of chemistry.

(To be continued.)

PHARMACY, TOXICOLOGY, &c.

Improved Process for the Preparation of Liquor Bismuthi, by A. E. Ebert.*

Take of subcarbonate of bismuth a troy ounce; citric acid, in powder, 420 grains; nitric acid, sp. gr. 1·42, a troy ounce and a-half; pure caustic potassa, 450 grains; distilled water and alcohol, each a sufficient quantity.

Dissolve, by gradual addition, 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; now add the citric acid, and stir until it is dissolved. In eight fluid ounces of distilled water dissolve the caustic potassa, and add this gradually to the acid solution. Permit the mixture to stand for six or eight hours, then transfer to a moistened paper filter, and wash the precipitate until the washings no longer contain nitrate of potassa. Transfer the still moist magma to a dish, and add, very gradually, water of ammonia until the precipitate is dissolved, and a neutral solution is obtained. Dilute this solution with an equal volume of distilled water, and treat half a fluid-ounce of the liquid with hydrosulphate of ammonia, in slight excess; wash the precipitate on a tared filter, dry on a water-bath, and weigh. Multiply the weight of the sulphide of bismuth by the fraction ·908, to determine its equivalent in teroxide of bismuth. Apply the same ratio to the remainder of the liquid, and dilute it to such an extent that a fluid drachm shall contain one grain of teroxide of bismuth, seven-eighths of which measure must be made up with distilled water, and the remainder with alcohol. The average product of liquor bismuthi, from a troy ounce of subcarbonate of bismuth, was fifty fluid ounces, indicating a loss of bismuth amounting to 7·6 per cent.

This loss is occasioned by the slight solubility of citrate of bismuth in the washings, and though this portion may be recovered, it is too small in amount to compensate for the time and trouble necessarily expended in its separation.

Chicago, December, 1865.

New Test for Uric Acid.—Dr. Dietrich has remarked that when a bromated alkaline solution of hypochlorite of soda, is added to urine, an intense rose-red colour is produced. The colour disappears after some time, and quickly on the addition of more of the bromated solution. It probably, he says, depends on the formation of alloxantin. The experiment answers well with serpents' dung, but is difficult to recognise with pigeons' dung and guano, because the substances themselves are of a dirty-brown colour. This test may, in many cases, replace the murexide test, since it is made with little trouble and in a short time. — *Zeitschrift für Analyt. Chem.*, p. 176.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 15.

Professor E. Frankland, *Ph.D., F.R.S., in the chair.*

The minutes of the previous meeting were read and confirmed, and the library donations duly announced. Mr. Franklin Epps, Mr. Theodore Maxwell, and Mr. William Thorpe, were formally admitted Fellows of the Society; and the following gentlemen were duly elected—viz., Mr. Mr. G. B. Ferguson, B.A., Magdalen Hall, Oxford; Mr. Benjamin Nickels, Ripponden College, near Halifax; and Mr. W. H. Walenn, Talbot Road, Tufnell Park West. The names of candidates proposed for the first time were —Mr. Samuel Crawley, St. Peter's College, York, and Mr. C. Patmore Phillips, Fenchurch Street. For the second time were read the names of Mr. W. H. Cawfield, Pembroke College, Oxford; Mr. Robert Bell, Professor of Chemistry, Queen's College, Kingston, Canada West; and Mr. G. W. Webster, Bridge Street, Warrington.

The Council's proposition referring to the removal from the list of Fellows of the names of those who had allowed their subscription to the Society to lapse for three years and upwards, was read for the third time, and the ballot taken, which declared unanimously for the removal of the said Members. The names in question are—Messrs. H. Brunner, J. Christian, Samuel Highley, T. Ludwig, John Mitchell, P. McOwen, James Napier, jun., H. C. Salmon, W. V. Simons, C. A. Sauceau, A. N. Tate, and Dr. Kirkpatrick.

The programme relative to the election of officers for the ensuing year was announced. Among the Vice-Presidents, the name of Professor F. A. Abel would be substituted for Mr. Robert Warington, who retires; and for Members of Council, Mr. Crookes, Mr. Field, Dr. F. Crace Calvert, Dr. Noad, and Dr. Letheby, in place of Messrs. Buckton, Duppa, Lawes, and C. Greville Williams.

Mr. Ernest T. Chapman read a paper on "*The Action of Nitrous Acid upon Naphthylamine.*" Referring to the previous researches of Messrs. Perkin and Church upon azodinaphthyldiamine, the author stated that he could not succeed in obtaining this red base (which turned violet on the addition of acids) by acting upon dinitronaphthyline alone with nascent hydrogen, but since the above-mentioned authors had amended their formula from $C_{10}H_8N_2O$ to $C_{20}H_{15}N_3$ (*vide Journal of Chemical Society*, vol. i., p. 207) it did not seem possible that such a compound could be formed in this manner. Mr. Chapman had, however, succeeded in producing the substance by acting upon two equivalents of naphthylamine with one of nitrous acid in the presence of an alkali, according to the later instructions of Messrs. Perkin and Church, and its formation was thus explained:—

$$2(C_{10}H_9NHCl) + KNO_2 + KHO = C_{20}H_{15}N_3 + 2KCl + 3H_2O.$$

The solutions should be cold and dilute to ensure success, and the substance takes the form of a white precipitate, gradually changing to scarlet. This body has been discovered by the author amongst the products of the action of zinc ethyl upon a mixture of nitro- and dinitronaphthyline, and it was only necessary to treat this last-named mixture in alcoholic solution with hydrochloric acid and zinc to develope immediately the splendid violet colour of azodinaphthyldiamine. The nascent hydrogen having reduced the nitronaphthyline to naphthylamine, the body in question is formed with elimination of water, thus:—

$$C_{10}H_8N_2O + C_{10}H_9N = C_{20}H_{15}N_3 + H_2O.$$

The author then proceeded to describe the physical properties and means of purification adopted in the case of several products resulting from variations in the relative proportions of nitrous acid and naphthylamine. Difficulties were experienced in the removal of impurities from some

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[*] *American Journal of Pharmacy.*

of these by reason of their uncrystallisable characters. The author believes he has established the existence of a body having the formula $C_{20}H_{10}N_4O_5$, the production of which is thus explained—

$$2(C_{10}H_9N)+6HNO_2=C_{20}H_{10}N_4O_5+N_4+7H_2O.$$

Drs. Frankland and Odling having offered some remarks favourable to the author's views,

Dr. Hugo Muller inquired of Mr. Chapman whether he had noticed any indications of the existence of an intermediate compound between that just now described and the dinitronaphthyl-alcohol of Dr. Martius, which was isomeric with alizarine.

Mr. Chapman replied to the effect that his new body was formed in aqueous solutions only: he had obtained some intermediate products, which were colourless, but they had not yet been examined.

Mr. James S. Brown explained the principles upon which he had constructed *Tables for the Calculation of Vapour-Density Determinations.*

Dr. Frankland, in presenting a vote of thanks to Mr. Brown, said they would supply a great want. He did not remember any tables of this kind having appeared since those of Prof. Marchand, which had proved to him very serviceable in times past.

A paper "*On the Action of Heat on Ferric Hydrate in Presence of Water,*" by Mr. Edward Davies, was read by the Secretary. The author's experiments conclusively establish the fact of water being expelled from the ferric hydrate by long-continued heating in contact with water. The formula of the precipitated hydrate, as usually prepared, is Fe_2O_3,H_2O, and it contains 10·11 per cent. of water. Of this amount varying proportions, usually about one-half, were driven out by exposure to temperature varying from 50° to 100° C., the effect of the more moderated degrees of temperature being compensated by longer duration of the experiment. Thus the product of the action of ammonia upon ferric chloride, without washing, was boiled in water for a hundred hours, and then collected and dried at 100° C. It retained 4·05 per cent. of water—an amount identical with that existing in a product which had been digested for a thousand hours in water maintained at 50° to 60° C. When precipitated by the fixed caustic alkalies, ferric hydrate gradually underwent the same change, but did not lose water so speedily. The colour of the product was generally a brick-red, and its specific gravity rose as high as 4·545, red hæmatite being 4·7 sp. gr. The author concludes that the natural beds of ferric oxide ore may have been deposited from aqueous solution, and become subsequently dehydrated by long exposure to moderate heat. The gelatinous aluminic and chromic hydrates did not suffer any loss of water under similar circumstances. They were said to contain three and five equivalents of water respectively.

Dr. Odling did not consider the existence of a penthydrate of chromium sufficiently established; but, on the other hand, he thought that Mr. Davies' results would warrant an expression by formula of the lower ferric hydrate—thus, $2Fe_2O_3,H_2O$.

An abstruse theoretical paper, entitled "*The Prognosis of Alcohols and Aldehydes,*" by Professor H. Kolbe, of Leipsig, was read by the Secretary, and commented upon by Dr. Frankland and Professor Wanklyn. The last-named speaker having stated his belief that the "oxide of mesityl," which Sir Robert Kane obtained by the action of hydrochloric acid upon acetone, was really one of the double ketones, the existence of which Kolbe predicts,

Sir Robert Kane humorously confessed he did not recognise his own children in the diversity of envelopes in which they were now presented to him. With regard to the action of hydrochloric acid upon pure acetone, he had come to the conclusion that *two* bodies were formed, the boiling points of which were respectively 170° and 230° Fahr., one of which might possibly be identical with M. Frémy's metacetone. He had been lately engaged in a re-examination of these bodies, and hoped soon to be able to report further results.

The Chairman having made a statement in confirmation of Sir R. Kane's original views, moved a vote of thanks to the authors of the several communications, and adjourned the meeting until March 1, when a paper entitled "*Contributions to our Knowledge of the Action of Sunlight upon Sensitive Photographic Papers,*" by Charles R. Wright, B.Sc., of Manchester, will be read.

PHARMACEUTICAL SOCIETY.

Wednesday, January 7.

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

(Continued from page 81.)

Mr. Haselden read a paper "*On Gelatine as a Material for Capsuling Bottles.*" He began by reading an extract of considerable length from an article in *Temple Bar*, entitled "Patents and Patentees," in which the story of the litigation in the matter of Betts' patent metallic capsules is very well told. The article, after telling this story, goes on to suggest an efficient substitute for metallic capsules as follows:—

"We beg leave to suggest to them a most efficient substitute for the patent metallic capsule—namely, gelatine, applied precisely in the same way as sealing wax or rosin—that is to say, in its melted condition, the top of the bottle being dipped into it. It is obvious that by repeated dippings after cooling any thickness of capsule may be effected.

"We must observe, however, that gelatine is too brittle when used alone; but fortunately science suggests a ready and effectual 'alloy,' acting precisely like the lead of existing metallic capsules. This alloy is glycerine—that curious substance of which we may say that it is impossible to decide to what purpose it may not be applied. The proportion in which it may be added to the melted gelatine, to give it pliability and toughness, is about one ounce and a-half to the pound of the latter, well stirred in.

"Of course, any colours may be given to these capsules, either for ornament or to distinguish readily the various liquids or other preparations.

"In hot climates there are voracious insects that attack and eat everything—and of course they are fond of all animal matter—so that the gelatine capsule will be endangered. But here again we are ready with the remedy. Bitter aloes and other repellants may be added to the melted mass to secure this opportune rival from those tropical plagues, whilst it rescues its users from the worst of all plagues—the law, lawyers, and inexorable 'patent-rights.'"

Mr. Haselden exhibited a variety of bottles capsuled in various styles with gelatine—some with the corks standing up and tied over with gutskin, or leather before dipping in the gelatine; others with the corks cut flush with the mouth and not tied over. All of these had a pleasing and even elegant appearance. The plan the author recommended was to melt the gelatine in as little water as possible, and then to add the glycerine. The colour could be given by any convenient material, such as white lead, vermilion, or gamboge. A transparent solution could also be used, and then any trade mark might be fixed on the cork before dipping in the gelatine. Three dippings he had found were sufficient to give a firm protective covering. As regards the cost, he believed it was not equal to that of the metallic capsules.

In answer to a doubt expressed that the gelatine capsules would not resist moisture, Dr. Redwood mentioned that copaiba capsules withstood damp well, and suggested that a dip in a solution of tannic acid might render the capsules more repellent. He stated also that gelatine absorbed three or four times its weight of water, and suggested that the best way of preparing the solution would be to cover the gelatine with water, leave it standing for a night, pour off the water not absorbed in the morning, dissolve by heat, and then add the glycerine.

A vote of thanks to Mr. Haselden was passed unanimously.

Professor Bentley then read a paper "*On a New Adulteration of Saffron.*" After referring to the ordinary adulterations of saffron, and the temptation to make use of them, 60,000 flowers being required to furnish 1 lb. of true saffron, the Professor stated that two Spaniards had recently offered some quantity of the drug for sale, samples of which had been sent to the Society for examination. The article closely resembled genuine saffron in colour, and in odour; but the odour was not so penetrating, and was somewhat peculiar. On placing a little in cold water, however, a great difference was immediately remarked. Genuine saffron yielded its colour to water slowly, but the sample under examination gave up its colour immediately. Structural differences were also perceived after maceration in water; and, in short, the Professor soon discovered that the sample consisted in part of genuine saffron—the stigmata and part of the style of *crocus sativa*,—but for the most part consisted of the stamens of the same flower dyed with some orange-yellow colouring matter, possibly that of saffron itself, but probably some other material, the exact nature of which the Professor had not yet determined. The adulteration is easily detected from the circumstance that the stamens have the anthers attached, and pollen granules separate and deposit on soaking in water, and are easily recognised by the microscope. The Professor has recognised the same adulteration in other specimens of saffron, but not to the same extent. One was in the Exhibition of 1862, and the other was twenty years old. He was at one time disposed to believe that the mixture of the stamens was accidental; but the quantity present, and the fact of their being dyed, proved conclusively that their presence was a fraudulent adulteration. In conclusion, the Professor remarked that the existence of a fraud like that now exposed showed clearly the value of knowledge of botany to pharmaceutists.

After passing a vote of thanks to Professor Bentley, the meeting adjourned.

SOCIETY OF ARTS.

CANTOR LECTURES.

"[illegible] of the most important Chemical Discoveries made within the last Two Years."

By Dr. F. Crace Calvert, *F.R.S., F.C.S.*

Lecture 6.

Tuesday, May 16, 1865.

Recent Researches on Metals and Alloys.

The importance of the subject which I intend to bring before you this evening is so extensive, that it ought to be the subject of a series of lectures instead of attempting to condense it into one, and, therefore, I shall only give a *resumé* of some of the discoveries which have been made during the last two years.

You are probably all aware that England occupies the first position among nations as a source of mineral wealth, and to enable you to appreciate the truth of this assertion, allow me to cite a few figures, published by Mr. Robert Hunt, F.R.S., the keeper of mining records of the Royal School of Mines. In 1863 the value of minerals produced was 29,151,976*l*., from which metal of the value of 16,364,327*l*. was extracted. There were produced—

Tin ore	15,170	tons
Copper ore	212,947	,,
Lead ore	91,283	,,
Silver ore	88	,,
Zinc ore	12,941	,,
Iron ore	3,500,000	,,

Further, it is interesting to compare the results given by Mr. Hunt in 1858 with the above, for we find that the mineral wealth of England has nearly doubled in five years, for in 1858 the value of the metals produced amounted only to 18,105,708*l*. I must not omit to state that, during the last few years, England has also taken the lead in the manufacture of aluminium (Jno. Bell and Co., manufacturers, Newcastle) and magnesium, by Messrs. Mellon and Co., Salford, who have adopted the method proposed by Mr. Sonstadt. As to the four new metals which have been of late discovered, viz., cæsium, rubidium, thallium, and indium, they are as yet but scientific curiosities, but as their discovery is due to spectrum analysis, I shall refer to them more especially when treating of the method by means of which the discovery of these metals has been made, an illustration of which I shall be able to give, through the kindness of Mr. Ladd, who will show you the various spectra on the screen at the conclusion of the lecture.

Since I had the pleasure of drawing your attention last year to the then novel application of magnesium to the art of photography, owing to the intense light which that metal produces (for it has been calculated to he equal to $\frac{1}{524}$th part of that of solar light, and has been seen at a distance of twenty-eight miles at sea, and also to its intense actinic power), Mr. Bultinck has proposed the substitution of this metal for zinc in galvanic batteries, and states that he believes the substitution would prove a very advantageous one to electricians. The employment of this metal will be greatly facilitated by the large works which have been erected for its manufacture at Boston, in America.

Although Mr. Faraday observed many years ago that light was transmitted through thin leaves or sheets of the following metals: platinum, palladium, rhodium, gold, silver, copper, tin, lead, iron, and aluminium, still we were not prepared for the interesting results that Mr. Quincke has obtained and published in the *Philosophical Magazine* for March, 1864. That gentleman endeavoured to determine directly the velocity with which light travels through metals, and he found, strange to say, that it travels faster through gold and silver than through a vacuum. Further, he adds that he was unable to detect any difference in the components of the light which had previously passed through transparent substances, such as plates of glass. The comparative rapidity of light in passing through metals and a vacuum appears to me to be in favour of the new theory of light, which I took the liberty of expounding to you in my first lecture. Although we could conceive the passage of light through a thin film of metal, still chemists were astonished when M. Henry St. Claire Deville, whose name I have had the pleasure of often citing in these lectures, published, conjointly with M. Troost, some interesting papers on the porosity of substances under the influence of high temperatures. His experiments enabled him to show that even platinum and wrought iron tubes, the latter one-eighth of an inch thick, are, when carried to a high temperature, permeable to gases. The importance of these results cannot be overrated by chemists when the permeability of platinum is considered, as that metal has been employed by them under the conviction that its high density and mode of manufacture destroyed all porosity. As to iron, the knowledge of that fact is most important, especially in the manufacture of coal-gas, where iron retorts are used for distilling the coal. So complete is the permeability of iron at a high temperature, that an iron tube which had been filled with hydrogen gas before the experiment was found to contain only a trace of it at the end of a few hours.

Considering the short space of time which I have at my command, I can only state that you will find in the Royal Society's *Transactions* (vol. clii., part 1, page 1) a most elaborate paper on "The Influence of Temperature on the Electrical Conducting Power of Metals," and also vol. cl., part 1, page 85) on "The Conductibility of

Copper." These researches of Dr. Matthiessen deserve the close attention of all electric telegraph engineers.

The study of metals must convince every student that, although science has progressed in a marked manner during the last fifty years, still that there is a great deal more to do than has been done. Although we have known copper, zinc, lead, tin, and iron for many centuries, still hardly a month passes without new properties of these metals being discovered, or facts connected with the improvement of their manufacture or the removal of the impurities they contain. I, therefore, deem it my duty to advert to a few papers that have been published recently respecting certain impurities which particular metals contain, which impurities, in some instances, enhance the value of the metal, and in others lower their commercial value. No class of substances teaches the young chemist the difficulties and the labours he must be prepared for, if he wishes to be what is technically termed a good operator, and if he pretends to prepare a pure substance. I would, therefore, advise all young men studying chemistry, carefully to read the labours of J. S. Stas on "The Determination of the Equivalents of Chlorine, Sulphur, Nitrogen, Silver, Potassium, Sodium, and Lead," published in the *Moniteur Scientifique* of 1861 and 1864, where they will notice that Stas has spent months of time to obtain a few ounces of *pure* silver, lead, &c.

Copper.—The same may be said of the researches of Matthiessen to obtain pure copper, for his studies above alluded to have enabled him to state that there is no alloy of copper which conducts electricity better than pure copper (page 92 of the above memoir), for he found that the most minute quantities of arsenic, phosphorus, sulphur, selenium, tellurium, and oxygen diminished the conducting power of that metal. Whilst on the impurities of copper, I must not fail to mention some valuable additions which Messrs. Abel and Field have published in the *Journal of the Chemical Society of London*, on the means of determining various impurities which copper contains; thus they found sometimes traces, and sometimes several per cent. of the following impurities in many samples of commercial copper, silver, arsenic, antimony, bismuth, lead, tin, and iron (see Tables, vol. xiv., page 302), and Mr. Abel in a paper inserted in the same journal in 1864, proved that copper contained sulphur, as a general constituent, but only in minute quantities; selenium, as an occasional constituent; and that oxygen was always present and sometimes in considerable proportion; thus, in dry copper he found the quantity of oxide of copper, not as Messrs. Dick and Percy have stated, from 10·21 to 9·34 per cent., but from 3·77 to 4·56 per cent. Mr. Abel gives the following numbers as representing the average proportion of oxygen obtained with a series of samples taken in diverse stages in the manufacture of copper:—

	Oxygen per cent.
"Dry" copper	0·42
Ditto (another specimen)	0·50
"Half-poled" copper	0·20
"Tough-pitch" ,,	0·03
"Over-poled" ,,	0·03

Iron.—As far as our present day's knowledge extends, no metal is more influenced than iron, either for good or for bad, by the presence in it of a minute quantity of another element; thus a few thousandths of carbon transform it into steel, and a few per cent. of the same element converts it into cast-iron; a few thousands of sulphur, or a few per cent. of silicium, renders iron "red-short"—that is to say, brittle at a red heat—whilst the same quantity (thousandths) of phophorus makes it "cold-short," or brittle at natural temperature. These facts explain why iron smelters and manufacturers do all in their power to use ores as free as possible from these impurities, or apply all their skill to remove them from the ores or metal when present. I am, therefore, satisfied that all iron smelters will appreciate the value of the following facts published by M. Caron in the *Comptes Rendus* of the Academy of Sciences of 1863, on the influence of manganese when used on the blast furnace to remove silicium from cast-iron. The following table shows the relative quantity of manganese and silicium existing in the cast-iron thus produced:—

	Manganese.	Silicium.
No. 1	7·93	0·05
,, 2	6·32	0·08
,, 3	4·70	0·30
,, 4	3·81	0·55
,, 5	2·25	0·76
,, 6	3·90	0·50 cold blast.
,, 7	2·10	0·75 hot blast.

This table shows that as the quantity of manganese decreases in the pig iron the quantity of silicium increases; further, that the higher the temperature (all the rest of the operation being conducted in the same manner), the quantity of silicium increases and the manganese decreases.

M. Caron has further made the important remark, that it is the interest of the iron-smelter to use as much lime in the blast furnace as practicable when manganiferous ores are employed, for not only does lime facilitate the introduction of manganese into the iron, but also helps in a marked degree to remove the excess of silicium.

Eight or nine years ago I made the observation that if manganese had not the property of removing phosphorus from iron, it had the one of hiding or of counteracting the bad influence of that element on iron; in fact, I found that cast-iron, containing as much as one or two per cent. of phosphorus, would yield good mercantile iron if the pig iron contained at the same time five or six per cent. of manganese, and I have lately heard that manganiferous ores have been used with great advantage by the Cleveland iron smelters to overcome the "cold shortness" of their cast-iron, which is due, as is well-known, to the presence of phosphorus compounds in the Cleveland iron ore.

It is highly probable that the advantages which have been derived from the employment of "spiegeleisen" iron, in improving the quality of steel produced by Bessemer's process, is owing, not only to the fact that this peculiar iron contains a large quantity of carbon, which it yields to the molten iron contained in the large crucible used in Bessemer's process, but that the manganese it contains contributes also to hide the influence of the phosphorus or to overcome the detrimental properties which a trace of phosphorus would impart to the steel produced by this process. I say hide, because the phosphorus is still present, since that substance cannot be removed by the above process from any pig iron in which it may be present.

M. Caron has published in the *Technologiste* for 1864 a paper in which he shows that no amount of lime on the blast will remove phosphorus from any ore which may contain it; and that tin-plate manufacturers and others who employ charcoal iron, should pay the greatest attention to the quantity of phosphorus contained in the charcoal they employ for refining ordinary iron; thus some charcoals are susceptible of yielding as much as 1 per cent. of phosphorus to iron, whilst others only 0·12 per cent., and lastly some only a trace.

If phosphorus, sulphur, and silicium are injurious to the quality of iron, the metal called tungsten, on the contrary, appears to improve in a marked degree its quality, especially when in the state of steel. This fact has not only been demonstrated beyond all doubt by Mr. Mushet, but also recently by some scientific researches due to M. Caron, who has proved that steel containing tungsten presents greater tenacity, and can be used with great advantage for many purposes; in fact, he thinks that tungsten can be used instead of carbon as a converter of iron into steel. There can be no doubt that the employment of tungsten in connection with the hardening of steel, and other various applications which that metal is susceptible of, will be greatly enhanced if the fact stated in the Chemical News of August 25th is brought to bear, viz., that a Swedish chemist has found a simple and practical method of extracting tungsten from its ore so as to reduce its cost of production to a few shillings per pound.

Mr. R. Johnson and myself have published a paper in the Memoirs of the Royal Society, in which we showed that the conductibility of iron was greatly modified by the quantity of carbon it contained, as proved by the following table:—

	Found.	Conductibility of silver = 1000.
Wrought iron . . .	13·92	436
Steel	12·65	397
Cast iron	11·45	359

We also found that the hardening of steel had the greatest influence on its expansibility, for whilst a steel bar, hardened to the maximum, expanded to a degree which may be represented by 84, the same steel rendered as soft as possible, expanded only 62.

(To be continued.)

ACADEMY OF SCIENCES.

February 12.

M. Pelouze read a memoir "*On the Composition of Soda made from Chloride of Sodium by Leblanc's Process.*" The author does not believe in the formation of an oxysulphide of calcium, thus agreeing with Messrs. Gossage and Kynaston. The memoir is of considerable length, so we only give the author's *resumé*. His analyses and a study of the reactions of the different substances, he says, have led him to the following conclusions:—1. That black ash is a mixture of carbonate of soda, sulphide of calcium, carbonate of calcium, and free lime. 2. The ash, on *prolonged* contact with water, hot or cold, gives an amount of caustic soda proportional to the free lime the ash contains, and then the lime in the waste is completely neutralised by sulphydric and carbonic acid. But (3) as the waste obtained in the ordinary process of manufacture has not been placed in circumstances to ensure the complete reaction of the lime on the carbonate of soda, such waste usually contains free lime. 4. Any black ash being given, free lime may be left in the waste or not, just as the lixiviation is managed. And he adds (5) that nothing has yet demonstrated the existence of an oxysulphide of calcium, nor any other compound of lime and sulphide of calcium.

M. Corenvinder presented a memoir entitled "*Chemical Researches on Vegetation: Functions of Leaves.*" The author adds little to what M. Boussingault has recently published. He confirms to some extent an opinion expressed by Saussure, that leaves constantly evolved carbonic acid day and night, for he states that buds and leaves also in their earliest stages of development give off carbonic acid in full sunlight, the amount of oxygen given off at the same time gradually increasing with their growth. He adds that the adult leaves of plants kept in a dull lighted room give off more or less carbonic acid during the day.

M. Bertrand de Lom communicated a note, "*New Geological and Mineralogical Facts concerning Various Deposits of Phosphate of Lime.*" The author, or rather M. Damour for him, has discovered phosphate of lime in basalt. It has also been discovered in granite, and the author contends for an "eruptive origin" for the phosphate in general.

M. D. E. Splitberger presented a note "*On the Colouration of Glass,*" giving an analysis of a yellowish-brown glass which contained free sulphur, to the presence of which the author attributes the peculiar colour.

NOTICES OF BOOKS.

Zeitschrift für Analytische Chemie. Edited by Dr. C. R. Fresenius. Vol. 4. No. 2. 1865.

This number opens with a paper "*On Volumetric Gas Analysis, with especial reference to Carbonic Acid,*" which gives some useful tables, which must have been compiled with great labour. Table 1 gives in milligrammes the weight of a cubic centimetre of carbonic acid at temperatures between 10° and 25° C., with a barometrical pressure between 720 and 770 millimetres. Another table gives the volume of carbonic acid absorbed by a given volume of hydrochloric acid in proportion to the amount disengaged. These tables will be found of great use in calculating results.

The next paper is by Mitscherlich "*On the Use of the Spectroscope in the detection of small quantities of Chlorine, Bromine, and Iodine*"—a paper we have already published.

M. Weyl communicates a "*Process for Estimating Carbon in Steel.*" The author's original process, which answers well for some kinds of iron, is not altogether applicable for steel, and a modification is here suggested which obviates the disadvantages. On this subject we have another paper by Rinman, who shows that the carbon is brought into solution when hardened steel is dissolved in hot hydrochloric acid. We shall give both of these papers at length.

Stolba makes some further contributions to analytical chemistry. The first is a process for the separation of magnesia from potash and soda; and the second a process for the volumetric determination of silica. Both are troublesome, and of little practical value.

K. Kraut has a paper "*On the Behaviour of some Phosphates towards Cobalt Solutions in Blowpipe Experiments,*" in which he shows that all phosphates do not give a blue glass—some giving a more or less violet bead. The same author makes a short communication "*On the Action of Boracic Acid and Zirconia on Turmeric Paper,*" which will be found in another place.

Some papers on physiological chemistry succeed, of which we need only quote the titles: "*On Kreatin and Kreatinin,*" by Nawrocki; "*On Myelin,*" by Liebrich. Dr. Dietrich communicates "*A New Reaction of Uric Acid,*" which will be found elsewhere.

The editor (Fresenius) publishes a valuable paper "*On Drying Gases by the Ordinary Means,*" in which he shows that gases are only imperfectly dried by passing over lime dehydrated sulphate of copper, fused chloride of calcium, and through strong sulphuric acid, some moisture after all being retained by phosphoric anhydride. He shows also that air dried by means of phosphoric acid takes up no water from strong sulphuric acid; while gas dried by strong sulphuric acid will take a small amount of water from moist chloride of calcium.

The next paper is by Braun, "*On the Transformation of Picric into Picramic Acid and on the Recognition of Grape Sugar,*" to which we shall return for a useful test.

The continuation of a paper by Gauhe, "*On the Estimation of Cobalt and Nickel,*" succeeds, this part being devoted to a short review of the ordinary methods of estimating nickel.

The rest of the number is devoted to the usual reports on the progress of analytical chemistry.

Pictures in the South Kensington Museum.—A commission, consisting of the Master of the Mint (Professor Graham), Professor Tyndall, Dr. Percy, Dr. Frankland, Lieut.-Colonel Scott, R.E., and Captain Donelly, R.E., has been appointed to inquire into the cracking and gradual destruction of the pictures in the South Kensington Museum. The committee seek evidence from all possessors of pictures and others competent to give it,

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

3374. E. J. Hughes, Manchester, "Improvements in the manufacture of aniline green." A communication from C. Lauth, Paris.—Petition recorded December 29, 1865.

70. J. M. Macrum, Hill Street, Knightsbridge, Middlesex, "Improvements in the apparatus and process for distilling oils and other liquids." A communication from J. Johnston and J. Davis, Alleghany, Penn., U.S.A—January 9, 1866.

121. B. Todd, Victoria Terrace, Newcastle-on-Tyne, "Improvements in the manufacture of arsenic."—January 13, 1866.

162. M. F. Anderson, Much Park Street, Coventry, "Improvements in refining sugar."—January 17, 1866.

200. C. G. Penney, Greenwich, "Improvements in the treatment and utilisation of certain waste products resulting from the combustion of boghead, cannel, and other coals and minerals, and for the treatment of china clay and other analogous substances."

210. J. Stringer, Kidderminster, and G. Birch, Halifax, Yorkshire, "Improvements in printing yarns."—January 22, 1866.

269. T. Drane, Cockermouth, Cumberlandshire, "Improvements in the manufacture of coke, and in the apparatus connected therewith."—January 27, 1866.

300. W. R. Lake, Southampton Buildings, Chancery Lane, "Improvements in working and treating india-rubber, gutta-percha, and other similar gums." A communication from F. Marquard, Rathway, New Jersey, U.S.A.

302. J. Miller and J. Pyle, Glasgow, "Improvements in apparatus for cooling worts or other liquids."—January 31, 1866.

319. J. B. Grant, Euston Road, Middlesex, "Improvements in apparatus or machinery for distilling and refining petroleum and other oils."—February 1, 1866.

341. J. Holliday, Huddersfield, "Improvements in the manufacture of red colouring matter or dye."—February 3, 1866.

349. C. D. Abel, Southampton Buildings, Chancery Lane, "Improvements in coke ovens." A communication from J. Bowers, Connellsville, Fayette, Penn., U.S.A.—February 5, 1866.

Notices to Proceed.

2535. R. A. Brooman, Fleet Street, "Improvements in apparatus for decomposing and superheating liquids, vapours, and gases." A communication from G. Renard, St. Ouen, and A. Lipman, Paris.—October 3, 1865.

2592. J. B. Thompson, Rothwell Street, Regent's Park Road, Middlesex, "Improvements in coating iron and steel with gold, silver, platinum, or copper."—October 7, 1865.

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.—October 16, 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.

2564. J. Holliday, Huddersfield, "Improvements in preparing violet, blue, and red colouring matters."—October 6, 1865.

2590. T. Campbell, Jamaica, "Improvements in evaporating and distilling liquids, and in the apparatus employed therein."—October 7, 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.

3095. E. B. Wilson, Edinburgh, "Improvements in furnaces."—December 2, 1865.

3208. C. K. Tomlinson and C. J. Hayward, High Street, Lincoln, "Improvements in the preparation of the invention of sheep ointment."—December 12, 1865.

97. C. Crump, Yealmpton, Devonshire, "Improvements in the preparation of tetra-chloride of carbon."—January 11, 1866.

CORRESPONDENCE.

The Cavendish Society.

To the Editor of the Chemical News.

Sir,—March is approaching, and the annual farce—as it really has been for the last few years—of a meeting of the Cavendish Society will be repeated. What report the directors will make this year it is easy to guess. The German edition of Gmelin is still incomplete, and as far as I can learn it is likely to remain incomplete. May I suggest once more that the Council should commission Mr. Watts to finish the book, bringing the matter up to a recent date? Then, as I have said before, a new Cavendish Society may be started, and something better done for the subscribers. I am, &c.

A Subscriber to the Cavendish.

Manchester, February 13.

MISCELLANEOUS.

Chemical Society.—The next meeting will be held on Thursday, March 1, at 8 o'clock, when the following papers will be read:—"Chemical Action of Sunlight," C. R. Wright, B.Sc.; "New Cornish Minerals," Professor Church.

Royal Institution of Great Britain.—The following are the arrangements for the week:—Tuesday, February 27, and Thursday, March 1, at 3 o'clock, Professor Frankland, F.R.S., "On the Non-Metallic Elements." Friday, March 2, at 8 o'clock, G. Scharf, Esq., F.RS., "On Portraiture; its Fallacies and Curiosities as connected with English History." Saturday, March 3, at 3 o'clock, Rev. G. Henslow, "On Systematic and Structural Botany."

Mr. Worms' Cure for the Rinderpest.—Take a pound of small red pickling onions, and a pound of garlic, peel them, put them together into a mortar, and reduce them to a fine pulp; to this pulp add a pound of ground ginger, and mix thoroughly. Take three-quarters of a pound of assafœtida, pour sufficient water over it to cover it, then allow it to boil till no sediment remains, carefully removing all hard portions. Pour this decoction of assafœtida over the pulp of onions, garlic, and ginger, and stir the whole mass thoroughly; add to this eight quarts of rice water, and allow it to cool. This is sufficient for fourteen full-grown animals. Sufficient stress cannot be laid on the necessity of administering the medicine the moment the breath is tainted. [Mr. Worms has recently written to say that the proportions of onions and garlic in the mixture may be doubled with advantage.]

ANSWERS TO CORRESPONDENTS.

A Reader.—Whatever Swedenborg may have thought, there is no evidence that he ever saw or obtained oxygen *per se.*

W. Moffatt.—Received. The article by M. Kopp will be continued next week.

Received.—R. L. S.; F. T. B.; J. F. S.; Ozone.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Crystallisation of Sulphur, and upon the Reaction between Sulphide of Hydrogen, Ammonia, and Alcohol, by Charles M. Wetherill, Ph.D, M.D.

(Continued from page 89.)

If the experiments had rested at this point, the erroneous inference would have been drawn from them that the presence of organic matter (from the glucose,) occasioned the prismatic crystallisation of sulphur; but the solution in the last example was filtered to remove the crystals; and the clear liquid was returned to the bottle. The crystals were washed upon the filter with a little alcohol, which was suffered to drop into the bottle and formed a stratum of a few lines in depth upon the surface of the dark coloured solution.

On the next day a beautiful crystallisation of sulphur in prisms was observed, and its advance was watched for several days. The crystals formed upon the sides of the vessel at the surface of the liquid, extended inwards, and developed themselves downward. In proportion as they grew, the liquid exchanged its dark red for a light amber colour until the whole of the solution had acquired that tinge, the advance being from the surface, downward. The prisms were very slender, and terminated in planes oblique to the axis of the crystal. Not a single octahedron was detected. By their insolubility in water, and by heating upon platina foil, they were proved beyond a doubt to be sulphur. Some of the crystals measured over two inches in length; they were at first transparent, and of a canary yellow colour.

On the second day after their appearance they had lost their transparency, and the microscope showed them to be full of fissures. Very minute crystals were formed upon the prisms and upon the sides of the bottle. Those occupying the latter position were magnified with a high power, and appeared to be bushes or star-shaped groups of prismatic crystals, radiating from a central globular and minute molecule.

On the third day the latter crystals had become sufficiently developed to show that they were not prisms, but rhombic octahedra, and that the crystals strung along the primary prisms like beads were also rhombic octahedra. These crystals were all truncated as to their apices by planes perpendicular to the principal axes. The similar faces (O) of the lines of octahedra situated along the primary prisms were contained in parallel planes. These octahedra did not appear to have resulted from a breaking up of the primary prisms; but to be deposited upon the latter. I inferred that the prisms were at first (βS), in which a change to multitudes of octahedral crystals of (αS), contained within the prism, was effected; and that the contact of this group of (αS) crystals with the sulphur separating gradually from its solution determined the crystallisation, in the neighbourhood of the altered prisms, according to the alpha modification. It was remarkable that while this octahedral crystallisation was going on, transparent prismatic crystals were forming in other parts of the solution, and I supposed at first that the prisms might belong to the trimetric system; but long observation of them assured me that they were monoclinic.

On June 4 the separation of the sulphur was complete from the liquid, which was of amber colour. At this time other crystals in the form of transparent scales were forming. These were ascertained, by the taste and action of reagents, to be hyposulphite of ammonia. There was nothing new in the crystallisation of the sulphur except the very instructive fact that where a prism had fallen from the side of the vessel to the bottom, the sulphur had crystallised in beautiful, well-defined rhombic octahedra, with perfect apices, and which were as clear and colourless as rock crystal. They were arranged in rows, thus indicating the former positions of the prisms upon the bottle.

All of these crystals were first treated with water to dissolve the hyposulphite of ammonia. When this was performed under the microscope, the transparent scales were seen to disappear, and there remained octahedrons and prisms, some of which had imperfect octahedral crystals deposited upon them. The prisms appeared granular, and were of canary colour; the octahedrons were almost white. When heated, and observed thus with the microscope, the crystals became of deep yellow colour, and by elevating the temperature fused, yielding all of the characters of sulphur. It would seem to result from these experiments that sulphur exists in combination with hydrogen, or perhaps with ammonium, in the B allotropic condition. We may readily conceive a change in the sulphur after it has been separated from the β to the α modification; but we cannot so readily imagine that it should leave its alpha form to assume the more unstable beta condition.

We have also here an example of the crystallisation of (βS) without heat. Since the original prisms of beta sulphur are canary coloured, and not of brownish tinge, it would seem that the prisms obtained by fusion owe their brown tint to γ sulphur. The hypothesis may be ventured that the colour of (αS) is white or very pale yellow, that of (βS) yellow, that of (γS) reddish brown, and that of (δS) nearly black.

In the reaction between sulphide of hydrogen in the alcoholic solution of ammonium, sulphide of ammonium, distinguished by its odour, is at first formed; the smell is gradually exchanged for a strong and persistent one of sulphide of ethyl until at least no ammonium sulphide can be, by the proper reagents, detected in the liquid. The sulphur is then contained in the clear solution partly as hyposulphite and in part as free sulphur dissolved, or in some manner kept from separating by the hyposulphite.* It is to this dissolved sulphur that the liquid owes its dark tinge, which depth of colour came on gradually as the sulphide of ammonium was oxidised. When the solution lost a portion of its hyposulphite by crystallisation, the free sulphur separated and the liquid lost its dark colour. Then another portion of hyposulphite of ammonia appeared in crystals.

As the experiment has been set aside for further examination by slow crystallisation, I am unable at present to say whether any sulphite of ammonia has been formed. The odour of free ammonia is very powerful, and the liquid contains sulphite of ethyl. A drop evaporated in the air upon a glass slide exhibits microscopic oil globules, having a strong smell of the sulphide of ethyl. The same globules may be absorbed by agitating the liquid with ether, precipitating by water, and suffering the ethereal solution to evaporate spontaneously in a watch glass.

The liquid also contains hyposulphite of ammonia in solution, and there are no crystals in it at present.

The following formula may illustrate its reaction—

$$3NH_4S + 5O = NH_4O,S_2O_2 + 2NH_4O + S;$$

and for the sulphide of ethyl, perhaps—

$$NH_4S + C_4H_5O,HO = NH_4O,HO + C_4H_5S.$$

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* Are γS or βS soluble in the hyposulphite?

I cannot say whether mercaptan was formed; the odour appeared to be different from that of this alcohol, and there was no action by the solution on oxide of mercury. I have regarded the formation of the ethyl sulphide as without influence upon the peculiar crystallisation of sulphur here described. It may, however, be otherwise, for MM. Dietzenbacher and Moutier (C. R., lx. 353) have recently discovered that naphthaline, camphor, creosote, oil of turpentine, carbon, &c., modify the condition of sulphur, rendering it soft and plastic, as well as partially insoluble in sulphide of carbon.—*American Journal of Science and Art,* No. 120.

Researches on the Volatile Hydrocarbons, *by* C. M. Warren.

(*Continued from page* 88.)

Of the Calculated Boiling-points of Hydrocarbons by Schröder's Theory.

The subjoined tables exhibit the theoretical boiling-points of the above-mentioned hydrocarbons,* as calculated according to Schröder's last theory, in comparison with the boiling-points actually found. By this theory, as already stated, each double atom of carbon (C_2) contained in a body is supposed to influence the boiling-point by 30°, and each double atom of hydrogen (H_2) to influence the same—10°; from the sum of these influences the number 70° is in all cases to be deducted in order to find the boiling-point.

1. *Hydrocarbons from Pennsylvania Petroleum.*

1st Series.

Formula.	Determined boiling-point.	Calculated boiling-point by Schröder's theory.	Difference between calculated and determined boiling-point.
	Degs.	Degs.	Degs.
C_8H_{10}	0·0(?)	0	
$C_{10}H_{12}$	30·2	20	10·2
$C_{12}H_{14}$	61·3	40	21·3
$C_{14}H_{16}$	90·4	60	30·4
$C_{16}H_{18}$	119·5	80	39·5
$C_{18}H_{20}$	150·8	100	50·8

2nd Series.

Formula.(?)	Determined boiling point.	Calculated boiling-point by Schröder's theory.	Difference between calculated and determined boiling-point.
	Degs.	Degs.	Degs.
C_8H_{10}	8-9	0	8-9
$C_{10}H_{12}$	37·0	20	17·0
$C_{12}H_{14}$	68·5	40	28·5
$C_{14}H_{16}$	98·1	60	38·1
$C_{16}H_{18}$	127·6	80	47·6

3rd Series (not completed).

Formula.	Determined boiling-point.	Calculated boiling-point by Schröder's theory.	Difference between calculated and determined boiling-point.
	Degs.	Degs.	Degs.
$C_{20}H_{20}$	174·9	130	44·9
$C_{22}H_{22}$	195·8	150	45·8
$C_{24}H_{24}$	216·2	170	46·2

2. *Hydrocarbons from Coal-tar Naphtha.*

Name of Substance.	Formula.	Determined boiling-point.	Calculated boiling-point by Schröder's theory.	Difference between calculated and determined boiling-point.
		Degs.	Degs.	Degs.
Benzole	$C_{12}H_6$	80·0	80	0·0
Toluole	$C_{14}H_8$	110·3	100	10·3
Xylole	$C_{16}H_{10}$	139·8	120	19·8
Isocumole	$C_{18}H_{12}$	169·9	140	29·8

3. *The Homologous Hydrocarbons from Oil of Cumin and Cuminic Acid.*

Name of Substance.	Formula.	Determined boiling-point.	Calculated boiling-point by Schröder's theory.	Difference between calculated and determined boiling-point.
		Degs.	Degs.	Degs.
Cumole	$C_{18}H_{12}$	151·1	140	11·1
Cymole	$C_{20}H_{14}$	179·6	160	19·6

It appears, therefore, that the theory of Schröder finds no support from any one of the different series of hydrocarbons presented in these tables. The discrepancy between the observed and calculated boiling-points, as shown, varies from about 10° to 50° C. This discrepancy is found to increase pretty uniformly by about 10° as we rise from one member to the next higher in the ascending series. In the series of the formula C_nH_n, however, the discrepancy is nearly a constant one—viz., about 46°. I would not overlook the fact that the calculated boiling-point of benzole is absolutely identical with that found by experiment; nor the remarkable coincidence that the agreement is almost perfect between the probable boiling-point and that obtained by calculation, for the body of the probable formula C_8H_{10} in the 1st series from petroleum. It is obvious, however, that these are merely accidental circumstances, to which no importance can attach.

Of the Calculated Boiling-points of Hydrocarbons by Löwig's Theory—viz., that One Atom of Carbon (C) raises the Boiling-point 38°·4, and One Atom of Hydrogen (H) lowers it 29°·2.

Hydrocarbons from Pennsylvania Petroleum.

1st Series.

Formula.	Determined Boiling-point.	Calculated boiling-point by Löwig's theory.	Difference between calculated and determined boiling-point.
	Degs.	Degs.	Degs.
C_8H_{10}	0·0(?)	15·2	
$C_{10}H_{12}$	30·2	33·6	3·4
$C_{12}H_{14}$	61·3	52·0	9·3
$C_{14}H_{16}$	90·4	70·4	20·0
$C_{16}H_{18}$	119·5	88·8	30·7
$C_{18}H_{20}$	150·8	107·2	43·6

2nd Series.

Formula (?)	Determined boiling-point.	Calculated boiling-point by Löwig's theory.	Difference between calculated and determined boiling-point.
	Degs.	Degs.	Degs.
C_8H_{10}	8-9	15·2	6·7
$C_{10}H_{12}$	37·0	33·6	3·4
$C_{12}H_{14}$	68·5	52·0	16·5
$C_{14}H_{16}$	98·1	70·4	27·7
$C_{16}H_{18}$	127·6	88·8	38·8

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* To avoid useless repetition, the hydrocarbons from Albert coal-oil will be omitted in this series of tables, they being considered identical with the corresponding bodies from petroleum.

3RD SERIES (not completed).

Formula.	Determined boiling-point.	Calculated boiling-point by Löwig's theory.	Difference between calculated and determined boiling-point.
	Degs.	Degs.	Degs.
$C_{20}H_{20}$	174·9	184·0	10·9
$C_{22}H_{22}$	195·8	202·4	6·6
$C_{24}H_{24}$	216·2	220·8	4·6

A cursory examination of the last three tables will suffice to show that, so far as regards the hydrocarbons of the formulæ C_nH and $C_nH_n+_2$, the theory of Löwig also has no foundation in fact. That his theory did not hold good with the hydrocarbons of the formula C_nH_{n-6} was observed by Löwig himself, who found that it would place the boiling-point of benzole at 285°·6—*i.e.*, 205° above its actual boiling-point.

(To be continued.)

On Producing High Temperatures by Means of Coal Gas and Air, by M. TH. SCHLŒSING.*

CHEMISTS have not as yet derived from coal gas all the advantages as a source of heat which it is capable of affording. The apparatus used in laboratories gives, at most, the temperature of white heat, unless the air is replaced by oxygen, as is done by MM. H. Sainte-Claire Deville and Debray. By ascertaining the temperature produced by gas burnt with an exactly sufficient quantity of air, and that produced simply by the flame of a jet, the possibility of producing high temperatures by its simple combustion in air is proved. It is a question of apparatuses, which I propose to resolve as follows:—

I considered that there were two principal conditions o be fulfilled; 1. Combustion, without excess of air or gas, effected entirely in the space to be heated; 2. Sufficiently rapid supply of the burning gases to keep up the high temperature, in spite of the losses by the casings, or any other expenditure of heat. With respect to this second condition, in most of the operations requiring a high temperature the loss of heat through the casings is the chief cause of cooling, and it is in proportion to their size; hence the advantage of large furnaces over small ones—taking into account only the better employment of the heat.

These two conditions I found to be realised by the following arrangement:—Air is forced into a copper pipe of from three to four decimetres long, through a tube running a few centimetres into the pipe; two opposite holes are pierced in the pipe a little behind the orifice of the tube; at this point the pipe is surrounded by a muff supplied with gas, which is drawn into the current of air, and becomes mixed with it. The action of this apparatus cannot be better described than by supposing a Bunsen's jet with the air and gas entrances reversed, the gas entrance much enlarged and admitting air, and the air holes admitting gas. The delivery of gas is of course regulated by a cock, that of the air by a given pressure. On igniting in the air the gaseous mixture thus produced a large blue flame is the result, the heat of which does not appear to be more intense than that of an ordinary blowpipe of equal expenditure; but if the jet penetrates a refractory envelope, without taking the outer air with it, the flame, which I suppose to be produced by a mixture, in theoretical proportions, of gas and air, becomes very short and the combustion takes place entirely in a confined space; this is doubtless caused by the previous condition of the mixture of fluids, due to their simultaneous entrance into the same pipe. It does not follow that this mixture of explosive gases is dangerous. In fact, from the researches made both by M. Demondésir and myself, on the combustion of gaseous mixtures, it has been found that the velocity with which combustion is propagated in a large tube, is for the theoretical mixture of gas and air, not more than five metres the second. If, then, the speed of supply in my blowpipe is notably greater, the flame would not be able to back so as to burn in the interior of the pipe. Moreover, an explosion under such conditions need cause no alarm. Nor need any attention be paid to the fan furnishing the air, pressures of from fifteen to twenty centimetres of water being quite sufficient; but great care must be taken to provide for the escape of the products of combustion.

I use M. Enfer's bellows, which I regulate by conveying the current into a kind of gasometer formed by a large receiver fixed in an outer cover filled with water, a gauge indicating the pressure. The gas is regulated by a cock, the key of which is provided with a long handle, so that very slight movements may be made. The mixture is at its highest point of perfection when two very slightly different positions of the cock give by turns oxidising and deoxidising gases, which can be ascertained by applying a large copper wire to the entrance of the furnace.

To heat a porcelain tube to white heat I fix at the end of the blowpipe a kind of flattened funnel, which transforms the cylindrical jet into a sheet of flame; I place the edge of the funnel between two refractory bricks bound together by iron wires, one of them having been filed so as to make after its junction with the other a vacant space, forming the continuation of the funnel, and in which the gaseous sheet spreads out until it escapes through an opening from 11 to 18 centimetres long and from 2 to 3 millimetres broad; it is only after thus escaping, and provided its velocity is greater than that above mentioned, that it burns. I avoid exposing my tube too near the escape, as the porcelain would be melted wherever struck directly by the flame. At each side and at the two ends of the aperture I place four pieces of brick, confining the flame in a space from one to two centimetres broad by from five to six high. A little above I place my tube, and cover it with some conveniently-shaped pieces of brick; the lighted gases divided by the tube surround it and reunite above to escape by a longitudinal aperture. The heating should of course be gradual from the first. I commence by admitting very little air, then slowly open the gas cock until the limit at which the mixture of air and gas is inflammable is barely exceeded. In spite of the excess of air the combustion is then very incomplete; the hydrogen burns, but the carbon only forms oxide; the temperature is then very slightly raised, and the tube bears it without injury. Little by little I increase the air and the proportion of gas, until in about five minutes I arrive at the desired speed.

For heating a crucible I make other arrangements: placing two bricks flatwise together, to form the pedestal of the furnace, in the centre I place the crucible on a cheese; for which I make a vertical covering with pieces of brick of equal size bound together with an iron wire. This covering rests on four blocks, so arranged as to have between it and the pedestal a free space of three to four millimetres. This vertical envelope I cover with a brick pierced through the middle to receive my blow-pipe. Thus, I heat from above, the flame

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* *Comptes Rendus*, lxi, 1131.

strikes the cover, spreads over, descends, and escapes all around by the circular outlet made by the blocks.

It is possible to vary in many ways the form of the flame and that of the coverings, according to the object to be heated. Surprising results are produced by this mode of heating. I once melted, in twenty minutes, in a Paris crucible, a piece of iron weighing 400 grammes, and, in the same length of time, the porcelain of a Bayeux tube was transformed into transparent glass. Nor is the consumption of gas excessive. I have estimated it approximatively, and found that, to heat to white heat during twenty minutes, a porcelain tube, of twenty millimetres by eighteen centimetres long, about 250 litres of gas were consumed; while from 400 to 500 were required to melt a piece of iron. The danger of melting porcelain tubes necessitates some precautions. I place at one end a flask with the bottom blackened, and through this I watch the effects of the heat on the porcelain; the flask is tubulated when the gas is required to circulate in the tube. On the first appearance of any distortion in the tube I diminish the current. With a blow-pipe and a furnace with tubes, the pressure of air corresponding to the commencement of fusion of porcelain should be ascertained, and the temperature kept below that point. This pressure limit is evidently variable, according to the dimensions of the blow-pipe and furnace. It is, of course, advisable to increase as much as possible the diameter of the former, so as to diminish the bellows' work, bearing in mind that the velocity of the gaseous mixture has a low limit, which must not be exceeded.

TECHNICAL CHEMISTRY.

The Manufacture of Citric Acid by Citrate of Magnesia,* *by M.* Perret.

The manufacture of citric acid from lemon juice is an operation of considerable delicacy.

The industrial resources of Sicily, and the want of practical processes, render this fabrication impossible on the spot where the fruit is produced; the readiness with which lemon juice, the natural lemous, and the citrates of lime which have been made on the spot become altered, occasions great losses to the English manufacturer, who imports these various products from Sicily.

These considerations, joined to that of the saving in cost of transport, which would result from producing the citric acid in Sicily itself, have determined me to undertake some researches in this direction, by which I have arrived at a very satisfactory process.

It consists in making a tribasic salt of magnesia and transforming this salt into a crystallisable bibasic salt.

The fresh lemon juices are treated directly by an excess of magnesia, which is abundant in Italy.

A perfectly insoluble tribasic citrate of magnesia is thus formed. This salt does not become altered; precipitated hot from the juices it is in the form of a granular powder, very dense, readily separating in water (which softens it), and which, seen through a magnifying glass, is found to be composed of a mass of small prismatic crystals; this powder, freed from mother liquor by some cold washings, or by a single washing, and dried is perfectly unalterable, resisting moisture and heat for a long time without becoming covered with mould.

This salt, then, such as it is, may be despatched from the place where the citric acid is made; but it is evidently better to accumulate the acid upon this salt, and for this purpose I treat a given weight of tribasic citrate with a fresh quantity of lemon juice equal to that which served in the first operation; throwing the tribasic citrate in small portions into the hot lemon juice, where it instantly dissolves.

Having thus obtained the solution of bibasic salt, I leave the solution to deposit, decant, and evaporate in vessels as wide as possible, until the boiling solution marks 23°, when I allow the liquid to stand. In twelve hours' time an abundant crystallisation (which continued for ten days) was already deposited, consisting of a citrate, which was the bibasic citrate.

I have submitted to the Society some specimens of this salt prepared in the way described, and which, it may be seen, crystallise very distinctly.

It is this compound which, being very easily made in Sicily itself, it would be advisable for English and French manufacturers of citric acid to import.

The object of my note is to make known,—

1st. A new process for making citric acid.

2nd. An easy way of obtaining citrate of magnesia, which has not hitherto been obtained, and which is therapeutically of importance.

I obtained the same result by using citric acid and magnesia or sub-carbonate; so that for pharmaceutical purposes my crystallised citrate is very easily prepared, and for lemonade may be used in the proportion of

Crystallised citrate	80 gr.
Sweetened and flavoured liquid .	350 to 400 „
Bicarbonate of soda	4 „

Lemonade prepared in this way will keep a very long time.

PHYSICAL SCIENCE.

Why do Bees Work in the Dark? by Charles Tomlinson, *F.C.S.*

About two years ago a paragraph appeared in the Chemical News (April 30, 1864), and went the round of the papers, under the title of "Why Bees Work in the Dark," in which it was stated (1) "that the change of honey from a clear yellow syrup to a solid mass is a photographic action; that the same agent which alters the molecular arrangement of the iodide of silver on the excited collodion plate, and determines the formation of camphor and iodine crystals in a bottle causes the syrupy honey to assume a crystalline form." In proof of this, M. Scheibler enclosed honey in stoppered flasks, some of which were kept in the dark while others were exposed to the light, when it was found that the sunned portion rapidly crystallised, while the honey kept in the dark remained perfectly liquid. (2) "We now see," he says, "why bees are so careful to work in perfect darkness, and why they are so careful to obscure the glass windows which are sometimes placed in their hives. The existence of their young depends on the liquidity of the saccharine food presented to them, and if light were allowed access to this the syrup would gradually acquire a more or less solid consistency; it would seal up the cells, and in all probability prove fatal to the inmates of the hives."

While I was on a visit to a village on the Dorsetshire coast at the end of July, 1864, some new combs were brought in containing virgin honey, when it occurred to me to test the observation on which the above theory is founded, and the more so since the remark that "light determines the formation of camphor and iodine crystals

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* *Bulletin de la Société Chimique*, January, 1866.

in a bottle," I knew to be erroneous. Accordingly, I collected a small quantity of this new honey in two bottles, and wrapped one of them in several folds of stout paper and left the other exposed. On my return to town early in August, I placed the bottles in an east window, where they remained many months exposed to the cold of winter and the sun of spring, with the temperature often below freezing point, and on warm days above 70° Fahr. The honey in both bottles remained quite fluid, and the only change was the deposit in each bottle of a few bright crystalline grains.

A still more perfect experiment was made in July, 1865. Being in the same Dorsetshire village I procured some virgin comb that had never seen the light, squeezed it gently through clean linen, and received the stream of pure, limpid honey into two eight-ounce white glass bottles. When these were nearly filled the stoppers were inserted, tied over, and the bottles labelled. One was wrapped up in opaque paper, and the other was, a few days afterwards, exposed to the light on a window frame, where it has remained ever since, exposed to the direct sunshine of summer, and to the cold of winter; but the honey, whether exposed to the light or covered, remains perfectly limpid after about eight months.

A bottle of honey from Rosenthal, in Switzerland, was procured from Messrs. Fortnum and Mason. This, they said, was three years old and improved by keeping. It was in a bottle of light-green glass, and had been in their shop window for a long time. I transferred a portion of this honey to a white glass bottle, and it has been exposed to the light for about ten months, and is still (February, 1866) quite fluid.

Virgin honey from Bromborough Pool, near Birkenhead, exposed to the light during many months, remains quite fluid; but old honey—*i.e.*, gathered from combs of the second year, whether exposed to the light or not, soon became solid. So also honey from near Dunstable, gathered from a new comb, became solid, contrary to the above experience, whether exposed to the light or not.

These facts sufficiently prove that "the sunned portions" of virgin honey do not always "rapidly crystallise."

The specimens of new honey, then, had, with one exception, not solidified after many months' exposure. I endeavoured to bring some Dorsetshire honey into the candied state by placing it in a capsule over sulphuric acid under the receiver of an air-pump. The honey thus operated on was taken from a jar prepared in the usual way, by steaming the combs; it was darker in colour than that exposed to the light, but still quite fluid. It was kept *in vacuo* about a fortnight; the pump was worked two or three times a day, and at each working there was a disengagement of air bubbles, as if a slight fermentation had been going on in the honey, but it did not candy. The capsule was now placed on the window ledge by the side of the bottles containing the virgin honey. It was left exposed to the air during some weeks, in which time it not only did not candy, but increased in bulk to overflowing, thus proving the presence of some deliquescent material.

Acting on this idea, I weighed out 100 grain portions of honey from different sources into watch glasses, and exposed them on the window-ledge. They all absorbed moisture more or less, and the absorption was greatest in damp weather, but in very unequal proportions; for while Normandy honey absorbed 8½ grains of moisture, [illegible] honey absorbed only 3½ grains, and when the former weighed 103½ grains the latter had actually lost weight, the 100 grains being only 99¼ grains. The Dorsetshire honey was by no means so absorptive as the Rosenthal, but in all four cases that were tried there was absorption of moisture during damp weather, and loss of moisture during dry; showing, in fact, the presence, in greater or less quantity, of deliquescent salts in the honey.

Remembering the fondness of bees for salt water, it seemed probable that the difference between the Dorsetshire honey and the Hertfordshire honey might arise from the fact that the one contained a minute proportion of salt, or of the salts of sea water, which was absent in the other.

The fondness of bees for salt has long been a puzzle to entomologists. Dr. Bevan, in his work on "The Honey Bee," says:—"I keep a constant supply of salt-and-water (about a teaspoonful to a pint) near my apiary, in a shallow dish, covering the bottom with small pebbles, and find it thronged with bees from early noon to late in the evening. About this period (*i.e.*, the spring) the quantity they consume is considerable, but afterwards they seem indifferent to it." In the volume on bees contained in Sir William Jardine's "Naturalists' Library," it is stated, p. 49, that "bees have recourse in spring, but generally speaking in spring only, to dunghills and stagnant marshes for the sake of the salts with which they are impregnated, and which their instinct teaches them are advantageous to their health after their long winter confinement."

It seemed more probable that bees collect small portions of salt for the purpose of keeping their honey fluid than for the purposes of medicine, as suggested by the last quotation. To test this, two portions of 120 grs. each of the candied Hertfordshire honey were scraped from a spatula upon the edges of two evaporating dishes; one specimen was sprinkled with about 2 grs. weight of marine salts, such as are used for making artificial sea water. In the course of a few hours this honey showed signs of liquefaction, although the weather was cold; and in the course of two or three days it had run down into the dish in a liquid form, so that it could be poured. The honey in the other dish continued for weeks adhering to the edge, showing much less decided signs of liquefaction.

The examination of various specimens of honey did not confirm this view, but it led to the detection of a variety of salts, among which lime was particularly abundant, especially in honey from inland places. Potash was also found in considerable quantity, and this would tend to make the honey deliquescent. As far as my examination has extended, nothing seems to explain why some varieties of new honey become candied sooner than others. The presence of lime does not seem to explain anything, except that bees may introduce a good deal of filth into their honey; for the lime was probably gathered in the form of nitrate, which is an abundant salt in water from dunghills, stagnant ponds, and bogs, and wherever there is decaying animal matter; so that the bees drinking at such places must be a happy thought for honey eaters. But one practical suggestion arises from this examination—namely, supply your bees with salt-and-water, and they will probably not frequent dunghills. In places near the sea bees can procure common salt and the salts of sea water for themselves; and it will be remembered that the most celebrated honeys of the world, such as those of Mount Hymettus, Mount Ida, Mahon, Cuba, the Bermudas, &c., are all fluid, and even syrupy, and that all these places are within easy access of the sea.

I asked my friend Mr. Rodwell to examine two specimens of honey, both inland—one from Switzerland and the other from Hertfordshire. He found in the Swiss honey, iron, alumina, and phosphates, together with lime, magnesia, and potash; and in the Hertfordshire honey all the above ingredients, together with ammonia. As far as the results of the examination of these and the other specimens are concerned, it would seem that bees are extensive collectors, picking up all sorts of stray materials for the purpose of making up their tale of honey. Whether there is any dishonesty in this on the part of the workers, whether these various salts serve some purpose not yet determined, or whether they get accidentally into various kinds of dirty water which the bees drink, we cannot say. At any rate, the fact is very curious that such a variety of salts should be found in honey. It is most probable that honey from other localities would show a similar varied constitution of the ash.

Honey has been regarded by chemists as a solution, more or less concentrated and aromatised, of a concrete in a liquid sugar; but that the climate, the season, the temperature, the kinds of plants on which the bees pasture, give rise to the great differences noticed in the honey of different localities. Some kinds contain only a small proportion of the concrete sugar; others so much as to be nearly solid. The colour and aroma are said to depend on the plants, but in wet years or in moist climates and in marshy places, the honey is more liquid, and remains so for a longer time.

Honey is nearly always acid, and the presence of acids tends to keep it fluid, of alkalies to turn it brown. The honey from marshy districts is said to be brown, and the taste not pleasant.

The liquid sugar of honey is said to consist of $C_{12}H_9O_9 + 3HO$, and the solid portion or glucose of $C_{12}H_9O_9 + 5HO$; so that the change from the liquid to the concrete form arises from the combination of two atoms of water. In such cases the $2HO$ must be taken from another portion of the same honey—that is, the elements are simply re-arranged; for if the change were, as stated in some books on chemistry, due to time and the appropriation of two atoms of water from the air, we should have $C_{12}H_{12}O_{12} = 72 + 12 + 96 = 180$ lbs. of fluid honey, becoming $C_{12}H_{14}O_{14}$, or $72 + 14 + 112 = 198$ lbs. of solid honey—an increase of 10 per cent. in weight, which cannot take place when liquid honey in sealed bottles becomes candied. My experiments tend to show that the absorption of water by exposure renders the honey more liquid, not more solid. The change in the honey may be a molecular one, resembling in some respect that which takes place in barley sugar when kept some time either in the light or in the dark.

The proportions of the two sugars in honey vary so much as probably to account for most of the differences observable in different specimens. It is said the concrete glucose is more abundant in spring than in autumn if the year be dry than if wet, and in countries abounding in labiated and aromatic plants than in others. The liquid portion is more soluble in concentrated alcohol than the solid, and in this way the two can be separated.

Any experiments on this subject must be with virgin honey, or that drained from the new comb. This, in the Dorsetshire specimen, was colourless and limpid, but when prepared from new and old combs by the action of heat the honey becomes changed, and candies sooner, although a jar of Dorsetshire honey thus prepared at the end of July, 1864, was sufficiently fluid to be poured from the jar in the following March.

But the question still remains unanswered "Why do bees work in the dark?" In reply to this question from the bees' point of view, it must be remembered that the bees know nothing of the physical property of transparency; they argue that the path by which light enters will also admit their enemies. The poor fly that knocks his head against the pane of glass will never understand why he cannot get through it; and the bee, with all his sagacity, will not appreciate his security under a transparent hive. But it is not true that honey does not solidify in the hive. The volume of the "Naturalists' Library" from which we have already quoted, states (p. 119) that the heat and vapour of the hive are injurious to the honey, and that "in very severe seasons it is sometimes candied."

King's College, London, February 17.

Notes on the History of Spectrum Analysis,[*] *by Sir* DAVID BREWSTER.

THE great interest excited by the important researches of MM. Kirchhoff and Bunsen, on what is called spectrum analysis, renders it desirable that previous researches should not be forgotten.

M. Zantedeschi has called the attention of the Academy to his former observations relative to the application of luminous spectra to chemical analysis,[†] but I may be allowed to remark that my friend M. Fox Talbot has claims even more ancient to this important application.

In March, 1826, he transmitted to me an interesting article, entitled "*Some Experiments on Coloured Flames,*" in which he described the brilliant lines discovered by him in different flames, and concluded with the following remarkable paragraph:—"The orange ray, for instance, may be the effect of strontian, as Herschel has found a ray of this colour in the flame of muriate of strontian. Were this opinion correct, a glance at the prismatic spectrum of a flame would be sufficient to show that it contained certain substances which could otherwise be discovered only by laborious chemical analysis."

In the *Comptes Rendus* of September 21, 1863, M. Volpicelli was good enough to state my claim to "*Some Discoveries in Spectrum Analysis, made with Modern Spectroscopes,*"[‡] citing in support of this statement my memoir "*On the Lines of the Solar Spectrum,*" published in the *Edinburgh Transactions* for 1833,[§] and reprinted in the *Philosophical Magazine,*[||] and in the *Poggendorff's Annalen*[¶] in 1863. The following extracts will show how far this statement is correct:—In a memoir "*On Mono-Chromatic Lamps,*" printed in 1822,[**] I published my earliest experiments on the action of coloured media on the solar spectrum; and in reprinting them in 1833 I stated that "the first and chief object of my researches was the discovery of a general principle of chemical analysis, in which the simple and compound bodies would be characterised by their action on the defined portions of the spectrum."

As a great number of coloured bodies acted on the spectrum at different points, I put forward the hypothesis "that the number and intensity of such actions

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[*] *Comptes Rendus*, lxii., 17.

[†] *Ibid*, liv., 732.

[‡] *Ibid*, lvii., 573.

[§] *Edinburgh Transactions*, xii., 519.

[||] *Philosophical Magazine*, viii., 384.

[¶] *Poggendorff*, xxxviii., 61 and 63.

[**] *Edinburgh Transactions*, ix., 433.

might depend on the number and nature of the elements entering into the composition of the body." This speculative idea was, however, abandoned when I found that the nitrous acid gas affected the spectrum at a great many points throughout its whole length.

In concluding this memoir I observed "that the same absorbing elements which existed in nitrous acid gas existed also in the atmospheres of the sun and earth," and "that very interesting results may be expected from the examination of the spectra of planets."

I expressed the same opinion in my memoir "*On the Colours of Natural Bodies*," published in 1833. "Hence," I said, "it is evident that there are, in our atmosphere, elements which exercise a specific action on the rays of definite refrangibility, and that this action, in some of these rays, is identical with that exercised upon them by the atmosphere of the sun," and subsequently I added that the parts of the white light absorbed in place of the lines of the spectrum "are those which have the greatest affinity for those elements of the matter which, at the same time they enter into the composition of the sublunary bodies, exist also in the atmospheres of the central luminaries of other systems.[††]

In the year 1842 I discovered that the luminous and brilliant lines in certain flames corresponded to the missing lines in the light of the sun. This observation was made for the first time in the spectrum produced by burning nitre, and I afterwards found this was "a property belonging to almost every flame."[‡‡]

This result was the fruit of a long series of experiments made in 1842 on nearly one hundred and twenty four substances, set on fire in a platinum cup, by the flame obtained from a mixture of oxygen and coal gas (Bude light). A notice of these experiments was read at the meeting of the British Association at Manchester in 1842,[§§] and the remarkably brilliant lines produced by some of these experiments were especially described. The object of these experiments was simply to discover new facts. The position of the lines could be seen at a glance. Other investigations of a less laborious nature have prevented my determining the places of these brilliant lines, relative to the bodies where their number and position were remarkable, but this will no doubt be better executed by some of the numerous observers now making such important discoveries with the spectroscope.

PROCEEDINGS OF SOCIETIES.

ROYAL SOCIETY.

February 1, 1866.

Lieut.-General Sabine, *President, in the Chair.*

The following communications were read:—

1. "*On the Specific Gravity of Mercury*," by Balfour Stewart, M.A., LL.D., F.R.S. Some time since, in connection with a research on the fusing-point of mercury, several observations were made at Kew of the specific gravity of this fluid. A specific-gravity bottle was used for this purpose and it was washed, in the first place with sulphuric acid, secondly with distilled water, and thirdly with alcohol; when this was done it was found to contain mercury without any air-specks or any diminution of that metallic lustre which pure mercury exhibits when in contact with a vessel of clean glass. Three different specimens of pure mercury were used, and were separately weighed in the specific-gravity hottle at 62° Fahr. The following results were obtained:

	Weighed in air. grs.
Mercury from the cistern of the old Kew standard barometer, filling the bottle, weighed at 62° F..	13591·36
Mercury from the cistern of the new Kew standard barometer weighed at 62° F. .	13591·66
Mercury used in experiments with air-thermometer weighed at 62° F. . .	13591·96

The mean of these will be 13591·66 grs. It was found that the specific-gravity bottle had an internal volume equal very nearly to four cubic inches, and assuming that a cubic inch of air weighs 0·31 grs., then the air displaced by the liquid filling the bottle would weigh 1·24 grs. In like manner the air displaced by the Kew standard weights (sp. gr. 8·2) would have the volume of 6·6 cubic inches, and would weigh 2·04 grs. From these premises we find that the real weight of the mercury *in vacuo* would have been 13590·86 grs. Again, the amount of water which the same bottle held at 62° F. weighed in air 1000·53 grs. Here the air displaced by the bottle is, as before, 1·24 grs., while that displaced by the weights is only 0·15 gr. From this we find that the real weight of water filling the bottle at 62° F. would be *in vacuo* 1001·62 grs. We have thus—

True weight of mercury filling the bottle at 62° F. = 13590·86 grs.

True weight of the same volume of water at 62° F. = 1001·62 grs.

And hence the specific gravity of mercury at 62° F., as compared with water at the same temperature, will be 13·569 nearly. Again, if we assume the correctness of Regnault's Table of the absolute dilatation of mercury, and also that of Despretz's Table of the absolute dilatation of water, we shall find that the weight at 32° F. of a volume of mercury weighing 13590·86 grs. at 62° F. will be

$$13590{\cdot}86 \times 1{\cdot}00298 = 13631{\cdot}361 \text{ grs.}$$

Also the volume at 4° C., or 39°·2 F., of a volume of water weighing at 62° F. 1001·62 grs., will be

$$1001{\cdot}62 \times 1{\cdot}0011437 = 1002{\cdot}766 \text{ grs.}$$

Hence the specific gravity of mercury, according to the French method of determining it, will be

$$\frac{13631{\cdot}361}{1002{\cdot}766} = 13{\cdot}594.$$

A determination by Regnault gives 13·596. These two results agree very nearly with one another; and this agreement tends not only to verify the correctness of Regnault's determination, but to show that Regnault's Table of the dilatation of mercury, and Despretz's Table of the dilatation of water, agree together; a remark that had been previously made by Dr. Matthiessen in a paper which he recently presented to the Society.

2. "*On the Forms of Graphitoidal Silicon and Graphitoidal Boron*," by W. H. Miller, M.A.

Graphitoidal Silicon.—It has been so confidently assumed that graphitoidal silicon is an allotropic condition of silicon crystallised in octahedrons, that on ascertaining by measurement of angles that some graphitoidal silicon given me by Dr. Matthiessen was in simple and twin octahedrons, I at once concluded that the substance had been wrongly named. Later, however, I obtained from Dr. Percy a supply of graphitoidal silicon of unquestionable authenticity. Its lustre was that of the crystals I had previously examined. It occurred in small scales, having for the most part the appearance of crystals of the oblique system. On measurement, however, they proved to be octahedrons in which two parallel faces were much larger than any of the other faces, and two other parallel faces were either too small to be observed or were altogether wanting. One of the scales had all the faces of a

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[††] *Edinburgh Transactions*, xii., 544 and 545.

[‡‡] Report of the British Association for 1842, p. 15.

[§§] Report of the British Association for 1842, p. 15.

twin octahedron. It appears, then, that there is no reason, founded on a difference of form, for separating graphitoidal from octahedral silicon, the sole distinction being that the crystals of the latter are more perfect than those of the former.

Graphitoidal Boron.—The forms of boron have been described by the Commendatore Quintino Sella in two papers read before the Royal Academy of Turin on January 4 and June 14, 1857, and by the Baron Sartorius v. Waltershausen in a paper presented to the Royal Society of Göttingen on August 1 of the same year. They found independently that the adamantine boron of Wöhler and Deville, containing a variable and not inconsiderable amount of aluminium and carbon, considered by Sella as possibly a definite compound of boron with aluminium and carbon with a mechanical mixture of pure boron, crystallises in forms belonging to the pyramidal system. Boron containing 2·4 per cent. of carbon, the boro-semplice of Sella, is described by him as occurring in crystals, the faces of which are not so perfect as to admit of a very accurate determination of the angles they make with one another. The angles approximate to some of the angles of crystals of the cubic system, but the aspect of the crystals, which are usually twins, leads to the supposition that they belong to the oblique system, and that the angle between the oblique axes differs but little from 90°.

Besides the two forms already mentioned, Wöhler and Deville obtained boron in extremely thin scales, which were supposed to be a different modification of boron, and was accordingly called graphitoidal. Sella, however, relying apparently upon the evidence afforded by the lustre and colour of the scales, for he was unable to obtain any measurements, expresses his conviction that they are not different from pure boron. Some scales of this substance, for which, as well as a supply of crystals of pure boron, I am indebted to Dr. Matthiessen, have faces on their edges, but so narrow that the reflected image of the bright signal is diffracted into a line of considerable length, and therefore difficult to bisect. For this reason it is not possible to determine the positions of the faces with accuracy; but the agreement in position of many of the faces with those of pure boron appears to leave but little doubt of the identity of the forms of the two substances.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

MICROSCOPICAL AND NATURAL HISTORY SECTIONS.

January 17th, 1866.

A. G. Latham, *Esq., President of the Section, in the Chair.*

The Secretary reported that he had made a catalogue of the collection of microscopical objects belonging to the Section.

Mr. Sidebotham remarked on the best cement to use in forming cells for fluid preparations, and stated that gold size appeared to prevent the entrance of air bubbles better than Japan varnish or Brunswick black, which latter in time became porous, and also, from the evaporation of its turpentine, brittle. He said he and Mr. Thwaite were perhaps the first to use this method of mounting objects, and that he possessed slides of gold size cells made in 1844, which were still quite perfect, while those he mounted with Japan black in 1850 were most of them spoiled, and that he had again reverted to the use of gold size for the formation of the cell, using Japan varnish for its final closing only.

The Secretary said gold size remained viscid for a long time, and that if the cells formed of it were not well dried for a considerable period, or even baked in an oven, the size was very liable to "run in" and spoil the preparation. He had re-varnished the Section's collection with a mixture of Japan varnish and gold size, and thought the gold size would prevent the Japan varnish from becoming brittle or porous, while the latter would prevent the gold size from running in; but he strongly recommended that all collections should be re-varnished every five years, and deprecated the use of covering papers on slides of fluid preparations, as it prevented this.

Mr. Latham recommended the addition of a solution of india-rubber, and Mr. Parry of wax, to Japan varnish, to obviate its tendency to become porous and brittle.

Mr. Heys showed a well-mounted specimen of the exuvium of the larva of a Dragon Fly, and stated he found these insects were easily brought to cast off their skins by changing the water in which they were kept—if soft, to hard, and *vice versa*, or if muddy, to fresh.

ACADEMY OF SCIENCES.

February 19.

M. Daubrée gave a further account of his "*Synthetical Experiments Relative to Meteorites.*" In this paper he describes his attempts at producing imitations of the crystalline structure of meteoric iron. The peculiar structure alluded to is seen when the stone is polished and the surface afterwards treated with a strong acid, and the regular designs observed are known as "Widmanstaetten's figures." They are not produced by crystallisation alone, but result also from the non-homogeneity of the mass, and the separation of a substance less easily attacked by acids than the iron. The author has succeeded in producing very similar appearances by melting soft iron with nickel, phosphide of iron, protosulphate of iron, and cast-iron strongly charged with silicium. He arrived at somewhat similar results by fusing certain ferruginous silicates containing phosphates or phosphide and small amounts of nickel. The author postpones for the present his general conclusions, and now only offers a conjecture that the formation of meteorites has been accompanied by a reducing action, which he is inclined to attribute to the influence of a hydrogenated atmosphere. He mentions that the ferruginous silicates referred to, when heated in a current of hydrogen, give up in the metallic state the iron which existed as silicate of the protoxide. Under the same conditions, phosphates are reduced to phosphides, and thus, he states, the final product of the action of hydrogen presents a strong resemblance, chemically, to meteorites.

M. Pelouze presented, in the name of Mr. C. Greville Williams, the note "*On the Action of Sulphuric Acid on the More Volatile Portion of Coal Naphtha,*" which we published a fortnight ago.

MM. Hugo Schiff and E. Becchi made a second communication "*On Boracic Ethers.*" In their former communication (see vol. xii., p. 219) the authors showed that the lower alcohols of the series $\mathrm{C\!\!\!-}nH_2n+2\Theta$ by their action on boric anhydride formed three ethers with the general formulæ $BEt\Theta_2$, $BEt_3\Theta_3$, and $B_3Et\Theta_5$.

The higher terms of the series do not give the same results. When cetylic alcohol is heated with boric anhydride, water is eliminated and a monocetylic borate is found. This substance is separated from excess of boric anhydride by ether. It fuses at 58°; when cold it forms a white crystalline mass, tolerably permanent in the air, and decomposed with difficulty by cold water. Cetylic alcohol appears to form no other compound with boracic acid. With glycerine also only one ether is obtained. Glyceric borate forms a yellow, vitreous, very deliquescent mass, which is easily decomposed by hot water. It partly fuses, but remains very dense at 170°. The above two bodies are obtained pure by the direct action of the two re-agents. Phenic alcohol at first also yields a monophenic borate, but at a higher temperature this compound unites with another molecule of boracic anhydride, and even decomposes boracic hydrate, forming a monophenic triborate. This is an amber-coloured vitreous mass, tolerably permanent in the air. By boiling an alcoholic solution triethylic borate and monophenic borate are obtained. The former will distil; the latter will not, and may be heated to 250° without decomposing. Monophenic borate, is a viscous body, at 30°, and solidifies at 0°. It has a faint odour of phenic alcohol. Above 300° it splits up into phenic triborate and tetraphenic diborate, yielding at the same a small quantity of a dense liquid with a powerful odour of geranium, and boiling between 250° and 300°. This is phenic oxide. The fact that cetylic, glyceric, and phenic alcohols form primarily monoalcoholic borates, the authors attribute to the temperature at which the reaction takes place. It is too high to allow the formation of the hydrate $BH_3\Theta_3$, but permits the existence of the hydrate $BH\Theta_2$, and to form this only decomposes one equivalent of the alcohol. In conclusion, the authors remark that the above alcohols may form borates with the direct elimination of liquid water; whilst in the action of methylic, ethylic, and amylic alcohols with which the primary reaction produces trialcoholic ethers, the water only separates in the form of boracic hydrate.

NOTICES OF BOOKS.

The Modern Practice of Photography. By R. W. Thomas, F.C.S. London: Harrison. 1866.

We can recommend this book to all amateur photographers as a work in which they will find the best practical advice on the art told in comparatively few words. The author has evidently a horror of big books, and quotes Voltaire and Bishop Horne, who, if they agreed about nothing else, seem to have been of the same opinion as to the relative merits of long and short books.

But in truth the practice of photography can be taught in a very few words, when science and art are left out of the question. When, however, the reader has made himself acquainted with the directions here given, "How to make the negative; how to clean the glass plate; how to varnish the negative; how to print from the negative; and how to prevent fog, stains, and streaks in the negative;" with their accompanying appendices and formulæ, it is only long practice and careful observation that can make him a good photographer. We say this in case any one who reads this notice should be surprised at his want of success in first attempts. But the beginner has only to attend carefully to these instructions and persevere in his attempts, and a short time will find him tolerably *au fait* in the art.

The work is eminently practical, and all we need say of it is that we know of no book which is likely to prove so useful to one commencing the practice of photography.

A Companion to the Medicine Chest; giving the Properties and Doses of the most useful Domestic Medicines, also Directions for Sick-room Cookery. By Peter Squire. London: Churchill and Sons. 1866.

The title of this little book well describes its contents, and all we need say in addition is that the author, in most cases, gives the French, German, and Italian names of the different medicines for the information of travellers.

New Filter.—A new form of filter has been devised by the Apparateur of the College of France. It is made by placing in a tank of impure water a vessel so arranged that a sponge which it contains shall lap over its edge and dip into the water of the tank. The sponge gradually sucks up and purifies the water in the reservoir, and allows it to drop into the smaller vessel or receiver, from which it may be drawn off by a tube. By placing a few lumps of charcoal in the bottom of the receiver, filtration of the most perfect kind is effected.—*Scientific American.*

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

258. J. M. A. Moutclar, Java, "Improvements in the manufacture of materials or compositions for decolorising or purifying saccharine or other liquids, and for making paint, blacking, and foundry blackening, and in apparatus therefor."—Petition recorded January 26, 1866.

322. W. B. Nation, Hatcham, Surrey, "Improvements in the purification and hardening of paraffin wax."—February 1, 1866.

330. G. Gwynne, Mortimer Street, Cavendish Square, Middlesex, "Improvements in treating fatty and oily bodies."

332. H. Larkin, Leighton Road, N.W., and R. Purkis, Cheam, Surrey, "Improvements in the manufacture of paper by the employment of a fibre not hitherto used in this manufacture."—February 2, 1866.

338. A. Horwood and C. Brumfit, Pall Mall West, "Improvements in galvanic batteries for keeping up constant currents of electricity for railway train signals and electric telegraphic purposes."

342. P. H. Muntz, Keresley, near Coventry, "Improvements in furnaces for melting metals."—February 3, 1866.

356. T. Spencer, Euston Square, Middlesex, "Improvements in the mode of and apparatus for filtering water and other fluids."—February 5, 1866.

367. S. Holmes, Lincoln's Inn Fields, Middlesex, "Improvements in the manufacture of printing ink."—February 6, 1866.

NOTICES TO PROCEED.

2620. J. Crutchett, Stroud, Gloucestershire, "Improvements in the manufacture of gas."—Petition recorded October 11, 1865.

2630. A. A. Lerenard, Rue Pali-Kas, Paris, "A new composition of indiarubber, mastic, or cement, made in a more or less fluid state, according to the use to be made of it, and the process or contrivance for applying the same."—October 12, 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 and keeping clean the bottoms of iron vessels, and also for the preservation of iron submerged and iron structures exposed to the action of atmosphere or water."—October 14, 1865.

2660. A. J. Mott, Liverpool, "Certain improvements in the production and uses of carbonic acid gas."—October 16, 1865.

2701. W. Clark, Chancery Lane, "Improvements in printing or impressing and dyeing fabrics and tissues."—A communication from F. Dehaut, M.D., Boulevart St. Martin, Paris.

2702. W. Clark, Chancery Lane, "Improvements in the manufacture of chromates of ammonia and chromic acid, and in the preparation of nitrates of lime and baryta."—A communication from F. Dehaut, M.D., Boulevart St. Martin, Paris.—October 19, 1865.

2741. W. Clark, Chancery Lane, "Improvements in the manufacture of paper from marine vegetable matters."—A communication from P. E. Gégnon, and C. M. Gagnage, Boulevart St. Martin, Paris.—October 23, 1865.

138. Don F. Lecocq, Monte Video, "Improvements in the means or method of preserving in a fresh condition animal and vegetable substances, and in the apparatus to be employed therein."—January 15, 1866.

CORRESPONDENCE.

Continental Science.

Paris, February 12.

An accident which recently happened in M. Wurtz's laboratory at the School of Medicine may serve as a caution to some of your readers. Dr. Oppenheim—for what purpose I know not—had just sealed a flask containing 120 grammes of oxalate of silver, when it suddenly exploded, knocking the doctor completely over, and driving a piece of glass into his carotid artery, besides giving him a frightful gash in his arm. Luckily, a surgeon was close at hand, and the doctor did not die from loss of blood. The accident is supposed to have been caused by a little of the oxalate remaining in the neck of the matrass where it was sealed. Dr. Oppenheim is said to be now out of danger.

There is little of novelty in science to mention. The proceedings of the Academy this year have been singularly destitute of chemical interest, and the journals are unusually dull.

Derbyshire has two specialties—the Derbyshire neck and Derbyshire spar. Is there any connection between these two? M. Maumené would say, "Yes," for he believes that fluorides in water cause *goitre*. In fact, he gave fluoride of potassium to a bitch, and in five months she got a general swelling in her neck. Whether it was true goitre or not, neither M. Maumené nor an anatomical professor he called in is able to say. You will remember that M. Lager recently gave pyrites to a dog, and that animal also got a swelling in the neck. We seem to be as far as ever from arriving at the real cause of these enlargements, but M. Maumené's observation would suggest an examination for fluorides of the water in districts where goitre is common.

MISCELLANEOUS.

Chemical Society.—We are requested to insert the following corrected report of Dr. Hugo Müller's remarks at the last meeting of the Chemical Society:—"Dr. Hugo Müller inquired of Mr. Chapman whether his experiments were made with aqueous solutions of the naphthylamin salts, because, if so, the product might be, perhaps, some intermediate step between naphthylamin and dinitronaphthylic alcohol of Martius. This latter is a well-defined compound, from which Griess and Martius have recently obtained a well crystallised substance, isomeric with alizarin."

Royal Institution of Great Britain.—The following are the arrangements for the week:—Monday, March 5, at 2 o'clock, General Monthly Meeting. Tuesday, March 6, and Thursday, March 8, at 3 o'clock, Professor Frankland, "On the Non-Metallic Elements." Friday, March 9, at 8 o'clock, Sir John Lubbock, Bart., "On Transformation of Insects." Saturday, March 10, at 3 o'clock, Rev. G. Henslow, "On Systematic and Structural Botany."

University of Oxford—In a congregation holden on February 27, a form of statute relating to the Professorship of Experimental Philosophy was promulgated. Also a form of statute for suppressing the Aldrichian Professorship of Chemistry, a new professorship in the same science having been founded by the Society of Magdalen, to be called a Waynflete Professor of Chemistry. With regard to the latter, Sir B. Brodie asked whether the new disposition of the funds would be permanent, or whether a power would be taken for restoring them at a future time to the Professor of Chemistry. It appeared, after some discussion, that the diversion by the statute would become permanent, so Sir B. Brodie proposed an amendment to the effect that the endowment should not be permanently diverted from the Professor of Chemistry.

Dr. Odling's Lectures on "Animal Chemistry."—We have much pleasure in announcing that the lectures delivered by Dr. Odling at the College of Physicians, and printed in our last volume, will be ready for publication separately in the course of a few days.

The Cattle Plague.—The following recommendations have been drawn up by the Royal Commission on the Cattle Plague, and circulated to the local authorities throughout the country:—

"Disinfection.

"Recommendations on this subject may conveniently be ranged under the following heads:—

"1. The cleansing of sheds, infected or otherwise; of markets, slaughterhouses, lairs, &c.

"2. The cleansing of waggons, trucks, &c.

"3. The disposal of manure or litter.

"4. The disposal of carcases of infected animals.

"5. The disposal of blood, offal, and hides of apparently healthy cattle which have been killed after being in contact with infected cattle.

"6. Precautions to be taken by butchers, inspectors, and others, who visit farms for the purpose of seeing or killing diseased beasts.

"7. Further disinfecting measures which may be useful in infected or endangered farms.

"1. *The Cleansing of Sheds, infected or otherwise; of Markets, Slaughter-houses, Lairs, &c*—Wash the woodwork of the sheds everywhere with boiling water, containing in each gallon a wineglassful of carbolic acid.* Then limewash the walls and roof of the shed with good freshly-burnt lime, adding to each pailful of whitewash one pint of carbolic acid. Sprinkle the floors, after well cleaning with water, with undiluted carbolic acid. Lastly, close all the doors and openings, and burn sulphur in the shed, taking care that neither men nor cattle remain in the shed while the burning is going on. Allow the shed to remain closed for at least two hours, then open doors and windows. About 1 lb. of sulphur is sufficient for a 10 or 12-stall shed. The sulphur should be burnt in the centre of the shed, so as to get the fumes diffused everywhere. It may be placed on a shovel of burning coals. This process should not only be used in sheds where infected cattle have been kept, but also where there is any reason to apprehend the presence of infectious matter on the premises. When disease is in the neighbourhood it may be usefully employed once a week. In cleansing sheds from which the cattle cannot be removed, sulphur must not be used. In such a case, follow the above instructions, omitting only the fumigation with sulphur. All markets, slaughter-houses, lairs, and places where cattle have been customarily collected, should be carefully and thoroughly disinfected in the above manner before they are used again, the manure, blood, and offal being treated as directed in Sections 3 and 5.

"2. *The Cleansing of Waggons, Trucks, &c.*—Well scrape the boards of the truck or waggon, and burn the scrapings. Then wash everywhere with boiling water, adding some washing soda. Then wash again with chloride of lime or carbolic solution.

"3. *Disposal of Manure or Litter.*—The most effectual

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* Wherever carbolic acid is mentioned, it must be understood that either this or cresylic acid may be used indifferently. These two agents are derived from coal tar, and have the greatest similarity to each other. Of the two, carbolic acid is better known, and is in general easier obtained; but cresylic acid appears to possess slightly more antiseptic properties, and is at present cheaper. The commoner kinds of commercial "carbolic acid" consist, almost entirely, of cresylic acid. If carbolic or cresylic acid cannot be obtained, chloride of lime must be used, in the proportion of one pound to a pailful of water. Where chloride of lime is used, neither carbolic acid nor fumigation with sulphur can be employed with advantage; and the former disinfectant, although very valuable where the two latter cannot be used, is decidedly inferior to the combination of carbolic acid and sulphurous fumigation.

way of disposing of manure is to burn or bury it; but if neither plan can be adopted it must be ploughed in. Before burying or ploughing it in, water it well every day for a few weeks with the carbolic solution by means of a watering pot or hose. When the disinfectant has well penetrated remove the heap to some neighbouring arable land, and immediately plough it deeply in; care being taken that the whole of it is buried. If there is no arable land available, place the manure, after the above treatment with carbolic acid, in a heap in a field, and consolidate by the passage of carts over it. After a final watering with carbolic acid, cover it with at least one foot of earth. If the heap has to be packed over, previous to being applied to the land, water it once more with carbolic acid, and cover it again with earth. Carefully cleanse and disinfect by sponging with the carbolic solution all carts and tools used in moving the manure, and the boots of the men, as well as the feet and legs of the horses. After the manure has been removed from the premises, thoroughly disinfect the yards by the method given in Section 1. Add carbolic acid to the liquid manure in tanks, in the proportion of one pint daily to every hundred gallons.

"4. *Disposal of Carcasses of Infected Animals.*—Bury the carcass six feet deep; cover it well with good quicklime, mixed with carbolic acid in proportion of half-a-gallon to each hundredweight.[†]

"5. *The Disposal of Blood, Offal, and Hides of apparently Healthy Cattle which have been Killed after being in Contact with Infected Cattle.*—Carefully collect all blood and offal; mix with a little carbolic acid, and then bury. Hides and horns may be disinfected either by washing in a solution of carbolic acid, or by soaking in a solution of chloride of lime. It is considered advisable by importers of hides to first remove the moisture by covering them for twelve hours with common salt before they are soaked in the above solutions.

"6. *Precautions to be taken by Butchers, Inspectors, and others who Visit Farms for the Purpose of Seeing or Killing Diseased Beasts.*—The greatest care as to cleanliness is necessary in the case of butchers and others who go to farms to kill or see infected animals. They should never go near healthy beasts in their infected clothes. They should wash carefully, and dip their boots in the carbolic solution, and should thoroughly brush their clothes, sprinkle or sponge them with the same solution, and expose them to the air. In addition to these precautions, inspectors will follow the directions already issued to them. All persons who have been in contact with or near to diseased animals must also use similar precautions. All cloths and baskets used for meat should be steamed or plunged into boiling water after being used.

"7. *Further Disinfecting Measures which may be Used in Infected or Endangered Farms.*—Wash the cattle all over with a solution of one pound of soft soap, a wineglassful of carbolic acid, and a gallon of warm water. This should not only be done when cattle have been near infected stock, but also when disease is in the neighbourhood. In the latter case it may advantageously be done once a-week. Take a paint brush, with bristles about three inches long, and having dipped it into the undiluted carbolic acid, well sprinkle the liquid over the floors of the cattle-sheds, the lower parts of the walls, and the droppings of the animals every day. Be very particular to have the farm buildings always smelling of carbolic acid, especially those sheds containing sick beasts. No care need be taken to prevent the cattle licking the carbolic acid, as it is likely to do good rather than harm. All clothing, baskets, cloths, tools, and utensils of any description may readily be disinfected by exposing them to the action of burning sulphur in a close shed while undergoing fumigation as directed in Section 1. It must especially be borne in mind that disinfectants are of little use where cleanliness is not observed. The former must never be considered a substitute for the latter."

[We assist in giving the widest circulation to these recommendations, because it is within our own knowledge that the use of cresylic acid has been attended with apparently the happiest results. A healthy and a diseased animal being placed together in a shed in which the acid was freely used, the former has remained in perfect health.]

Royal Polytechnic Institution.—The ordinary general meeting of the shareholders was held on Saturday at the institution: the Rev. J. B. Owen in the chair. After the usual preliminary business, the Chairman said it was with deep regret he had to announce that, in consequence of a very severe indisposition, Mr. Pepper had not been able to attend at the institution for several days past, and as the same cause prevented his being present that day he had sent a report to the board of directors, which he (the Chairman) would read to the meeting. The Chairman then read the report. Professor Pepper regretted that the public had not come forward to support the institution during the last six months as they had in the corresponding period in 1864. This he attributed in a great degree to the intense heat which prevailed during the last summer and the disagreeable weather during the Christmas holidays. As an illustration of the effect which the weather has upon the receipts of the institution, Professor Pepper drew attention to the fact that a serious diminution of receipts was sustained during the late three days' snow. After referring to some of the principal entertainments during the last six months, Professor Pepper remarked that the portion of the public really appreciating scientific discourses was very small compared with the majority, who require the light entertainments to be at a maximum and scientific lectures at a minimum. The laboratory had been further utilised by the delivery of regular courses of lectures on electricity, geology, and chemistry. The Chairman said he was happy to add to the report of Professor Pepper that since Christmas the new exhibitions had been wonderfully successful. He took the last week as an instance, when they cleared 28*l.*; whereas in the corresponding week last year they lost 30*l.*, which showed a difference of 58*l.* The Rev. C. Mackenzie, hon. manager of the education department, read a report showing a more successful result than any previous half-year. Votes of thanks to Professor Pepper and his assistants, and to the Chairman and directors, concluded the business.

William Thomas Brande, Esq., D.C.L., F.R.S., the able and well-known chemist, who died on the 11th inst., at Tunbridge Wells, was the scion of a Hanoverian family, which settled in England, *temp.* George II., his grandfather and father being both Royal physicians here. He was born in 1786, and was educated at Westminster School. After a subsequent sojourn in Hanover, he returned to England, and became a student of St. George's Hospital, attending in 1805 and 1806 the lectures of Dr. George Pearson on Chemistry, &c., and afterwards those of Frederick Accum. Subsequently he became assistant to Sir Humphry Davy, at the Royal Institution. He, in 1808, gave satisfaction as a lecturer on chemistry at Dr. Hooper's, in Cork Street, and then joined, as teacher and demonstrator of chemistry, the medical school in Windmill Street. In 1809 he was made a F.R.S., he received the Copley medal in 1813, and was made Senior Secretary of the Royal Society. In 1812 he was appointed Professor of Chemistry and Materia Medica to the Apothecaries' Company, and, in 1851, was elected Master of the Company. He was, in 1813, made Professor of Chemistry at the Royal Institution, and delivered lectures for many years, with great success and popularity,

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[†] Owing to its antiseptic properties, the addition of carbolic acid to the lime is strongly urged in all cases where it is suspected that putrefaction has commenced.

in conjunction with Mr. Faraday, who was also associated with him as editor, for a long period, of the *Quarterly Journal of Science.* He was, in 1825, made superintendent of the coining department of the Mint. About 1837 he was associated with Mr. Griffiths in chemical lectures at St. Bartholomew's Hospital. He was also a fellow and examiner of the London University. He was the author of a standard "Manual of Chemistry," which has been translated into many foreign languages. He was also author of "Outlines of Geology" and a "Dictionary of Pharmacy," and was editor of a "Dictionary of Science, Literature, and Art." He, in 1853, received the honorary degree of D.C.L. from the University of Oxford.

Scurvy and Adulterated Limejuice.—On Tuesday evening Mr. C. J. Carttar, coroner for Kent, resumed and concluded, at the Beehive Tavern, Bridge Street, Greenwich, an inquiry relative to the death from scurvy of Henry Griffiths, one of the crew of the *St. Andrew's Castle.* Samples of the limejuice supplied to the ship were handed round to the jury, and practical men pronounced it to be of good quality. Several of the crew were now examined, and they spoke well of the provisions on board, which were above the average quality. With respect to the limejuice, they stated it was excellent, and better by far than that usually served out on board ships. Dr. Henry Leach, medical officer on board the *Dreadnought*, said that the cases of scurvy brought under his care on the 16th ult. from on board the *St. Andrew's Castle* were the worst he had ever seen. The man Griffiths died the next day. He had analysed some of the so-called limejuice from on board that ship. He was assisted by a chemist of high standing. They found that the fluid was not limejuice at all. It was either citric acid and water or weak lemonjuice and water, but they believed that it was merely citric acid and water. The mixture was quite inert and useless as an anti-scorbutic. If mariners had good limejuice on board ship, and if it were taken regularly, 80 per cent. of the cases of scurvy which occurred would never take place. The jury returned a verdict—"That the deceased died from scurvy; and the jury further say that the juice shipped on board the *St. Andrew's Castle* was a chemical decoction perfectly useless as a preventive of scurvy." The coroner said the case of this ship would be brought under the notice of the House of Commons.

Welsh Gold.—Five mines in Merionethshire have been producing gold during 1864; 2336 tons of quartz have been crushed, and 2887 ozs. of gold obtained, the value of which was 9991*l.* This is in excess of the quantity obtained in 1863, which was only 552 ozs.; but it is considerably less than the production of 1862, when 5299 ozs. were extracted, having the value of 20,390*l.*—*Mineral Statistics for 1864.*

Swedenborg the First Discoverer of Oxygen.—A correspondent writes to a Manchester paper as follows:—"When all the world besides believed both atmospheric air and water to be elements, Swedenborg, in 1721, and again in 1733-4, or half a century before Priestley, announced to the learned the contrary. "Air consists," he says, in his 'Principia,' p. 304, vol. ii, "superficially of fifth finites (oxygen), and within it are enclosed the first and second elementaries." Again, page 305, "The fifth finites (oxygen) have entered into the surface of the aërial particle, and the first and second elementaries into the internal space." That this author was aware that the two constituents of air are combined in unequal proportions, and that these vary according to circumstances of altitude, climate, &c., is obvious from the following quotations: "From a small volume of finites may originate a large volume of elementaries or of air." (Ibid, p. 106). In his "Miscellaneous Observations' (I quote from an article in the 'Intellectual Repository' for 1850, p. 373) he has the following remarks:—'In the highest regions of the atmosphere, on the tops of mountains, . . . we find that the air is very rare, and scarcely affords matter (*i. e.*, fifth finites or oxygen) for supporting fire.' That the element least in quantity in the air is also a constituent in water was also published in 1721. 'The particles,' says he, 'of water belong to the sixth kind of hard particles. . . . On its surface there are crystals of the fifth kind.'—'Principles of Chemistry,' p. 16. The writer, in the 'Intell. Repos.' further shows that Swedenborg was acquainted with the numerical proportions of the constituents of water, oxygen 8, hydrogen 1 (9), and adds: 'Thus Swedenborg proves himself to have formed a conception of the compound nature of water, its twofold composition, the equality of the volumes constituting the identity of one of its elements with one of the elements of air, &c.' That he was not unacquainted with the theory so ably advocated by Professor Tyndal with regard to heat will be obvious from the following quotation from his 'Principia,' p. 312: 'The actives of the fourth finite create subtle elementary fire, and the actives of the fifth finite (oxygen), or fifth finites made active create the common culinary or atmospheric fire.' Again, in his 'True Christian Religion,' published 1771, he has this sentence: 'The sun of this world consists of created substances, the activity of which produces fire.' "

Substitute for Pharaoh's Serpents.—"Serpents' Eggs," being made by sulpho-cyanide of mercury, an article which is difficult to make and a hard matter to obtain in country towns or even cities, I would suggest a cheap and simple mode of making an article which forms an excellent substitute:—Take 1 part of flour sulphur, 6 parts of cyanide of mercury; rub the sulphur in a mortar with the cyanide of mercury to a very fine powder (the finer the better), then make a cone of tin foil and pack the powder into it rather loosely, leaving sufficient room at its bottom to close it. If tin foil is not convenient, moisten the powder and form a cone of the same, as pastilles are formed, place in the sun or near a fire until sufficiently dry. —*Correspondent of Scientific American.*

Preparation of Alumina for Colours.—Dullo obtains pure alumina in a very fine state of division by dissolving one kilog. of alum in five litres of water, adding five grammes of sulphate of copper. He then throws into the solution about 250 grammes of zinc cuttings, and places the whole in a properly heated place for two days. The copper is first precipitated on the zinc, and a voltaic battery is formed. By continued action the zinc is dissolved, and the alumina is gradually deposited. The reaction is ended when the solution gives no precipitate with excess of ammonia. If the action is prolonged, oxide of iron may be thrown down, which will give the alumina a yellow colour. Should this happen, the iron may be removed by boiling a few moments with very dilute sulphuric acid.—*Deutsche Illust. Gew. Zeit. and Bull. de la Soc. Chim.*, Jan., 1865, p. 78.

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.

R. L. S.—1. Gmelin, when completed. 2. No. 3. We do not know when a new edition of the organic part of Dr. Miller's Chemistry will be published.

F. T. B.—We know of no general work of the kind you mention.

Mr. Spencer.—Received with thanks.

C. P. B.—There is no book on aniline dyes. The best account of them is in Dr. Hofmann's Exhibition Report.

Os.—Put up and labelled as you describe, we do not think they would be liable to stamp duty.

A Young Reader.—You will find a good account in Lardner's "Museum of Science and Art."

A Journeyman Dyer.—Received. We will make inquiries.

Ozone.—The letter is too long for insertion. The writer has not seen the appendix to the report, which will shortly be published. Dr. Moffatt has proposed to employ ozone; but there are great practical difficulties in the way.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

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

PART II.

THEORY OF TYPES AND ATOMICITY.

SECTION III.—*Atomicity of the Compound Radicals.*

(*Continued from page* 91.)

The principle of atomicity was established in the science slowly and by degrees. The germ of it is contained in the law of multiple proportions, and above all in the laws of Gay-Lussac concerning the volumetric relations which regulate the combinations of the gaseous bodies.

1 volume of chlorine combines with 1 volume of hydrogen.

1 volume of oxygen combines with 2 volumes of hydrogen.

1 volume of nitrogen combines with 3 volumes of hydrogen.

The combining capacity of the three bodies for hydrogen is, therefore, essentially different. Chemists were less struck with the importance of this deduction because the law of multiple proportions taught them also that the combining power of one element for another exerts itself by degrees. How could they have given to the fact of the triatomicity of nitrogen in ammonia the attention it deserved, when they knew that 1 volume of nitrogen also combined with half a volume of oxygen, which equals 1 volume of hydrogen?

Besides, the idea of the atomicity or equivalence of atoms could only attain development when the notion of the atom was clearly separated from that of the equivalent; and we know what confusion there has long existed on this point. But, when this distinction was established, it was at once seen that the simple or compound radicals are not all equivalent to each other, do not possess the same power of substitution or combination. In his article on thiacetic acid, Kekulé has mentioned the *bibasic nature of sulphur.*[*]

Developing the idea of Dr. Williamson on the substitution value of the group $S\Theta_2$ in sulphuric acid

$$\left.\begin{matrix} S\Theta_2 \\ H_2 \end{matrix}\right\} \Theta_2$$

where it replaces 2 atoms of hydrogen, Dr. Odling[†] applied this view to other compound radicals, and, which is of considerable importance, to a certain number of elements. He remarked that, whilst potassium displaces only 1 atom of the hydrogen of water, and, consequently, has a substitution value only equal to that of hydrogen, bismuth, for example, possesses a substitution value equal to that of 3 atoms of hydrogen. He put this thought in a very clear form by representing the composition of potassa and oxide of bismuth by the formulæ

$$\left.\begin{matrix} K' \\ H' \end{matrix}\right\} O'' \quad \text{and} \quad \left.\begin{matrix} Bi''' \\ Bi''' \end{matrix}\right\} 3O''$$

in which the accents show precisely this substitution value, which is now called atomicity.

I have myself called attention to the differences which exist between the combining powers of the elements, in my article on the organic radicals, where I speak of nitrogen and phosphorus as "tribasic radicals."

This is the origin of the theory of the atomicity of the elements. But this theory acquired a real importance only when the notion of polyatomic radicals was admitted into organic chemistry. I believe I was the first to introduce it, and my deductions were based, in the first place, on M. Berthelot's works on glycerine, and then on my own researches upon the glycols. It will be advisable, then, to show the logical connection and successive development of all these ideas; to define, in the first place, what is meant by this expression, now so often used, of polyatomic radicals, and to explain how the notion of radical compounds, in general, is derived from that of the saturation of bodies.

(To be continued.)

On Antozone,[*] *by M.* OSANN.

THE vapours accompanying the slow combustion of phosphorus have, by certain chemists, been regarded as phosphorous acid. M. Schoenbein considers them to be nitrite of ammonia; while M. Meissner, again, sees in them antozone. With a view of clearing up this point, the author has passed these vapours into solutions of ammoniacal nitrate of silver and alkaline solutions of oxide of lead. In the first place a black precipitate was obtained; this precipitate contained, on an average, 97·28 of silver to 2·72 of oxygen, which composition corresponds to the formula Ag_3O. The author at first thought that the oxygen contained in this precipitate was ozone, which, having more powerful affinities than ordinary oxygen, had displaced the latter in the oxide of silver, but the oxidising nature of ozone has caused him rather to attribute the formation of this body to a deoxidising action such as produces antozone. He afterwards passed the same vapours; first into an alkaline solution of pyrogallic acid, to retain the ozone; then partly into one of Woolf's bottles containing a little water; partly into an ammoniacal solution of nitrate of silver; in this case the same precipitate was obtained, though all the ozone must have been absorbed by the pyrogallic acid.

The water in Woolf's bottle, which had remained in contact with the vapours from the phosphorus, was shaken with blued tincture of guaiacum, which immediately lost its colour. The same thing happened with nitrite of ammonia and oxygenated water, but much more slowly with the latter, though it was highly concentrated. Hence the author does not hesitate to say that in his experiment the decoloration was due to nitrite of ammonia, and, consequently, he attributes the vapours produced during the slow combustion of phosphorus to the formation of this body.

Researches on the Volatile Hydrocarbons, *by* C. M. WARREN.

(*Continued from page* 99.)

Of the Calculated Boiling-points of Hydrocarbons by Gerhardt's Theory.

We come finally to test the law of Gerhardt, above mentioned. Inasmuch as this law was especially designed to apply exclusively to the hydrocarbons—upon the observed boiling-points of some of which it was indeed founded—we should naturally expect to find this more in accordance with facts than either the hypothesis of Schröder or that of Löwig, both of which claimed to be of more general application and were framed more especially with reference to other classes of substances. The facts presented in the following tables will show, how-

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[*] *Annalen der Chemie und Pharmacie*, vol. xc., p. 310. July, 1865.

[†] "On the Constitution of Acids and Salts." *Quarterly Journal of the Chemical Society*, vol. vii., p. 1, January, 1855.

[‡] *Annales de Chimie et de Physique*, 3rd series, vol. xliv., p. 360.

[*] *Journal für praktische Chemie*, xcv., 55.

ever, that this is far from being the case; and that the theory of Gerhardt, as well as those of Schröder and Löwig, so far as these relate to the hydrocarbons, was by no means legitimately drawn from nature, but is altogether artificial.

1. *Hydrocarbons from Pennsylvania Petroleum.*

1st Series.

Formula.	Determined Boiling-point.	Calculated boiling-point by Gerhardt's theory.	Difference between calculated and determined boiling-point.
	Degs.	Degs.	Degs.
C_8H_{10}	0·0(?)	-8·0	
$C_{10}H_{12}$	30·2	12·5	17·5
$C_{12}H_{14}$	61·3	33·0	28·3
$C_{14}H_{16}$	90·4	53·5	36·9
$C_{16}H_{18}$	119·5	74·0	45·5
$C_{18}H_{20}$	150·8	94·5	56·3

2nd Series.

Formula.(?)	Determined boiling-point.	Calculated boiling-point by Gerhardt's theory.	Difference between calculated and determined boiling-point.
	Degs.	Degs.	Degs.
C_8H_{10}	8-9	-8	16·5
$C_{10}H_{12}$	37·0	12·5	24·5
$C_{12}H_{14}$	68·5	33·0	35·5
$C_{14}H_{16}$	98·1	53·5	44·6
$C_{16}H_{18}$	127·6	74·0	53·6

3rd Series.

Formula.	Determined boiling-point.	Calculated boiling-point by Gerhardt's theory.	Difference between calculated and determined boiling-point.
	Degs.	Degs.	Degs.
$C_{20}H_{20}$	174·9	130·0	44·9
$C_{22}H_{22}$	195·8	150·5	45·3
$C_{24}H_{24}$	216·2	171·0	45·2

2. *Hydrocarbons from Coal-tar Naphtha.*

Name of Substance.	Formula.	Determined boiling-point.	Calculated boiling-point by Gerhardt's theory.	Difference between observed and calculated boiling-point.
		Degs.	Degs.	Degs.
Benzole .	$C_{12}H_6$	80·0	93·0	13·0
Toluole .	$C_{14}H_8$	110·3	113·5	3·5
Xylole .	$C_{16}H_{10}$	139·8	134·0	6·0
Isocumole	$C_{18}H_{12}$	169·9	155·5	15·5

3. *Hydrocarbons from Oil of Cumin and Cuminic Acid.*

Name of Substance.	Formula.	Determined boiling-point.	Calculated boiling-point by Gerhardt's theory.	Difference between observed and calculated boiling-point.
		Degs.	Degs.	Degs.
Cumole. .	$C_{18}H_{12}$	151·1	154·5	+ 3·4
Cymole. .	$C_{20}H_{14}$	179·6	175·0	− 4·6
Cumo-oil of turpentine.	$C_{20}H_{16}$	155·4	160·0	+ 4·6

The chief conclusions deduced from the foregoing facts and considerations may be briefly summed up as follows:

1. That the boiling-point difference for the addition of C_2H_2 in homologous series of hydrocarbons is generally 30° C., which is a much larger difference than has been commonly supposed.

2. That of the five series of hydrocarbons examined only one series was found exceptional to the rule just stated, and this presented the boiling-point difference of about 20°, which is but little larger than the number 19°, which Kopp found so common with other classes of substances.

3. That certain series of derivatives from the benzole series of hydrocarbons present boiling-point differences corresponding to the elementary difference of C_2H_2, considerably smaller than the number 19° of Kopp.

4. That the formulæ of Schröder, Löwig, and Gerhardt for the calculation of boiling-points, so far as these may be supposed to relate to the hydrocarbons, are incorrect and purely artificial.

5. That the custom of taking boiling-points with the bulb of the thermometer in the vapour is more liable to lead to an erroneous determination, at least in certain cases, than if the bulb be placed in the liquid.

Preparation of Carbolic Acid, by M. Muller.

Phenic acid or phenylic alcohol is usually accompanied by its congeners, xylic and cresylic alcohols, which adhere to it with great tenacity, and give it the property of becoming brown in contact with the air. For its purification the author has recourse to a partial neutralisation, and afterwards to the fractional distillation of the product.

The crude tar cedes to soda or lime water a mixture of the matters before mentioned, as well as naphthaline, which is soluble in concentrated solutions of the alkaline phenates. Water is added to this until it ceases to cause a precipitate, when the liquid is exposed in wide vessels, to facilitate the formation of the brown bodies and their deposit. After filtering, the approximative quantity of organic matter held in solution is determined; formed principally of phenic acid and its congeners, which are easily displaced by acids.

The phenic acid is always the last to separate, so that it is easy to disembarrass it of its associated matter and brown oxidised products by adding carefully the proportion of acid determined by calculation, so as to precipitate at first only these matters, and by means of several trials it is easy to arrive at the proper point to stop, so as to retain the phenate nearly pure. The acid is now separated and rectified, and soon crystallises. As a little water prevents its crystallisation, the author removes it by passing a current of dry air over the phenic acid nearly boiling.

The crystallisation is facilitated by cooling, or by the introduction into it of a small quantity of the crystallised acid.

The author insists on the necessity of exposing the alkaline solution of the acid for a long time to favour the resinification and deposition of the brown matters; phenic acid is always impure when it is coloured.

It should be quite pure when employed to make picric acid, because the impurities waste the nitric acid.

Phenic acid often contains a fetid substance, which appears to be a sulphuretted compound of phenyl or cresyle. It is removed by rectification from oxide of lead.—*From Zeitsch. für Chem., in Journ. de Pharm.*, Nov., 1865.

Testimonial to Professor Tuson.—On Wednesday week the students of the Royal Veterinary College, Camden Town, presented their Professor of Chemistry with a handsome microscope, as a memento of their personal esteem, and also of their appreciation of his professional abilities.

TECHNICAL CHEMISTRY.

*Memoir on the Utilisation of Chlorine Residues and Soda Waste, by M. E. Kopp.**

(Continued from page 40.)

Combustion of Sulphuretted Hydrogen.—The best means of extracting part of the sulphur from sulphuretted hydrogen, M. Kopp says, is by combustion. Under the influence of excess of air H_2S is transformed into H_2O and SO_2. It would appear at first sight that the best method of utilising the SO_2 and water thus produced would be to conduct the mixed vapours into a leaden chamber, and transform them into sulphuric acid in the usual way. This plan, however, has not been found to answer, the reasons for which the author gives at considerable length. They are, shortly, the large proportion of air necessary to effect the complete combustion, and the consequent introduction of a large amount of inert gas (nitrogen) into the chamber, so diluting the vapours, and preventing them, to a certain extent, from reacting on each other.

The author gives here a table of the minimum proportions of air necessary to convert a kilogramme of sulphur in various states into sulphuric acid. Thus—

	Litres of air.		Litres of nitrogen.
Free sulphur . .	5275	containing	4220
Pyrites	6595	„	5276
Sulphuretted hydrogen	7035	„	5628

If the sulphuretted hydrogen obtained by the author's process (see page 40) has not been purified from the carbonic acid, the proportion of inert gas is still further augmented.

Under these circumstances, M. Kopp has found that the sulphurous acid generated in the complete combustion of the sulphuretted hydrogen is best utilised in the production of hyposulphites of soda or lime, and sulphites and bisulphites of soda, lime, or alumina, &c. When these salts are not required, an incomplete combustion may be resorted to, which produces water and free sulphur.

The arrangements for effecting the combustion are described by the author in a few words. The burner, of cast iron, resembles an ordinary circular gas burner, the holes being about two mm. in diameter. A tube surrounding the one conveying the gas and fitted to the burner supplies most of the air required for the combustion; the lower extremity of this tube must be fitted with some contrivance by which the supply of air can be regulated.

A long chimney of sheet iron, also fitting closely to the burner, conveys away the products of combustion. This must be furnished with a sliding door, by which air may be supplied to the exterior of the flame. The apparatus altogether resembles the burner of a moderator lamp, surmounted by its chimney, but so arranged that the current of air may be more or less intercepted both inside and outside the flame.

Close to one of the holes of the burner a small depression is made in which a piece of sulphur can be lodged. The iron chimney is pierced with a small opening opposite to this depression, so that a slight current of air may be admitted to carry on the combustion of the sulphur previously lighted. The object of the lighted sulphur is to relight the gas in case it should be accidentally extinguished, and so prevent an accumulation of sulphuretted hydrogen in the condenser, and also the explosion which would probably ensue if the gas were relighted by a workman.

With this disposition of apparatus it will be seen that the admission of air can be so regulated that the sulphuretted hydrogen may be completely burnt to H_2O and SO_2, or incompletely, so that the hydrogen only is consumed and the sulphur deposited in a proper condensing apparatus, or even an intermediate combustion effected, so as to produce at once sulphur and sulphurous acid. An examination of the gas formed by the combustion will show its character and guide the operator in regulating the admission of air.

The author enters at some length into the risks of explosion, but these under proper management appear to be very small, and easily provided against.

The first application suggested for the sulphurous acid produced in a complete combustion is in the production of sulphite and bisulphite of soda. For this the iron chimney surrounding the burner is bent at a right angle and carried to a box in which crystals of carbonate of soda are placed on shelves. An exit tube is carried from the box to a chimney, and so a draught is kept up. The sulphurous acid disengages the carbonic acid from the crystals, and the sulphite of soda dissolving in the water of crystallisation falls to the bottom of the box in the state of a nearly neutral solution.

To form a bisulphite, the solution must be brought into contact with the sulphurous acid, which can be done by well agitating it in an atmosphere of the gas.

The bisulphites of alumina and lime may be prepared by making the sulphurous acid react on milk of lime or gelatinous alumina.

A dilute solution of sulphite of soda may be economically obtained by making the sulphurous acid react on a mixture of sulphate of soda and lime in equal equivalents. As the bisulphite of lime dissolves, a double decomposition with the sulphate of soda takes place, which results in the formation of sulphite of soda and sulphate of lime.

To prepare hyposulphite of lime and hyposulphite of soda, soda waste well rubbed and distributed in four or five times its weight of water, or, still better, a solution of alkaline polysulphides, is kept well agitated in the atmosphere of sulphurous acid. In the presence of a slight excess of soda waste, the carbonate of lime it contains remains unacted upon, and only the sulphide of calcium dissolves, passing to the state of hyposulphite. When the solution marks 12° B. it is run off, and after depositing, the clear solution is evaporated at as low a temperature as possible, by which crystals of calcio hyposulphite, containing six equivalents of water, are obtained. The solution of hyposulphite of lime, however, is best employed to form hyposulphite of soda, for which purpose it is decomposed with sulphate of soda. The precipitated sulphate of lime is strongly pressed, but not washed, sulphate of lime, with a little adhering hyposulphite of soda, being useful in the manufacture of paper.

When sulphurous acid is not required, the best method of utilising the sulphuretted hydrogen is to extract the sulphur from it. For this purpose the incomplete combustion before described is resorted to. The influx of air being diminished, until the smell of sulphurous acid is hardly perceived in the product of combustion, the gas burns with a long reddish-blue flame. The chimney bent at a second right angle is now carried down to a condensing apparatus, consisting of a long wooden box, the bottom of which is covered with water, and which contains a series of compartments so arranged as to

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* Abridged translation from the *Bulletin de la Société Chimique*, p. [illegible].

make the gas traverse a long distance. An exit tube as before is carried to a chimney shaft to produce a draught, which need not be great if the sulphuretted hydrogen has been purified. It is best to make the tube leading from the chimney of the burner to the condenser pass through a refrigerator, in which case nearly the whole of the sulphur becomes condensed. It is deposited on the sides of the condenser in the form of flocculi or threads, which adhere to one another, forming thin plates of a beautiful yellow colour. A large quantity of finely divided sulphur is also found in the water at the bottom of the condenser in the form of a yellow mud.

The water becomes slightly acid from the presence of sulphurous and pentathionic acid. When removed it only requires to be dried.

The author comes next to the method of utilising the acid solution resulting from the action of chlorine residues on soda waste.

(To be continued.)

PHARMACY, TOXICOLOGY, &c.

On the Active Principle of Rhus Toxicodendron,

by J. M. Maisch.*

The leaves of rhus toxicodendron are said by Dr Khittel to owe their irritating properties to the presence of a volatile alkaloid. The experiments of the author, on the contrary, prove that the active principle of the plant is volatile acid, for which he proposes the name of *Toxicodendric acid.* Mr. Maisch separates the acid by treating the bruised leaves with 6 per cent. of their weight of slacked lime, macerating with sufficient water and pressing out the liquor, which is made acid with sulphuric acid, and then distilled, the distillate being collected in water, holding carbonate of baryta in suspension.

The solution of the baryta salt was tested with various reagents: nitrate of silver producing a slight milkiness, removeable by nitric acid; on standing, a copious black precipitate was obtained; bichloride of mercury, after some time, produced a white precipitate, then supposed to be calomel; bichloride of platinum an extremely slight deposit; chloride of gold, after boiling, a separation of metallic gold adhering to the test tube; acetate of lead, a white precipitate, soluble in nitric acid; neutral tersulphate of iron (I had then no neutral sesquichloride of iron on hand), a precipitate of sulphate of baryta, and apparently a slight red colouration.

These reactions appeared to be so nearly identical with those of formic acid that I was almost satisfied that the dreaded poison of the rhus toxicodendron was the same compound which is generated by the little busy formica rufa.

The expressed liquid, set aside as before stated, was now subjected to distillation, after having been previously mixed with an excess of sulphuric acid. A portion of the distillate was again collected in water, holding carbonate of baryta in suspension; another quantity was condensed by itself, to obtain the pure acid. This acid had a similar odour, as noticed before, but it changed and disappeared almost entirely on rectifying the liquid over chloride of calcium.

The acid solution, as thus obtained, is colourless, strongly affects blue litmus paper, and neutralises bases; but the salts with the stronger bases show a distinct alkaline reaction. Added to solution of acetate or subacetate of lead, the acid produces a heavy white precipitate, which is scarcely soluble in boiling water, but readily soluble in nitric acid; with corrosive sublimate and bichloride of platinum no alteration takes place, even after boiling; chloride of gold is in the cold slowly, at the boiling heat rapidly, reduced, and a film of metallic gold deposited; with nitrate of silver, no immediate alteration occurred in the cold, but gradually a black precipitate of oxide of silver takes place, which is produced in a few minutes, if the mixture is boiled. This separation of the oxide of silver must be caused by the mutual decomposition of the acids, whereby the oxide is liberated; for, if the acid is boiled with pure oxide of silver, and the solution filtered while hot, it retains the silver in solution. A salt of the new acid produces, in nitrate of silver, a white turbidity, changing to a black precipitate on standing, or in a few minutes on boiling; but entirely removeable by the addition of nitric acid.

Protonitrate of mercury is not affected by the pure acid either in the cold or on boiling; but treated with the solution of a salt of the new acid, a white precipitate is produced, which gradually, but on boiling instantly changes black; nitric acid dissolves it readily.

Red oxide of mercury is dissolved by the boiling acid; the solution, filtered while hot, deposits on cooling nearly all the salt, leaving, however, enough in solution to affect hydrosulphuric acid considerably. This white mercuric salt is the same as the white precipitate occurring in solutions of a salt of the new acid with bichloride of mercury, and it is not reduced either on standing or by boiling.

Protoxide of lead is readily taken up by the boiling acid, forming a solution of a strong alkaline reaction, which, on cooling, precipitates most of the salt in white flocks, leaving the liquid decidedly alkaline; the salt is taken up by dilute nitric acid.

Carbonate of copper dissolves in the boiling acid to a bluish-green solution, which forms no precipitate on cooling.

Neutral sesquichloride of iron is not affected in colour, either by the pure acid, or by one of its salts.

Permanganate of potassa is readily reduced.

Chromate of potassa is not reduced to chromic oxide, on boiling, either with the free acid or one of its salts.

Comparing all these reactions with those of formic acid, it will be seen that only the behaviour to chloride of gold, and the reduction of metallic gold from the solution are identical; in the sparing solubility of the lead salt, the two acids likewise resemble each other. This acid has more reactions in common with acetic acid, among the most prominent of which are the slight alkaline reaction of their salts with alkalies and alkaline earths, and the strong alkaline reaction of the (basic ?) lead salt.

But the behaviour of this acid and its salts to oxide of silver, nitrate of silver, oxide of mercury, and corrosive sublimate, distinguish it readily from both formic and acetic acid.

Taking all the reactions together, it is, unquestionably, a new organic acid, for which I propose the name of toxicodendric acid.

That it is the principle to which the poison oak owes its effects on the human system, was proved to my entire satisfaction by the copious eruption and the formation of numerous vesicles on the back of my hand, on the fingers, wrists, and bare arms, while I was distilling and operating with it. Several persons, coming into the room while I was engaged with it, were more or less poisoned by the vapours diffused in the room; and I even

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* Abridged from *American Journal of Pharmacy*, vol. xiv., p. 4.

transferred the poisonous effects to some other persons, merely by shaking hands with them.

The dilute acid, as obtained by me, and stronger solutions of its salts, were applied to several persons, and eruptions were produced in several instances, probably by the former, though not always, which was most likely owing to the dilute state of the acid. Whenever this was boiled, I always felt the same itching sensation in the face, and on the bare arms, which I experience on continual exposure of my hands to the juice of the plant.

Ammonia appeared most successful in relieving the irritation.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 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 several donations to the Society's library announced. Dr. Holzmann and Mr. Waienn were formally admitted as Fellows, and the following gentlemen were duly elected, viz.:—Mr. W. H. Cawfield, Pembroke College, Oxford; Mr. Robert Bell, Professor of Chemistry, Queen's College, Kingston, Canada West; and Mr. G. W. Webster, Bridge Street, Warrington. For the second time were read the names of Mr. Samuel Crawley, St. Peter's College, York; and Mr. C. Patmore Phillips, Fenchurch Street, London. The candidates proposed for the first time were Mr. Robert McCalmont (of Messrs. Ritchie and Sons), Belfast; Mr. William Carr Stevens, 34, Mark Lane; and Mr. Thomas Vosper, 27, Nightingale Street, Manchester.

Professor A. H. Church gave a further account of his recent "*Chemical Researches on New and Rare Cornish Minerals.*" The author commenced with a statement respecting *Melaconite*, the native black cupric oxide of Cornwall, an analysis of which was published a year ago in the Chemical News, with a promise that its crystallographic characters should be examined.* Professor Maskelyne had, however, exhausted this part of the subject in a paper read before the British Association, which, although not yet published in this country, had appeared in Russia. *Marmatite.*—The author analysed a Cornish specimen of this black variety of blende, which gave results almost identical with the marmate specimen described by M. Boussingault, and having the formula $4ZnS,FeS$. *Erinite.*—The green compound of hydrate and arseniate of copper, hitherto found only in Limerick, had been identified amongst a number of copper minerals from Cornwall. Professor Church offered a few remarks respecting *Autunite* and *Cornwallite*, and proceeded to describe a new hydrated cupric-aluminium sulphate, for which he proposed the name of "*Woodwardite.*" This mineral occurs in the form of botryoidal aggregations of a greenish-blue colour and specific gravity about 2·38. A trace of copper is removed by digesting in cold water, and it dissolves readily in dilute acids. It is somewhat hygroscopic. Dried in vacuo over oil of vitriol, it was found to have the following composition:—

$$2\overset{\prime\prime}{Cu}SO_4,5\overset{\prime\prime}{Cu}H_2O_2,4\overset{\prime\prime\prime}{Al}H_3O_3+4H_2O.$$

The four outstanding atoms of water are easily driven off by exposure to 100° C. This mineral differs from Brochantite by containing alumina, and is more basic than lettsomite, with which the author compared it by stating his results alongside with those obtained by Dr. Percy.

Dr. Hugo Muller inquired whether the Cornish marmatite occurred in a crystallised form?

Mr. Church replied that its fracture indicated a dodecahedral form. The compound $3ZnS,FeS$ was likewise known, and it was isomorphous with blende.

Mr. John A. R. Newlands read a paper entitled "*The Law of Octaves, and the Causes of Numerical Relations among the Atomic Weights.*" The author claims the discovery of a law according to which the elements analogous in their properties exhibit peculiar relationships, similar to those subsisting in music between a note and its octave. Starting from the atomic weights on Cannizzaro's system, the author arranges the known elements in order of succession, beginning with the lowest atomic weight (hydrogen) and ending with thorium (= 231·5); placing, however, nickel and cobalt, platinum and iridium, cerium and lanthanum, &c., in positions of absolute equality or in the same line. The fifty-six elements so arranged are said to form the compass of eight octaves, and the author finds that chlorine, bromine, iodine, and fluorine are thus brought into the same line, or occupy corresponding places in his scale. Nitrogen and phosphorus, oxygen and sulphur, &c., are also considered as forming true octaves. The author's supposition will be exemplified in Table II., shown to the meeting, and here subjoined:—

Table II.—Elements arranged in Octaves.

	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	Os	51
G	3	Mg	10	Ca	17	Zn	24	Sr	31	Cd	38	Ba & V	45	Hg	52
Bo	4	Al	11	Cr	19	Y	25	Ce & La	33	U	40	Ta	46	Tl	53
C	5	Si	12	Ti	18	In	26	Zr	32	Sn	39	W	47	Pb	54
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	Th	56

Dr. Gladstone made objection on the score of its having been assumed that no elements remain to be discovered. The last few years had brought forth thallium, indium, cæsium, and rubidium, and now the finding of one more would throw out the whole system. The speaker believed there was as close an analogy subsisting between the metals named in the last vertical column as in any of the elements standing on the same horizontal line.

Professor G. F. Foster humorously inquired of Mr. Newlands whether he had ever examined the elements according to the order of their initial letters? For he believed that any arrangement would present occasional coincidences, but he condemned one which placed so far apart manganese and chromium, or iron from nickel and cobalt.

Mr. Newlands said that he had tried several other schemes before arriving at that now proposed. One founded upon the specific gravity of the elements had altogether failed, and no relation could be worked out of the atomic weights under any other system than that of Cannizzaro.

Professor J. A. Wanklyn then described "*A New Method of Forming Organo-Metallic Bodies.*" The author showed eight years ago that sodium attacks zinc-ethyl, precipitating the zinc and forming sodium-ethyl; and later that the metals potassium, lithium, &c., behave in a similar manner. Instead of following this mode of procedure, Mr. Wanklyn now prepares the organo-metallic bodies by the action of mercury, in union with the metal whose combination is to be effected, upon sodium-ethyl or other compound radical of an electro-positive metal, utilising in this manner the well-known affinity of mercury for the alkali metals. The following change was effected upon this principle:—

$$Hg+Zn+2NaC_2H_5=HgNa_2+Zn(C_2H_5)_2.$$

And the same was true when magnesium took the place of zinc; but when the crystalline double ethide of zinc and sodium (formed by the action of sodium upon zinc-ethyl) was employed, the resulting product was a compound containing both zinc and magnesium, which took fire spon-

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* *Vide* vol. xi., page 12 of this journal.

taneously on exposure to air. By the action of mercury alone, or of that metal in the presence of copper, iron, or silver, nothing but mercury-ethyl and sodium amalgam were formed. The foregoing experiments prove that sodium-ethyl possesses the very singular property of giving up its sodium to mercury, and may furnish an explanation of the anomalous results obtained by Messrs. Buckton and Odling in the determination of the vapour-densities of aluminium-ethyl and aluminium-methyl.

The CHAIRMAN remarked upon the importance of Professor Wanklyn's discovery, inasmuch as it exhibited the affinities of mercury in a new light.

An abstract of a paper, entitled "*Contributions to our Knowledge of the Chemical Action of Sunlight upon Sensitive Photographic Papers,*" by C. R. Wright, B.Sc., was read by the Secretary. Following the method adopted by Mr. McDougall, and described in his paper (*Journal of the Chemical Society*, vol. iii., p. 183), the author proposed to determine the relative degrees of sensitiveness exhibited by papers coated with the chloride, bromide, and iodide of silver, and mixtures of these, in the proportion of single equivalents, in the presence of a constant excess of nitrate of silver. The conclusions established by the author's experiments are stated in the form of eight propositions; but the general nature of the results may be gathered from the subjoined table, which describes the relative degrees of sensitiveness observed when the several papers were referred to a normal tint; thus:—

Chloride of silver paper	1000
Chloro-iodide of silver	1078
Chloro-bromide of silver	4022
Bromide of silver	2396
Bromo-iodide of silver	4060

A vote of thanks to the authors of the several communications was moved by the CHAIRMAN, who took occasion to announce the names of the auditors—Dr. J. Attfield, Mr. C. Heisch, and Professor J. A. Wanklyn,—and to read for the second time the programme relative to the proposed changes in the Council, after which, at a late hour, the meeting was adjourned until the 15th instant.

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 6.

Tuesday, May 16, 1865.

Recent Researches on Metals and Alloys.

(Continued from page 95.)

Although the oxidation of iron, or its rapid destruction under the influence of the carbonic acid and oxygen of the air, is a source of great advantage to those who manufacture this article, still in many instances it is a source of annoyance to those who possess articles made of that valuable metal, and in others it is a national loss, as in the rapid decay which our iron ships of war undergo. Allow me, therefore, to say a few words on these points.

It is easy to preserve small articles made of iron from rust, either by plunging them into a weak solution of caustic alkali (whether the iron is preserved by a peculiar action of the alkali, or because it prevents the action of the carbonic acid of the atmosphere in conjunction with oxygen and moisture, are points to be determined), or covering them with a varnish made of india-rubber, gutta percha, and a small amount of fatty matter. As to the preservation of ships' bottoms from corrosion, without entering here into the various methods that have been proposed of late to effect this important object, still I deem it my duty to call your attention to one or two methods that have been tried with apparent success; thus Mr. Leach has applied on the iron surface of ships' bottoms a coating of gutta percha or other cement, and fastening by it sheets of glass of about one-fourth of an inch in thickness. The glass is previously bent to the shape of the ship, and pierced for the reception of the screw or bolts, which are preserved from immediate contact with the metal bolts by coating them with a little of the fastening mixture.

M. Becquerel relates, in the *Comptes Rendus* of the Academy of Sciences, 1864, the results which obtained by the application of his galvano-electric process on the iron keels of some of the French men-of-war. This process is based on the same principles as those adopted by Sir Humphry Davy, in 1824, for preventing copper sheathing from being rapidly corroded by sea water, and which consisted, as you are aware, in attaching at various distances blades of zinc between the wooden side of the vessel and the copper sheets, or, what effected the same purpose, in using brass nails for fastening the copper to the sides of the vessel.

M. Becquerel employs zinc in connexion with iron, thus establishing a galvanic current which renders the iron, like the copper in Sir H. Davy's experiment, electronegative, or possessing the same kind of electricity as oxygen, therefore communicating to it the property of liberating oxygen from any compound instead of absorbing or fixing it. M. Becquerel has proved that the galvanic action of the zinc on the iron exercises its influence on the whole of the iron surface of the ship, but nevertheless that its influence decreases as the square of the distance, and consequently that its action is only sufficiently powerful to preserve iron from corrosion for a limited distance, and consequently the preserving bands of zinc must be placed at short intervals from each other.

Mr. Johnson and myself published, as I hope you will remember, in the *Journal* of the Society two or three years since two papers bearing upon this same subject, the first paper containing facts exactly identical with those published in 1864 by Becquerel; the second showing the advantage that would be derived by ship-builders in using galvanised iron plates instead of wrought iron ones for plating our men-of-war, for you are aware that the attack of sea-water on iron plates in contact with oak was very great; being 2·880 as compared with galvanised iron, which was only 0·095, all the circumstances of action being equal in both cases.

But the most important result that Mr. Johnson and I have arrived at on this point, is the demonstration in a paper we have published on "The Action of Sea-water on certain Metals and Alloys," that the action of sea-water on lead is nearly *nil*, as seen by the following table:

Action of Sea-Water upon Metals.

1 Metre.	Grammes.
Steel.	29·16
Iron.	27·37
Copper (best selected)	12·96
Do. (rough cake)	13·85
Zinc.	5·66
Galvanised iron (Johnson's process).	1·12
Block tin.	1·45
Stream tin	1·45
Lead (virgin)	trace
Lead (common)	trace

This metal can, therefore, be used with great advantage to preserve the keels of iron ships from being corroded by the action of sea water, and that the objection which might be raised as to its softness might be easily overcome by adding to lead a few hundredths of either arsenic or antimony, which would increase its hardness, and thus render it better fitted for the purpose referred to. From experiments that we have made we can further state that, in our opinion, Muntz's metal is a far superior article to copper for sheathing ships.—(See *Society of Arts' Journal*, April 21, 1865.)

As a few ladies have done me the honour to attend these lectures, it may be interesting to them to have a simple method of cleaning silver or silver-plate without the trouble of employing rouge or other cleaning powder, which, besides rapidly wearing off the metal, takes up much of their servants' time. It consists in plunging for half-an-hour the silver article into a solution made of 1 gallon of water, 1 lb. hyposulphite of soda, 8 oz. muriate of ammonia, 4 oz. liquid ammonia, and 4 oz. cyanide of potassium; but, as the latter substance is poisonous, it can be dispensed with if necessary. The plate being taken out of the solution, is washed, and rubbed with a wash leather.

Improvements have also been made of late in coating cheap metals, such as iron and brass, with more valuable ones, so as to enhance the value of the fancy articles made with them. If you remember, I referred to a process devised by M. Oudry for coating cast-iron with copper or bronze. The method that I wish now to bring before your notice is one devised by M. Weil, and is based on the same principle as the one which has been in practice for some time in tinning iron pins, or covering brass with gold—viz., plunging the article to be coated into a boiling alkaline solution of a salt of tin, or a salt of gold; and, in the case of M. Weil, into one of copper, which consists of an organic salt of copper (say the double tartrate of copper and potash) with an excess of alkali, taking care that the cast or wrought iron to be coated is in contact with a brass wire during the operation.

I shall now take the liberty of dwelling for a short time on various memoirs which have been published in connexion with the physical properties and chemical composition of alloys.

You will find in the *Transactions* of the Royal Society, vol. cl., some extensive researches by Dr. Mathiessen on "The Electrical Conducting Power of Alloys;" also in vol. cliv., on the influence which heat exercises on that important physical property of alloys. Mr. Johnson and myself have published papers on the density of alloys, as well as on the hardness, expansion, and conductibility of the same. It was admitted some years ago that alloys were simply a mechanical mixture of various metals, but the systematic researches which we have published leave no doubt that when certain metals, such as tin and copper, bismuth and lead, zinc and copper, are employed in equivalent quantities, and that the proportion of each metal does not exceed two or three equivalents of one, to one equivalent of the other, that they are susceptible of combining and forming definite compounds. I may state, in corroboration of this statement, that if one equivalent of zinc and one equivalent of copper are melted together, or 49·32 of copper and 50·68 of zinc, and well stirred, and allowed to cool until a crust is formed on the surface, and then a hole be made in the crust and the fluid portion poured out, well-defined prismatic crystals, sometimes of half an inch long, will be found to coat the interior of the solidified mass, whilst if 45 per cent. of copper and 55 per cent. of zinc—that is to say, proportions which are no longer equivalent to each other, then, instead of obtaining a fine golden-coloured crystalline alloy, a white amorphous mass will be produced—in fact, no brass founder attempts to use more than 40 per cent. of copper to produce brass, for experience has taught him that if he exceeds that quantity he obtains such a white metal that it is no more a marketable article. Another example is furnished by certain alloys for bronze. Thus, when two equivalents of tin for one equivalent of copper are employed, the conductibility of this alloy for heat is equal to that of both the metals together entering into its composition; whilst if the conductibility of alloys, composed of three equivalents of copper to one equivalent of tin, or four equivalents of copper to one equivalent of tin, is ascertained, it will be found that their conductibility is quite different and independent of that of the metals entering into their composition; in fact, the conductibility of four equivalents of copper and one equivalent of tin is five times less than the one first cited.

Without occupying your time with further instances, let me call your attention to an important fact that Dr. Mathiessen, Mr. Johnson, and myself have observed—viz., that the addition of a small quantity of a metal which may be considered as an impurity completely modifies, in many instances, its properties, and the most important example that I am acquainted with is the influence which the addition of 1 or 2 per cent. iron exercises on the properties of brass. If a brass be composed of 60 per cent. copper and 40 per cent. zinc, it will be susceptible of being drawn or bent when cold, but cannot be forged or worked when heated, whilst if 1·75 or 2·0 per cent. of iron be substituted for the same quantity of zinc, then a most valuable brass is obtained, for not only is this brass capable of being forged at a red heat like iron, but its tenacity is increased in an enormous proportion, for each square inch of surface is able to support a "breaking weight" of from 27 to 28 tons—a tenacity nearly equal to that of iron.

Messrs. Beyer and Peacock, of Manchester, who experimented with bolts made of this alloy, in the hope of substituting them for iron ones in the fire-boxes of locomotives, found that these bolts would support a strain equal to those of iron, and that the threads of the screw were not stripped with more facility than those of iron when exposed to the same strain.

There is no doubt that when this alloy becomes more generally known many valuable applications of it will be made in the arts and manufactures.

Whilst dwelling on valuable brass alloys, let me state that two alloys have lately been introduced which will prove useful to those requiring them, namely, a white alloy, which is chiefly employed for the bearings of the driving wheels of locomotives, owing to its extreme hardness, and which is composed of—

Zinc	77
Tin	17
Copper	6
	100

The other alloy has been lately proposed to calico printers by Mr. Lenssen as a substitute for the steel blades used by them to remove the excess of colour which adheres to the surface of their printing-rollers, and which blades bear the name of "doctors."

Mr. Lenssen's metal is composed of—

Tin	4·93
Zinc	9·78
Copper	85·29
	100·00

This alloy is stated to have all the flexibility, tenacity, and hardness required for the "doctors" used in calico-printing, and, further, it presents the great advantage of not being acted upon by acid liquors, which action is often a great source of annoyance to calico printers.

I shall conclude this lecture by alluding to the extraordinary modification in the fusibility of metals when several are fused together; thus, for example, the following well-known alloys which liquify in boiling water:—

	Newton's alloy fusible at 212°.	D'Arcet's alloy fusible at 201°.
Bismuth	5	8
Tin	3	3
Lead	2	5

Whilst the fusing point of these metals, when taken separately, is as follows:—

Bismuth	513°
Tin	451°
Lead	620°

Therefore the fusing point of each metal is several hundred times higher than when they are mixed in the above proportions.

A still more fusible alloy has lately been brought before the notice of the public by a Mr. Wood, in one of the American journals, in which he states that by melting together

Lead	8 parts.
Bismuth	5 „
Tin	4 „
Cadmium	3 „

An alloy is obtained whose point of fusion is equal to 140 degrees, therefore susceptible of being used with great advantage for dental purposes.

I have now to refer to the four metals which have recently been discovered, viz., cæsium, from *coesius*, "sky-coloured," owing to two blue lines which it produces in the spectrum; rubidium, from *rubidus*, "dark red," owing to the existence in its spectrum of two red lines of remarkable low refrangibility; thallium, discovered by Mr. William Crookes, and which derives its name from *thallos*, "a budding twig," symbolising the beautiful green tint of budding végetation; indium, discovered by Messrs. Reich and Richter, of Freiberg; all of which are due to the introduction into science of a mode of investigation known as the "spectrum analysis."

The principle upon which this mode of research is based has been of late so well described and illustrated by Dr. William Allen Miller, in a paper read before the Pharmaceutical Society (see Society's *Journal*, February, 1862), and by Professor Roscoe, in four lectures at the Royal Institution, London (see Chemical News, vols. v. and ix.), and which lectures have received such a wide publication that I think it useless here to enter into details, and more especially as Mr. Ladd will illustrate, by means of his powerful electric lamp, the spectra of some of the above metals, as well as those of potassium, strontium, barium, &c.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 20.

R. Angus Smith, *Ph.D., F.R.S., &c., President, in the chair.*

A paper was read "*On Air from off the Atlantic, and from some London Law Courts,*" by the President. The specimens of air collected by Mr. Fryer when on his way to the West Indies, and those collected in Antigua, are worth remarking, as the first agrees with the figures obtained previously when examining air on the sea shore and open heaths of Scotland, where the highest average was obtained, and the second agrees with the numbers obtained in more inhabited but not closely inhabited places. Those from a law court are interesting; they are the most deficient in oxygen of any specimens found by me during the day in inhabited places above ground. The first is almost exactly the same as the average found in the currents of galleries in metalliferous mines; that from the lantern is nearly the same as the specimens found close to the shafts of the same mines, meaning of course the average of many specimens. I have not known any mills or workshops so deficient in air. I consider a room bad when it loses 1,000, and workshops very bad when they lose 2,000 of oxygen out of a million parts; here the loss is actually 5,000 less than the parks of London. The circumstance is strange, and I hope unusual. A scientific friend happened to call my attention to it and wished me to examine the air. The moisture from the window was collected and there were several ounces obtained, and more might have been easily found. It was perspiration in great part, the smell of it was distinct. It is putrefying, and decolorises more permanganate now than it did at first. Mere change of air will not purify a room like this—a current must pass through it for a long time until complete oxidation takes place.

Oxygen per cent. in some Specimens of Air.

18 ft. above water. Fine day. 2.30 p.m. Lat. 43·05, W. 17·12.	St. John's, Antigua. April 11th, 1865. 9 a.m. Showery morning.
21·0100	20·9600
21·0000	20·9100
20·9700	21·0000
Mean 20·9990*	Mean 20·9950
Law Court, Feb. 2, 1866.	Law Court, from the lantern, 4.30 p.m., just as the court was closing.
20·6400	20·5000
20·6700	20·4800
Mean 20·6500	Mean 20·4900

ACADEMY OF SCIENCES.

February 26.

MM. Naquet and Louguinine presented a note "*On some derivatives of Formobenzoilic Acid.*" The acid just named is formed by the action of hydrocyanic acid on benzoic aldehyde in the presence of hydrochloric acid. Oil of bitter almonds is dissolved in water, a little more than the theoretical quantity of hydrocyanic acid required and a little hydrochloric acid are added, and the mixture is distilled. The distillate is evaporated to dryness, and the formobenzoilic acid is extracted from the residue with ether. On spontaneous evaporation the etherial solution deposits crystals of the acid, which is further purified by solution in water, filtration, and evaporation of the filtered solution. The authors have prepared *formobenzoilate of ethyl* by heating formobenzoilate of silver with iodide of ethyl in a sealed tube. *Formobenzoilate of methyl* was prepared in a corresponding manner. Both are white crystalline bodies, soluble in alcohol and ether. *Acetoformobenzoilate of ethyl* was made by the action of the dry acid on chloride of acetyl. These two bodies react violently in the cold.

M. Berthelot communicated a note "*On a new class of Compound Metallic Radicals.*" These result from the action of acetylene on the salts of copper and silver. The compounds obtained by means of the cuprous salts are derived from one particular radical represented by the formula

$$(\mathrm{C_4Ꞓu_2H}) \text{ or } \left.\begin{matrix}\mathrm{C_4Ꞓu_2H}\\ \mathrm{C_4Ꞓu_2H}\end{matrix}\right\}$$

in which formulæ Ꞓu represents the radical of the protosalts of copper. This radical the author designates *cuprosacetyl*. The oxide of this is obtained when acetylene acts on the ammoniacal cuprous chloride, and the precipitate is washed with strong ammonia until free from chlorine. *Chloride of cuprosacetyl* is formed by the action of acetylene on a strong solution of cuprous chloride in chloride of potassium. The salt first obtained is a double chloride of cuprosacetyl and potassium, which is yellow, but by washing with a strong solution of chloride of potassium the colour changes gradually to a deep red, the colour of the chloride of cuprosacetyl.

The *oxychloride* is obtained by the action of acetylene on acid cuprous chloride, saturated with only a slight excess of ammonia. The way to obtain bromide and iodide of cuprosacetyl is suggested by the processes mentioned above.

The silver compounds of acetylene are analogous to those of copper. They form cheesy precipitates of a yellowish colour, while all the copper compounds are red.

These compounds, says M. Berthelot, offer the first examples of compound metallic radicals containing copper and silver, but their mode of formation indicates a consti-

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* May be read 209,900 in a million, and so with the others.

tution different from that of the radicals already known. The oxides of cuprosacetyl and argentacetyl are, in fact, formed (like the ammoniaco-metallic bases) by the direct action of a hydride upon a metallic salt, the copper or silver being substituted for the hydrogen of the hydride We may give this paper at length in a future number.

M. Wurtz presented a note "*On the Synthesis of Chloride of Thionyle.*" This body the author has formed by the direct action of anhydrous hypochlorous acid on sulphur. A molecule of hypochlorous anhydride unites with an atom of sulphur, and forms a molecule of chloride of thionyle

$$Cl_2O + S = SOCl_2.$$

To effect the synthesis the author passes the vapour of hypochlorous anhydride into subchloride of sulphur, holding sulphur in suspension, stopping the stream of gas before all the sulphur has disappeared. The chloride of thionyle is separated by distillation. It is a colourless, strongly-refractive liquid, which boils at 78°. We shall give this paper at length, but must mention that the experiments are not altogether free from danger. Hypochlorous anhydride acts violently on sulphur, and produces an explosion; hence the necessity for suspending the sulphur in an inert liquid like the subchloride.

Two or three small matters brought forward deserve a passing notice. M. Houzeau professes to have discovered the presence of peroxide of hydrogen in the atmosphere, and MM. Robinet and Lefort have analysed the *water of the Red Sea.* As they state that no analysis of this water has been published, we append their results. A litre of the water gave on evaporation 45·38 grammes of fixed salts, as under :—

	Grammes.
Chloride of sodium . .	30·30
Chloride of potassium .	2·88
Chloride of magnesium .	4·04
Bromide of sodium . .	0·06435
Sulphate of lime . .	1·79
Sulphate of magnesia .	2·74
Carbonate of soda Carbonate of ammonia } .	traces
	41·81435

We may also record the fact that M. Malaguti has found on the wall of an old privy "*A Natural Compound of Oxide of Zinc, Ammonia, and Water*"—

$$2ZnO,NH_3,6HO$$

which he has not been able to reproduce artificially.

NOTICES OF BOOKS.

Bulletin Mensuel de la Société Chimique de Paris. February, 1866.

The papers read before the Chemical Society have in most instances been previously communicated to the Academy of Sciences, and noticed in our report of the proceedings of that learned body. Some novelties were, however, brought forward at the last meeting. M. Berthelot described "*A Method of making a Qualitative Analysis of Mixed Gas.*" It is based on the fact that acetylene is formed when a mixture of gas containing a hydrocarbon is exposed to the action of the electric spark or incompletely burned, as described in the paper by the author we recently published. A mixture of carbonic oxide and hydrogen under these circumstances gives no acetylene; but the presence of a very small amount of marsh gas, or, indeed, any hydrocarbon vapour, will be shown by the formation of acetylene. The gaseous mixture to be examined is exposed to the action of the spark for two or three minutes, and then the ammoniacal cuprous chloride is introduced. The formation of the characteristic red precipitate shows the presence of acetylene, and consequently of a hydrocarbon gas in the primitive mixture.

M. Berthelot also made "*Some Remarks on the Properties of Acetylene.*" These are noticed in our report of the Academy this week.

M. Lauth communicated "*Some new Facts relating to the History of Aniline Black,*" in which he showed that Mr. Paraf's process (see *ante*, p. 51) for the production of an aniline black without the intervention of a metallic salt is useless. If the mixture described is made in an earthenware vessel, and printed on the cloth by hand with wooden blocks, only a greyish-blue colour is obtained. But when the mixture is made in a copper vessel, and printed in the usual way with copper rollers, a black is obtained, the vessel and the rollers furnishing sufficient copper to produce the colour. He shows further that Mr. Paraf's mixture dissolves copper with great facility, and that only a trace of that metal is necessary to develope the colour.

The usual analysis of foreign memoirs contains a few novelties which will be found in other parts of our columns.

Outline Facts of Chemistry, with Exercises. Intended Chiefly for Pupils in Government Science Classes. By T. Ward. Certificated Science Teacher. Part I., Metalloids. London: Simpkin and Marshall. Manchester: Heywood. 1866.

This is a very cheap and useful little book, unfortunately disfigured with a large number of errata,—a great fault in a book for students. We notice this to impress on the compiler the necessity for greater care in the parts still to be published. The exercises appended will be found very useful by students preparing for examinations.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

191. A. F. Mineur, Trequire, France, "New or improved description of manure." — Petition recorded January 20, 1866.

301. C. Delafield, Staten Island, Richmond, New York, U.S.A., "Improvements in the manufacture of saltpetre and white lead."

308. G. Greaves, Blackburn, Lancashire, "Improvements in treating certain chemical matters and compounds for producing glazed surfaces.—January 31, 1866.

383. P. A. F. Bobœuf, Rue Buffault, Paris, "Improvements in the manufacture of artificial coal tars and their solid derivatives, such as phenical soaps and salts.

394. H. E. F. De Brion, Marlborough Hill, St. John's Wood, Middlesex, "Improved compositions for preserving metals from oxidation, corrosion, and galvanic action; for protecting metals used in the construction of ships against the destructive effects of sea water, and preventing their fouling; for protecting wood from the attacks of animalculæ, and preserving wood from damp, rot, and decay; for excluding damp from walls; and for use in submarine and other telegraphy."—February 8, 1866.

399. E. Bevan, Birkenhead, Cheshire, and A. Fleming, Liverpool, "Improvements in the construction of furnaces and kilns employed in the manufacture of glass and in the heating and burning of articles of glass and earthenware." February 9, 1866.

461. A. C. Kirk, Anchenhard, Linlithgowshire, N.B., "Improved arrangements for distilling."

471. J. Soames and J. K. Soames, Greenwich, Kent, "Improvements in purifying paraffin."

513. J. Kidd, Battersea Rise, Surrey, "Improvements

in carburetting low pressure superheated steam, air, or coal gas for lighting and heating purposes, for generating steam or hydro-carbon vapour, and in apparatus employed therein."—February 17, 1866.

525. J. Barry, Ballyclough, Cork, J. P., "An improved dye."—February 20, 1866.

INVENTION PROTECTED BY THE DEPOSIT OF A COMPLETE SPECIFICATION.

554. C. J. Cannon, Toulouse, France, "Manufacturing iron and steel, and the alloyage of metals, together with preparing ores for the same."—Recorded February 23, 1866.

NOTICES TO PROCEED.

2726. J. Wright, Copthall Court, London, "Improvements in the method of and apparatus for utilising the liquors used in the treatment of straw or other fibrous materials for the manufacture of paper, which improvements are also applicable to the evaporation of liquids generally."—A communication from E. Porion, Rue St. Martin, Paris.—Petition recorded October 21, 1865.

2950. A. V. Newton, Chancery Lane, "An improved manufacture of caramel."—A communication from T. Hyatt, New York, U.S.A., November 16, 1865.

CORRESPONDENCE.

Continental Science.

PARIS, March 3.

THE first thing I may mention is a rumour I read in *Les Mondes* that the astronomical prize of the Academy of Sciences (the Lalande prize) is to be conferred on Mr. Warren De la Rue, for his photographs of the heavenly bodies.

The journal mentioned makes an announcement of some "discoveries which appear on the horizon." The first is one by M. Sorel, who employs chloride of magnesium in the production of blocks of artificial stone, wood, and ivory. This looks like an application of the process recently described by M. H. St. Claire Deville in his paper "On the Hydraulicity of Magnesia."

Signor Toselli seems to have perfected an ice-making machine for household use, in which compressed steam replaces the ammonia or the sulphurous acid gas employed in the machines with which your readers are already familiar. A small one will make 5 kilos. of ice an hour at a cost of from 3 to 5 centimes the kilo. The plan adopted is shortly as follows:—In one cylinder a solution of common salt is placed, and to this another cylinder is adapted. The saline solution is then heated (not above 100°), and the steam is passed into the second cylinder. After about an hour a tap between the two cylinders is turned, and the one containing the compressed steam is placed in a vessel of cold water.

M. Archereau, I read, has constructed an apparatus for the decomposition of sulphuric acid, according to the plan proposed by Deville, by which oxygen is obtained continuously at a very cheap rate—say a franc per cubic metre. We are promised a description of this apparatus soon. If it be simple and manageable, it will be of great value.

There are a few other small items which I may mention. M. Maiche, jun., has succeeded in gilding and silvering aluminium and tin electrolytically so completely that the layer cannot be disturbed by the hardest application of a burnisher.

M. Chevallier Bonelli and M. Hipp have contrived a printing telegraph with one wire, which will print 300 words a minute in Latin letters.

You published last year an account of M. Carlier's *Extincteur*. It is, as your readers know, an apparatus for extinguishing fires with something like soda-water, and it is only fair to add that under favourable circumstances it answers its purpose well. It is now proposed to use the same apparatus for extinguishing pain. Carbonic acid, it is well known, is a very useful anæsthetic, but this mode of applying it is certainly novel. Some Bordeaux surgeons have been using it for allaying pain in the bladder, and also overcoming obstructions in the urethra. They pass a catheter, with an opening at the end instead of at the side, and when the obstruction is arrived at, they turn the tap of the Extincteur. The rush of gas soon overcomes the obstruction, and the catheter can be passed on. They propose also, in cases of suppuration in the bladder, to make the carbonic acid the carrier of antiputrescent vapours or liquids—carbolic acid, for example; and they hint at the possibility of dissolving some calculi, by making use of proper liquids charged with carbonic acid.

I must correct a mistake in my last. Dr. Oppenheim's temporal artery was wounded in the explosion, not his carotid.

MISCELLANEOUS.

Royal Institution.—The following are the arrangements for the ensuing week:—Tuesday, March 13, and Thursday, March 15, at 3 o'clock, Professor Frankland, F.R.S., "On the Non-Metallic Elements." Thursday, March 16, at 8 o'clock, Balfour Stewart, Esq., F.R.S., "On the Evidence of the Existence of an Ethereal Medium Pervading Space." Saturday, March 17, at 3 o'clock, Rev. G. Henslow, M.A., "On Structural and Systematic Botany."

Cavendish Society.—The annual meeting of the Cavendish Society was held in the rooms of the Chemical Society on March 1, Mr. Graham, President, in the chair. The report, read by the Secretary, Dr. Redwood, stated that the Council had agreed to accept a proposal made by Mr. Harrison to undertake the publication of the remaining volumes of Gmelin's "Chemistry" at his own risk, supplying them to the members at one guinea each volume. Two volumes, it is anticipated, will complete the work. A considerable part of Vol. XVII. is in type, and this volume it is expected will be completed in about four months. The Council believe that the public demand for scientific works of a superior character is now so large that there is no longer any field for a publishing society like the Cavendish, and they think the operations of the Society may fitly close with the completion of Gmelin's work. In reply to some questions asked, the Secretary stated that the back stock of the Society formed part of the consideration to Mr. Harrison for undertaking the publication of the remaining volumes. There were about 300 complete sets of the organic part in stock, but no complete set of the inorganic part was left. An arrangement had been made with Mr. Harrison by which he was debarred from selling the volumes still to be issued for less than a guinea each for the next two years. The index volume is to be supplied to the subscribers *gratis*. The balance-sheet showed a sum of 183*l*. in hand, and the outstanding liabilities of the Society were said to be very small. The report was adopted by the meeting. A resolution to continue the present council and officers was also carried, as were the usual votes of thanks.

Preservation of Frescoes by Means of Paraffin.—Vohl coats the picture with a saturated solution of paraffin in benzole, and when the solvent has evaporated, washes the surface with a very soft brush. Paraffin has the advantage over other greasy matters of not becoming coloured by time.—*Dingler's Journal and Bulletin de la Société Chimique, etc.* Feb., 1866. [A similar solution, we may add, has been used in England for the preservation of photographs.—ED. C. N.]

The Cattle Plague Disinfectants.—In the House of Commons on Monday night, Mr. W. Miller asked the Secretary of State for the Home Department whether he is aware that the Cattle Plague Royal Commission, in their endeavours to discover the best disinfectant, referred the question only to a single individual—namely, Dr. Angus Smith, who reported in favour of carbolic acid, or M'Dougall's power, of which preparation he himself is co-partner with Mr. M'Dougall, and which is generally believed by chemists to be no disinfectant at all.

Mr. Baring said that the question was one which ought to be put to the member for Calne (Mr. Lowe), who was a member of the Commission. Dr. Angus Smith was annoyed at the reference to himself, and he wished that the question should be deferred until the report he prepared had been made and presented to Parliament. He had, however, given him the following information on that part of the question:—"I never had any interest, profit, or advantage from the sale or manufacture of M'Dougall's power, or of any other substance made by him, or by anybody else." Dr. A. Smith added:—"I do not recommend M'Dougall's powder as the best disinfectant." And upon the third point he said:—"Carbolic acid is not M'Dougall's powder, but a liquid not manufactured by M'Dougall." With regard to the second branch of the question, he had received the following from Mr. Montagu Bernard, the secretary of the Commission:—"Dr. Angus Smith was the person employed by the Commissioners to report on disinfection and disinfectants. He is an eminent chemist, as every one knows, and had previously turned his attention to the subject. After a long series of experiments on a great number of substances he reported in favour of chlorine, muriatic acid, sulphurous acid, and the two tar acids (otherwise called carbolic and cresylic acids). On a consideration of his report, the tar acids were deemed by the Commissioners most likely to be efficacious and best suited for general use. They then instructed a younger, but distinguished chemist, Mr. W. Crookes, F.R.S., to go to a district where the disease was raging to test in several ways the efficacy of the selected substances, and to ascertain by personal experience the best and simplest modes of using them. Mr. Crookes has been for some time at work, and the accounts received from him are very satisfactory. M'Dougall's powder is a preparation containing carbolic acid, with sulphites of magnesia and lime. It was among the many substances tested by Dr. Angus Smith, and he recommended it as useful in some ways, making no secret of the fact that it had been first produced by himself, together with Mr. M'Dougall, ten years ago." In answer to the latter part of the question, he had to state that the Home Office had no means of forming an opinion in regard to disinfectants, but when the Cattle Diseases Act was passed the Secretary of State for the Home Department directed a letter to be written to the Royal Commissioners, asking them to furnish him with the best plan for disinfecting premises, &c., from the contagion of the cattle plague. That information was supplied, and it had been circulated throughout the country. From the constitution of the Commission, and the manner in which they had directed the experiments to be made, it was impossible to suggest any body of persons better qualified to come to a proper conclusion on the matter.

Curiosities in Chemical Evidence.—Liver Catsup.—Mr. Hope, of the firm of Hope and Co., catsup, jam, and pickle manufacturers, of the Fort Road, Upper Grange Road, Bermondsey, was summoned by the Vestry of Bermondsey, under the Nuisances Removal Act, for having in his possession a large quantity of putrid liver for the manufacture of catsup, which he called pure and unadulterated Leicestershire catsup, such being unfit for human food and a nuisance to the neighbourhood. Dr. William Parker, the Medical Officer of Health to the Bermondsey Vestry, said that from information he received he went to defendant's premises, accompanied by the Inspector of Nuisances, and saw his foreman, whom he told he had come to inspect the premises. Witness found a barrel containing about a hundredweight of salted pigs' livers, and they were very offensive. He examined them, and found a large portion partially in a putrid state. The foreman told him that they were going to be boiled down to make catsup. At that time the defendant entered the premises, to whose attention he called the putrid state of the livers, and asked him if his name was Hope. He replied that it was, and produced a printed letter, of which the following is a copy:—"Hope and Co.'s Leicestershire Catsup, warranted pure, agreeably to Act of Parliament 22nd and 23rd Vic., cap. 84, entitled an Act for Preventing the Adulteration of Food or Drink." The witness went on to state that the livers were so putrid that his hands stank for hours afterwards. Mr. Edwin, for the defendant, contended that the Act under which his client was summoned applied to solids only, and not to liquids like catsup. He stated further that it was absolutely necessary for his client to use livers in its manufacture, but if any were found putrid they were thrown away. He called John Addison, a singular-looking man, who said he was an analytical chemist, 21, Townshend Street, Old Kent Road. He said that he had tested the catsup, and found it to be exceedingly wholesome, and fit to use with food for human consumption. He knew the bulks from which the livers had been taken, and he did not consider them putrid or unwholesome. He should not mind making a meal off them if soaked in water, properly cleaned, and boiled. Witness added that he had consumed the catsup daily for the last ten months and found it very good. Mr. Woolrych here observed that in looking at the Act of Parliament he found some difficulty in the way of a conviction, and he thought that the Act did not apply to a mere preparation, but simply to food to be directly consumed. The case was adjourned.

The Analysis of Waters for February, 1866, by Professor Frankland, F.R.S., of the Royal College of Chemistry:—

Companies.	Number of Houses supplied in January, 1866.	Average daily Supply of Water in Gallons during the Month of January, 1866. (See Note.)	Solid matter in 100,000 parts of the waters.	Organic and other Volatile matter included in column 4.	Amount of oxygen required for oxidation of organic matter.	Total hardness.*
Thames.						
Chelsea	26,436	7,658,800	31·14	2·59	·0912	21·1
West Middlesex	35,486	7,657,421	30·40	2·00	·0739	19·8
Southwark and Vauxhall	73,594	12,125,000	30·90	2·40	·0643	20·7
Grand Junction	25,301	8,067,112	31·40	1·60	·0555	22·2
Lambeth	35,420	7,620,200	31·16	1·65	·0592	21·0
Other Sources.						
Kent	32,412	5,376,676	37·92	1·80	·0104	27·4
New River	111,864	22,330,000	29·50	1·68	·0576	22·0
East London	88,340	17,592,000	35·78	1·68	·0636	23·1
South Essex	750	161,000	40·60	1·36	·0086	26·5

Note.—The quantities of water here given include the supply for manufactures and for various purposes other than domestic consumption. The table may be read thus:—The Chelsea Water Company supplied 26,436 houses, and an average daily quantity of 7,658,000 gallons in the month of January: 100,000 lb. of Chelsea water in February contained 31·14 lb. of solid matter, of which 2·59 lb. of organic and other volatile matters were driven off by incineration. 0911 lb. of oxygen was required to destroy organic matter in the said quantity of Chelsea water. 21·1 lb. are carbonate of lime or its equivalent. The fourth column of this table contains the amount of solid matter left on evaporation and desiccation at 120 deg. C.—130 deg. C. (248 deg F.—266 deg. F.) The results are recorded in 100,000 parts. By moving the decimal point one place to the right the above figures express in milligrammes the quantity contained in one kilogramme of the several waters.

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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 seven, and then moving the decimal point one place to the left.

In comparison with the month of January the majority of the waters exhibit an increase in the total amount of solid impurity: the West Middlesex, New River, and East London Companies' waters form the only exceptions to this rule. The amount of organic and other volatile matter is also greater in all the waters except those of the Grand Junction, Lambeth, East London, and South Essex Companies. Lastly, a larger quantity of oxygen is required for the oxidation of the organic matter than in the preceding month; the Chelsea, Grand Junction, South Essex, and Lambeth Companies' waters only being excepted. The waters of the Chelsea, Southwark, Lambeth, New River, and East London Companies were turbid when drawn from the companies' mains. The Registrar-General has to acknowledge the courtesy of the London water companies, who have all furnished him with the average daily supply of water for the month of January. It appears that the average daily supply is at the rate of 226 gallons of water per house, including manufactories, or 26 gallons to each person.

Composition and Quality of the Metropolitan Waters in February, 1866.—The following are the Returns of the Metropolitan Association of Medical Officers of Health:—

Names of Water Companies.	Total solid matter per gallon.	Loss by ignition.*	Oxydisable organic matter.†	Hardness.	
				Before boiling.	After boiling.
Thames Water Companies.	Grains.	Grns.	Grains.	Degs.	Degs.
Grand Junction	20·99	0·94	0·56	13·9	4·1
West Middlesex	20·56	1·09	0·60	13·6	3·8
Southwark & Vauxhall	21·81	1·34	0·72	13·9	4·5
Chelsea	20·51	1·28	0·64	13·9	4·0
Lambeth	21·15	1·00	0·66	14·0	4·5
Other Companies.					
Kent	26·38	1·45	0·19	14·0	8·5
New River	21·20	1·28	0·39	15·0	4·8
East London	22·20	1·00	0·49	15·5	5·0

* The loss by ignition represents a variety of volatile matters, as well as organic matter, as ammoniacal salts, moisture, and the volatile constituents of nitrates and nitrites.

† The oxydisable organic matter is determined by a standard solution of permanganate of potash—the available oxygen of which is to the organic matter as 1 : 8; and the results are controlled by the examination of the colour of the water when seen through a glass tube two feet in length and two inches in diameter.

H. Letheby, M.B., &c.

City of London Corporation Gas Bill.—This bill passed its second reading in the House of Commons on Tuesday by a majority of 26. It has now to undergo the ordeal of a Select Committee, before which it will be vigorously opposed by the three companies supplying the City at present.

A Plea for the Ailanthus Silkworm.—Some years ago we advocated the introduction of the ailanthus worm into this country, and we are glad to find from the following letter to a contemporary that attempts at its acclimatisation have been made with considerable success:—

"*To the Editor of the Times.*

"Sir,—Having seen a letter in the *Times* relating to the new oak silkworms, *Bombyx Yama-mai*, and their probable acclimatisation in England, may I be allowed to say a few words? I have cultivated them for two years with the greatest care, and from my observations fear they will never stand our changeable climate. I reared them successfully, both under glass and in the open air, till the fourth change of skin, when they all died of the malady called 'pebrine,' induced by a few days of rainy and cold weather in the month of June. The Ailanthus worm, on the contrary, is perfectly hardy, fearing no rain or wind, or even a slight frost. His only enemies are in infancy the ants; in old age, the tom-tits. I rear many thousands every year without the slightest difficulty, and shall be glad to give any persons the benefit of my experience. To show they are gaining much in the public estimation, since I introduced them into England three years ago, I have sold and given away 70,000 eggs annually, besides sending cocoons to all parts of the world; and more than that, I have a gown made from the silk. "Dorothy Nevill.

"Dangstein, Petersfield, Feb. 24."

Improvement in Pattinson's Process for Separating Lead from Silver.—In a factory at Holtzappel they melt the lead in one pot and then run it into a crystallising pan, where they cover the surface with small fragments of coke, upon which a thin stream of water is directed. An agitator being set in movement, a circular motion is given to the mass of metal covered with coke, and thus the entire surface is equally moistened and cooled by the stream of water. In about an hour the lead loses its fluidity, and forms a solid crust, which envelopes the small pieces of coke. The stream of water is now turned off, the agitator is stopped, and the unsolidified lead, rich in silver, is run off from the bottom. Strong iron hooks are inserted in the mass of lead and coke before complete solidification takes place, and the mass is lifted from the pan by a crane. The pan is then ready for a second operation.—*Polytech. Notizbl.*, 1865, p. 289, and *Bull. de la Soc. Chim.*, Jan. 1866, p. 76.

On the Preparation of Chrome Yellow.*—The preparation of a good chrome yellow is rather difficult, and frequently the product obtained, instead of preserving its light canary colour, becomes gradually orange coloured. This change of tint greatly damages the beauty of the colour, and consequently its value; it may, however, be altogether avoided, by leaving the precipitate of chromate of lead for some time in darkness. The reason why this orange tint is so easily produced is, that whilst the neutral chromate of lead which constitutes chrome yellow is of a light canary colour, the basic salt, commonly called chrome red, is orange coloured; but the former, like nearly every salt of lead, has a certain tendency to pass to the state of basic salt, whence arises a change of colour, more or less marked, which is especially produced when acetate of lead has been used to prepare the chrome yellow. This alteration is less to be feared when nitrate of lead is employed, and when the solution of this salt poured into that of chromate of potash is rather less in quantity. Nitrate of lead is perhaps too expensive for every case, but it gives a purer, and, above all, a less orange-coloured product than the acetate.

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. XII. 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., II., and VII. are out of print. All the others are kept in stock. Vol. XIII. commenced on January 5, 1866, and will be complete in 26 numbers.

G. B. will find the information in our report.

P.—There is no established form. Pancreatic emulsion is made with cod liver oil, suet, or lard.

B. W.—The paragraph was taken from our columns, which are much more often quoted than acknowledged.

X. Y. Z.—It is quite unimportant which acid you use.

Erratum.—Page 81, col. 1, line 22 *for* "Portugalis," *read* "Portorgalis."

Books received.—"The Year-Book of Pharmacy," edited by C. H. Wood, F.C.S., and C. Sharp; "On Tuberculosis, &c.," by Dr. H. Dobell; "On Prostitution," by Dr. Drysdale.

Received.—A. H. Hassall.

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* M. Dullo, *Deutsche illust. Gew. Zeit.*, *Polytech. Notizblatt*, 1865, p. 335.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Assimilation of Complex Nitrogenous Bodies by Vegetation, by S. W. JOHNSON.

DURING the summer of 1861 the writer undertook a series of observations on the nutrition of plants, which, though a failure as regards the principal object of the investigation, led to some interesting results. Besides various inorganic matters, the nitrogenous compounds occurring in urine which may be directly applied to crops as fertilisers—viz., urea, guanine, uric acid, and hippuric acid were intended to be made the subjects of experiment.

Washed and ignited flower-pots (of clay, unglazed) were employed to contain, for each trial, a soil consisting of 700 grms. of ignited and washed granitic sand, mixed with 0·25 grm. sulphate of lime, 2 grm. ashes of hay prepared in muffle, and 2·75 grm. bone ashes. This soil was placed upon 100 grm. of clean gravel to serve as drainage. In each of several pots containing the above soil was deposited July 6 a weighed kernel of maize. The pots were watered with equal quantities of distilled water containing a scarcely appreciable trace of ammonia. But four seeds germinated in a healthy manner; the plants developed slowly and alike until July 28, when the addition of nitrogenous matters was begun.

To No. 1 no solid addition was made.

To No. 2 was added, July 28, 0·420 grm. uric acid.

To No. 3 was added 1·790 grm. hippuric acid, at four different times—viz.: July 28 0·358 grm., August 26 0·358 grm., September 16 0·716 grm., and October 3 0·358 grm.

To No. 4 was added 0·4110 grm. hydrochlorate of guanine—viz.: July 28 0·0822 grm., August 26 0·0822 grm., September 16 0·1644 grm., October 3 0·0822 grm.

The nitrogenous additions contained in each case 140 grm. of nitrogen, and were strewn, as fine powder, over the surface of the soil.

It not being practicable to attend to the germination of other seeds, urea was not experimented with. This deficiency was of less account, since Cameron's paper on the direct nutritive effect of urea, read before the British Association in 1857, had demonstrated that this substance supplies the plant with nitrogen without previous decomposition in the soil, and has a fertilising effect equal to salts of ammonia.*

The plants continued to grow or to remain healthy (the lower leaves withering more or less) until they were removed from the soil November 8.

The plants exhibited striking differences in their development. No. 1 (no added nitrogen) produced in all seven slender leaves, and attained a height of seven inches. At the close of the experiment only the two newest leaves were perfectly fresh, the next was withered and dead throughout one third of its length. The newer portions of this plant grew chiefly at the expense of the older parts. No sign of floral organs appeared.

No. 2, fed with uric acid, was the best developed plant of the series. At the conclusion of the experiment it bore ten vigorous leaves, six of which were fresh and two but partly withered. It was fourteen inches high, and carried two rudimentary ears (pistillate flowers), from the upper one of which hung tassels six inches long.

No. 3, supplied with hippuric acid, bore eight leaves, four of which were withered, and two rudimentary ears, one of which was tasseled. Height, twelve inches.

No. 4, with hydrochlorate of guanine, had six leaves, only one withered, and two ears, one of which was tasseled. Height twelve inches.

These experiments, together with a large number of others simultaneously undertaken, failed to give satisfactory results from the unfavourable situation of the only apartment at disposition for conducting them in. The light was good but for a small part of the day, and very unequally distributed at that. For this reason, chiefly, most of the plants made but imperfect growth, and therefore the laborious analyses which would have properly supplemented the observations on growth were not attempted.

In the case of the four experiments under notice, the weight of the crops (dried at 212° F.) exclusive of the fine rootlets that could not be removed from the soil, was ascertained with the subjoined results:—

	Weight.
Dried crop	0·1935 grm.
„ seed	0·1644 „
No. 1 (no added nitrogen)	——
Gain . . .	0·0291 „

	Weight.
Dried crop	1·9470 grm.
„ seed	·1725 „
No. 2 (added 0·420 grm. uric acid)	——
Gain . . .	1·7745 „

	Weight.
Dried crop	1·0149 grm.
„ seed	0·1752 „
No. 3 (added 1·790 grm. hippuric acid)	——
Gain . . .	0·8397

	Weight.
Dried crop	0·9820 grm.
„ seed	0·1698 „
No. 4 (added 0·411 grm. hydrochlorate of guanine)	——
Gain . . .	0·8122 „

We thus have proof that all the substances employed contributed nitrogen to the growing plant. This is conclusively shown by the fact that the development of pistillate organs, which are especially rich in nitrogen, occurred in the three plants fed with the nitrogenous compounds, but was totally wanting in the other. The relation of the matter, now organised by growth to that derived from the seed, is strikingly seen from a comparison of the ratios of the weight of the seed to the increase of organised matter, the former being taken as unity.

The ratio is approximatively,—

For No. 1	1 : 0·2
„ No. 2	1 : 10·2
„ No. 3	1 : 4·8
„ No. 4	1 : 4·8

The relative gain by growth, that of No. 1 assumed as unity is,—

For No. 1	1
„ No. 2	56
„ No. 3	26
„ No. 4	26

No examination was made of the soil to ascertain whether the uric acid, etc., had undergone decomposition with formation of ammonia before entering the plant. If urea escapes decomposition, as Cameron and Hampe have shown, is true for the most part, it is not

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* This result has been recently confirmed by Hampe, of Göttingen, who has made maize to grow as a water plant, with its roots in a [illegible] solution containing sulphate of magnesia, chloride of calcium, [illegible] of potash, sesquichloride of iron, and urea. Hampe found in the well-developed plants—stems and leaves as well as roots—evident quantities of urea.

to be anticipated that the more stable bodies employed in these should suffer such alteration.

It will be noticed that the gain of dry matter during growth was identical in case of the plants fed with guanine and hippuric acid, and this quantity was again quite nearly half that manifested by the plant which was supplied with uric acid. Whether this is more than accidental is worthy of study.

From these experiments the writer concludes that the amids resulting from the disorganisation of protein compounds, as well as ammonia salts and nitrates, are capable of direct passage into the plant, and there serve for the reorganisation of albumen, &c.

Cameron, in the investigation alluded to, remarked that his results demonstrate that it is not necessary that urea should decompose into carbonate of ammonia in order to become available to vegetation, and the above facts warrant the generalisation that all amids existing in the urine of animals are ready for assimilation without any further resolution by decay. So far as they are directly concerned, then, any "fermenting" of manures of which they are ingredients is useless.—*Amer. Jour. of Science*, vol. xli., No. 121.

On Thallium, by M. HEBBERLING.*

WITH hyposulphite of soda salts of thallium form a white precipitate soluble in boiling water, as well as in an excess of hot hyposulphite; in the latter case a double hyposulphite is produced.

As is well known, chlorides form a white precipitate with these salts, which turns violet when exposed to light, like chloride of silver.

With alkaline iodides they give an orange precipitate, which turns yellow. The precipitate forms less readily in acid liquids. It is less soluble in alcohol than in water, and as Nicklès has shown, less soluble in iodide of potassium. (*Comptes Rendus*, January, 1864.)

Bichloride of platinum gives a yellow precipitate which passes easily through the filter. At 16° C. 1 part dissolves in about 1·600 parts of water.

TECHNICAL CHEMISTRY.

Points of Fusion and Solidification of Some Alloys,† *by M.* DULLO.

Composition of Alloys.

Lead.	Tin.	Bismuth.	Point of Fusion.	Point of Solidification.
120 parts.	140 parts.	120 parts	130° C.	112° C.
145 ,,	145 ,,	100 ,,	140	129
150 ,,	150 ,,	75 ,,	150	135
150 ,,	150 ,,	50 ,,	160	150
170 ,,	180 ,,	35 ,,	170	163
210 ,,	190 ,,	30 ,,	180	165
140 ,,	155 ,,	30 ,,	190	180
200 ,,	185 ,,	30 ,,	200	180
200 ,,	180 ,,	30 ,,	210	180
240 ,,	150 ,,	30 ,,	220	180
207 ,,	194 ,,	30 ,,	180	180

It is generally to be remarked that the fusion point of an alloy is not in relation to the proportions of the metals which enter into its composition. The alloy of 150 parts of lead, 150 parts of tin, and 50 parts of bismuth (proportions evidently corresponding to 6 atoms of lead, 12 atoms of tin, and 1 atom of bismuth) is one of those which solidify most regularly—that is to say, that no one of the metals entering into its composition crystallises separately on cooling, and that the alloy remains perfectly homogeneous.

It may be observed that the point of solidification of the last five alloys on this table is constant at 180°. When these alloys are melted and then allowed to cool, small crystals form at 220°, 210°, 200°, or 190°, according to their composition, and when the temperature has descended to 180°, the whole mass solidifies. It is noticeable that during the whole time of solidification the temperature remains at 180°, and that the mercury of the thermometer again begins to descend only when every part of the alloy has become solid.

Another alloy remaining very homogeneous, and unvarying in temperature during solidification, is that composed of 207 parts of lead and 294 parts of tin (2 equivalents lead to 5 equivalents tin). This alloy melts at 180°, and solidifies at precisely the same temperature.

In these two alloys, which have the most useful properties, the different metals are united in atomic proportions, which seems to prove that, to obtain a good alloy, it is necessary to take into consideration the atomic weight of the metals composing it. It is beyond a doubt that such alloys, remaining so homogeneous during solidification, are possessed of valuable properties not belonging to other and less homogeneous alloys. This question is certainly of great interest in the manufacture of printing type, and for similar purposes; and deserves to be thoroughly studied.

On a Method of Drying Glutinous Substances.

A LARGE number of substances, like gum, &c., have, as is well known, the property of agglomerating, upon drying, into amorphous masses, more or less solid and translucent, by which, on the one hand, the original appearance of the freshly-made preparation is lost, and, on the other, complete desiccation rendered very difficult. In order to obviate this adhesion of the elementary particles occurring during the drying of such substances under ordinary circumstances, Reischauer has proposed to carry on this operation out of contact with the atmosphere, and by the aid of a suitable ethereal medium.

The apparatus employed for this purpose is, in its simplest form, a well-closed glass vessel filled with ether or a similar liquid, at the bottom of which is placed the chloride of calcium, quicklime, calcined sulphate of copper, &c., intended to absorb the water. A shallow vessel is placed below the surface of the liquid for the reception of the substance to be dried. The *modus operandi* is now a very simple one. The ether continually yielding its water to the chloride of calcium, constantly withdraws it in turn from the substance to be dried, until finally, the latter corresponds in its hygroscopic state with that of the desiccating agent. The thorough wetting in this manner of the constituent particles of the substance to be dried, which of course must be those insoluble in an ethereal liquid, prevents their sticking together, and the original appearance is retained when dry.

Gum, separated by precipitating the aqueous solution with alcohol, gives an amorphous white mass of very slight adhesiveness, and with no trace of the common glass-like condition. The so-called diastase, or the body obtained by precipitating the extract of malt with alcohol, deprived of water under ether, forms spongy and

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* *Chem. Centralbl.*, 1865, p. 658. *Journ. de Pharm. et de Chim.*, Jan., 1866.

† *Bulletin de la Société Chimique*, January, 1866.

very light granules. In this state it retains its effect upon starch. The microscopical examination of starch paste dried by this process leaves scarcely a doubt that the starch grains exist in paste in a state only of extraordinary expansion, and not in that of actual solution. Hops give a mass similar to diastase, but, however, no longer capable of producing fermentation.

The organs of plants dry rapidly under this treatment, commonly retaining their colour, unless unusually delicate. Taken from the ether, they soon become moist again in the air, and rapidly lose their colour, which, by a continuance in the liquid, appears remarkably fine.

The behaviour of animal productions under this method of drying is of especial interest. It may be remarked that, generally, while vegetable matters are distinguished by their great brittleness in the dry state, those of animal origin are characterised by a remarkable toughness, which reaches its highest degree in the fibrous formations of the skin. The pliability of thick skin dried in ether over chloride of calcium is very extraordinary. Other animal preparations at the same time preserve their original form in the dry state, the usual contraction of the parts being thus avoided. The whole intestines of a young dog, treated in this manner, formed a remarkable anatomical preparation, in which the delicate structures were preserved in the most complete manner upon drying. The lungs and liver, to preserve which vain attempts have hitherto been made, formed a light spongy mass, retaining completely their organisation.

It is more than probable that anatomists can make use of this process in many cases; as, for instance, in the microscopical examination of the kidneys, pancreas, &c., particularly in those which have hitherto required the solidification of the object by chromic acid, &c. The use of the ether in a liquid form is frequently not necessary. The skin of animals, animal membrane, &c., readily assume, in an atmosphere saturated with the vapour of ether, containing a suitable, strongly hygroscopic substance, a condition similar to that of white dressed leather. A like satisfactory result, however, is not obtained in the desiccation of inorganic substances, oxide of iron, alumina, &c., in artificial media.

It is obvious that this process may be rendered useful, under suitable modifications, for other purposes. It is a ready method, according to Reischauer, for removing acid bodies soluble in ether from their aqueous solutions, by putting them into an ethereal liquid with caustic lime or potassa. — *Zeitsch. für Anal. Chemie and Scient. American.*

New Work on Toxicological Chemistry.—Mr. Horsley announces the speedy publication of a new manual on poisons, giving the best methods to be pursued for their detection, post-mortem or otherwise.

Useful and Accurate Information.—We extract the following from the *Pall Mall Gazette*, as a specimen of the way in which the daily press sometimes deals with scientific matters. It relates, of course, to the cattle plague inquiry:—"Perhaps the most interesting part of the inquiry practically is the chemical and experimental investigation of disinfecting agents. Mr. *Crocker*, F.R.S., who has taken up the investigations of Dr. *Hughes* Smith, has reported some remarkable instances of complete disinfection and even apparent destruction of the poison by *carbonic* acid and its congeners, and some further striking results have been obtained by the injection of solutions of *hypersulphate* of soda, which has been brought to notice by Italian doctors especially as a valuable antiseptic." Any one of our readers can make the corrections necessary in this paragraph for himself.

PHARMACY, TOXICOLOGY, &c.

On Turbith Root, by M. ANDOUARD.*

THE author is of opinion that turbith root constitutes a good and useful purgative. It is found in great abundance, he states, in the French possessions in India. From experiments made on a number of specimens he has found that the root contains on the average 10 per cent. of resin. This gives the means of forming some idea of its purgative power as compared with other purgatives of the same order. Jalap contains on an average 16 per cent. of resin, and scammony 75 per cent. The author adds the following analysis of the root:—

Water	3·6
Resin	10·20
Gum, albumen	7·20
Starch	12·35
Sugar	0·51
Ligneous matter	52·70
Salts	9·80
Loss	3·64
	100·00

PROCEEDINGS OF SOCIETIES.

PHARMACEUTICAL SOCIETY.

Wednesday, March 7.

Mr. T. H. HILLS, *Vice-President, in the Chair.*

DR. WARING read a paper "*On the Medicinal Properties of the Seeds of Pharbitis Nil.*" The author has long resided in India, and is anxious to see the drugs indigenous to that country employed when they can efficiently replace drugs imported from Europe. This wish has led him to propose the publication of a special pharmacopœia for India, which we are happy to hear is making good progress. One of the plants common in India is that known as *Pharbitis Nil* (Choisy), Convolvulus Nil (Linnæus), Ipomœa cerulea (Roxburgh).

The author first gave a general review of the medicinal plants of the order Convolvulaceæ, noticing that in the long list of purgatives derived from the order no mention was made of the Indian plant Ipomœa Tupethum, which furnished the once celebrated vegetable turbith, a remedy of extreme antiquity in India, and once in considerable use in Europe. For a thousand years, Dr. Waring said, Turbith root occupied a respectable place among the ranks of purgatives, but is has of late years fallen into disrepute, and it appeared as officinal for the last time in the French Codex of 1837.

Pharbitis Nil (*Ipomœa cerulea* of Roxburgh), the seeds of which the author recommends for use as a purgative, is a common plant in most parts of India, but is most abundant in Bengal. The specific name Nil is a Hindustani word signifying blue. Nil is also the Hindustani name of Indigo, or the blue dye—from this the word Aniline is derived. The seeds of Pharbitis Nil are commonly met with in the bazaars of Northern and Central India, under the name of *Kala dana*, or black seed, and are sold at the rate of about sixpence per pound. They weigh, on the average, about half a grain each, and have the form of a segment of an orange. They have a sweetish taste, but leave an acrid flavour in the mouth, and when fresh they have a peculiar heavy smell. According to O'Shaughnessy, they contain a resin, gum, starch, a bland fixed oil, fibre, and colouring matter. Their purgative nature has long been known to the natives of India, but the first

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* From a Memoir on Purgatives belonging to the order *Convolvulaceæ Journal de Pharmacie et de Chimie*, February, 1866.

clinical trials made with them were by Sir W. O'Shaughnessy, about 1840. He reported that in doses of thirty or forty grains they operated as a quick and safe cathartic. He reported equally favourably of an alcoholic extract prepared from them and administered in ten-grain doses. Dr. Kirkpatrick also made extensive trials with them, and came to the conclusion that the powdered seeds formed a valuable and certain purgative, intermediate in strength between rhubarb and jalap; adding that, although not quite so active as jalap, it was no less certain in its operation, and not so apt to nauseate. Dr. G. Bidie, Professor of Materia Medica at Madras, also speaks well of the action of the seeds; but, objecting to the largeness of the dose (thirty or forty grains), he proposes to substitute a resin which he calls *Pharbitisin*, in doses of from five to eight grains. This resin, Dr. Waring stated, may be easily prepared by the process recommended for the preparation of resin of jalap.

The author's own experience with the drug is small, but from what he has seen he is able to confirm the statements of O'Shaughnessy, Kirkpatrick, and Bidie. In conclusion, he expressed an opinion that the drug was worthy the attention of medical practitioners in India.

In the course of the discussion some further remarks were made on Turbith root, Professor Bentley observing that its purgative strength was about half that of jalap. Growing all over the world in great plenty, the Professor thinks the root might usefully replace jalap, in case of a scarcity of that drug. The active principle, Mr. Hanbury remarked, was a resin resembling that of jalap.

[A short account of this root, by M. Andouard, will be found in another part of our columns.]

Dr. Redwood made a communication "*On the Adulteration of Otto of Roses.*" He said he had made a series of experiments in order to ascertain the value of Hager's test for the detection of adulterations of otto. This test will be found described at page 182 of our last volume. It is based on the alleged fact that strong sulphuric acid forms with pure otto a resinous substance which is completely soluble in absolute alcohol, while the ordinary adulterants of the otto form resins which are only partially soluble in the alcohol. Dr. Redwood has been led to the conclusion that no reliance is to be placed on Hager's test. The great difficulty in general, the Doctor said, in making comparative experiments of this kind is to get a perfectly pure specimen to serve as a standard of comparison. In this case, however, he had the advantage of experimenting with specimens of otto the genuineness of which could hardly be called in question. The first was one distilled by Mr. Whipple, the others were two French and one Turkish obtained by Mr. Hanbury under circumstances which left little doubt of their being perfectly genuine. To each of these specimens Dr. Redwood added sulphuric acid, as directed by Hager, and found that while with some the exact results as stated by Hager followed, in others appearances were obtained which seem to denote adulteration. Thus, with Mr. Whipple's sample the sulphuric acid produced a brown mixture, but on the addition of alcohol a copious deposit separated which might be mistaken for spermaceti. The Turkish specimen behaved exactly as described by Hager, and so did one of the French. But with the other French sample obtained by Mr. Hanbury from Grasse, the resin did not dissolve without heat, and on cooling flocculi separated which had the appearance of spermaceti. Dr. Redwood next described the results of adding sulphuric acid and alcohol to the usual adulterants of otto. The first of these noticed was an oil, described episodically by Mr. Hanbury as being obtained in India from a fragrant grass, and finding its way to Turkey by a curious route. It is shipped from Bombay to the Red Sea, and sold at Jeddah to the Mussulman pilgrims who flock to Mecca, and is by them carried to Constantinople, where it is bought by dealers for the purpose of mixing with otto. The same oil is shipped from Bombay to London direct, and some comes from Constantinople to London. Another was a sample of a similar oil. Both of these give the appearances described by Hager as those of an adulterated otto. The resinous matter formed on the addition of sulphuric acid does not dissolve in alcohol, but collects at the bottom of the test-tube. Pelargonium oil, which is also said to be used as an adulterant, gave no deposit on the addition of alcohol; but as this oil is quite as expensive as otto, its employment is extremely doubtful. Spermaceti Dr. Redwood found to deposit in crystals, as described by Hager, and therefore the test may be useful for detection of this one substance; but still he had found that English otto gave a very similar appearance. Dr. Redwood went on to show that with otto of roses and other essential oils no test, chemical or physical, could probably be relied on to prove their genuineness. Two samples might give entirely opposite results, and yet both be undoubtedly genuine. Climate, for one thing, greatly affected the character of the oil. English otto, for example, was much harder, firmer, and had a higher melting-point than Turkish. The two French samples also differed from each other. In the same way the oils of cloves, peppermint, and lavender differed with the climate in which the plants were grown; and more than this, the oil obtained at different stages of the distillation differed. From all this it was clear that great injustice might be done by deciding on an adulteration from an inconclusive test—a test that was worse than useless. The subject of the adulteration of essential oils was an extremely difficult one, and the results of this investigation should inspire caution in the use of chemical tests for the detection of falsifications. With regard to physical tests, Dr. Redwood showed that they were as unreliable as chemical, the specific gravity, refractive power, and polarising properties of genuine oil, differing quite as much as their chemical properties. It is a well-known fact, the Doctor stated, that French and English oil of turpentine rotated the plane of polarisation in opposite directions.

Dr. Attfield mentioned that Mr. Whipple had once given him two samples of genuine oil of cloves, one of which he had found to be a pure hydrocarbon, while the other had changed to an oxygenated compound—eugenic acid, and had solidified to a mass of crystals.

Dr. Edwards suggested that spectrum analysis might be applied to aid in detecting intrinsic differences in essential oils.

Dr. Waring stated that oil of sandal wood was used in India to adulterate otto of roses.

A Member inquired whether Dr. Redwood has made any experiments to ascertain the cohesion figures as suggested by Mr. Tomlinson.

Dr. Redwood stated that he had not with these essential oils, and so far as he had experimented on other matters, he might state that he had never succeeded in obtaining the indications described by Mr. Tomlinson.

The meeting then adjourned until April 4, which, we may state, will be the last meeting of the season.

Preservation of Chlorophyll during the Decomposition of Leaves.—In the course of some studies on the formation of turf, M. Vohl sealed up a mass of moistened chesnut leaves in an earthen pot and left it to decompose. After nine years the author examined the earthy mass which resulted. It was first exhausted with water, and the residue was then treated with a mixture of alcohol and ether. The latter solution, on evaporation, left a residue of wax and chlorophyll, showing that nine years of putrefaction in the absence of light had not altered the colouring matter of the leaves.—*Journal für prackt. Chem. and Bulletin de la Société Chimique*, Feb., 1866.

ROYAL INSTITUTION OF GREAT BRITAIN.

Weekly Evening Meeting.

Friday, February 9, 1866.

Sir Henry Holland, *Bart., M.D., D.C.L., F.R.S., President, in the Chair.*

A paper, by Archibald Smith, Esq., M.A., F.R.S., was read, "*On the Deviation of the Compass in Iron Ships.*"

The deviation of the compass is a subject of great and increasing importance, owing to the great and increasing amount of iron used in the construction of vessels, and the consequent increase in the amount of the deviation and in the apparent irregularity of its laws.

On the present occasion it will be necessary for me to omit altogether some of the most important and most interesting parts of the subject—viz., first, the mathematical part, including algebraical formulæ, arithmetical processes, and graphic constructions of great interest and utility; and secondly, the numerical results for different ships and classes of ships which have been obtained from the reduction and discussion of observations made in a large number of ships in the Royal Navy. I must confine myself to an attempt to explain the principles on which the forces which cause the deviation act, and the principles on which the deviations produced can be reduced to law, and to stating generally what has been accomplished, and what remains to be accomplished.

General Considerations.—1. A magnet is a bar of steel, the ends of which have opposite properties. They are generally marked N. and S. (north and south), but to avoid the confusion which would be occasioned by speaking of the magnetism of the north end of the needle or of the north end of the earth as south magnetism, it is convenient to distinguish them as *red* and *blue* (which may be remembered from **R** occurring in North and U occurring in South).

The property is that the red end of one magnet attracts the blue end and repels the red end of another magnet, and *vice versâ.*

If we lay two magnets at a little distance in the same line with unlike poles turned to each other, and lay a soft iron rod in the interval between them, the soft iron rod will be magnetised by induction: the end next the blue pole of one magnet will become red, the end next the red end of the other magnet will become blue. If we turn the rod about its centre, it will gradually lose its magnetism, till, when at right angles to the line of magnetisation, it will be neutral, and if we turn it further, it will become magnetised in the opposite way.

The earth is a magnet, having a blue pole in latitude 70° N., long. 96° W., and a red pole in lat. 75° S., and long. 154° E.

The direction of the magnetic force in London at present is the same as if there were a blue pole $20\frac{1}{3}$° to the west of north, and 68° below the horizon, and a red pole $20\frac{1}{2}$° to the east of south, and 68° above the horizon. This direction is called the line of force, or the line of "dip." If we hold a soft iron rod in the line of dip, it becomes instantly magnetised, the north or lower end becoming red, the south or upper end becoming blue. If we hold the rod vertically, the lower end will still be red, but of less intensity, the upper end blue, also of less intensity. If we hold the rod horizontally north and south, the north end will be red, but of still lower intensity. If we now turn the rod in the same horizontal plane, its magnetism will diminish till it becomes east and west, when it will be neutral, and if we turn it still further the magnetism will be reversed; the amount of the changes will be greatly increased by hammering the rod in each position. In a rod which I used, the effect was increased by hammering from 12 to 80, or between six and sevenfold. If the iron had been perfectly soft, it results from the experiments of Weber and Thalen that the effect would have been about 36.

A sphere of soft iron will be magnetised in the same way however held. The diameter in the line of dip will be the axis of magnetism, and the lower and north half of the surface will be red, the upper and south half blue.

In bodies of any other shape the effects will be similar, though less regular, if the shape be irregular.

In an iron ship, on the stocks, intense magnetism is developed by the process of hammering; red magnetism being developed in the part of the ship which is below and towards the north, and blue magnetism in the part which is above and towards the north.

As the usual position of the compass is near the stern, it follows that in the case of ships built head north, the compass is in a position where there is an intense blue magnetism drawing the north end of the compass strongly to the stern and downwards, and generally producing a very large deviation, besides a large heeling error. In such ships it is of importance to have a standard compass well forward.

In ships built head south, there will generally be less deviation and little heeling error in the usual position of the compass.

In ships built east and west the amount of deviation is generally small, but is less regular than in ships built head south.

Theoretical Representation of the Deviation.—If we place a magnet before the compass with its blue end turned to the compass, it will draw the north end of the needle to the ship's head, and as the ship turns round there will be, in the first or eastern semicircle, a deviation of the north point of the compass to the right hand or east, in the second or western semicircle, a deviation to the left hand or west. This would produce one part of what is called the "semicircular" deviation.

If we place a soft iron rod vertically in front of the compass, with its upper end at the level of the compass, this end, which will be blue, will attract the north end of the needle, and produce a deviation of exactly the same kind as the magnet which we have considered. It will, therefore, simply increase the semicircular deviation caused by the first magnet. If the red end of the imaginary magnet, or the lower end of the imaginary rod, be nearest the compass, or if the magnet or rod be abaft the compass, an effect of the same kind, but in an opposite direction, will be produced.

A magnet to starboard or port of the compass will produce a similar effect, except that a deviation of one kind will be produced when the ship's head is on the north semicircle, and of the other kind when on the south semicircle. This is the other part of the "semicircular" deviation.

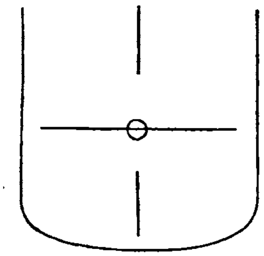
The effect of the two magnets and the one iron rod, which we have considered, make up the whole of what is called the "semicircular" deviation.

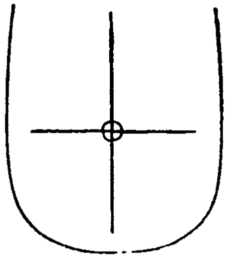
If we lay a horizontal soft iron rod, in front of and directed to the compass, it will easily be seen that when the ship's head is N., S., E., or W. it produces no deviation. When N.E. and S.W. it produces a deviation to the right hand or E., and when S.E. or N.W. a deviation to the left hand or W.; it therefore produces what is called the "quadrantal" deviation.

A horizontal soft iron rod directed to the compass, but placed to the starboard or port, will produce an effect of exactly the opposite kind, and would correct that produced by the first rod; but if the second rod, instead of being on one side, passes, as it were, through the compass, it will produce exactly the same effect as the first rod. The two rods will then conspire to produce the quadrantal deviation.

A quadrantal deviation of the same kind will be produced if the first rod instead of being on one side of the compass passes through it, provided always that its force is less than that of the transverse rod.

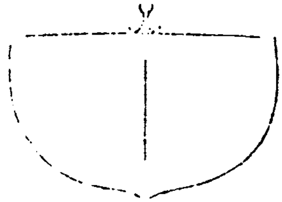
In almost all known ships the quadrantal deviation is what would be produced by two such rods—*i.e.*, rods of one or other of the following types:—

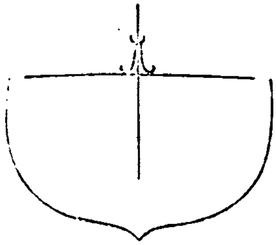




Between the two types there is an important difference, which will be easily traced out. The second type would always diminish the directive force of the needle, while the first type would increase or diminish it, according as the force of the fore and aft rods is greater or less than that of the transverse rod.

The effect of the magnetism when a ship heels over may be seen by the diagrams which follow:—





It will easily be seen that as the ship heels over, the upper end of the transverse rod becomes blue and attracts the north end of the needle to windward, and also that the upper end of the vertical rod which is below in the first figure by the effect of heeling, is moved to windward, and draws the north end of the needle to windward, and increases the heeling error caused by the transverse beam, while in the second figure it is moved to leeward and counteracts the heeling error caused by the transverse iron.

Compasses on the upper decks of iron ships, particularly if they have been built head north, are of the first type, and there is generally a large heeling error to windward. Compasses on the main deck, and particularly of iron-plated ships, are generally of the second type, and the heeling error is often to leeward.

The amount of error in each case may be easily determined by observations of vertical force, and by separating the two parts of the quadrantal deviation, without actually heeling the ship.

The magnets and soft iron rods we have imagined must not be considered as mere possible cases, but as representing truly the actual case in all ships. They are, in fact, the physical interpretation of Poisson's general formulæ for the action of induced magnetism, which interpreted amount to this,—that the effect of the iron of any body, however irregular, on a magnetic particle, is exactly the same as that of nine soft iron rods and three magnets. When the iron is symmetrically distributed, as in a ship, the rods are reduced five in number—viz., the four we have considered, and a fifth lying fore and aft, with one end below the compass, which would make the heeling error greater or less with the ship's head north than it is with the ship's head south, but this is not an effect of much importance.

Effect in Particular Ships.—In wooden ships the semicircular deviation is represented by the effect of a single vertical rod of soft iron in front of the compass, and the quadrantal deviation is very small.

In iron ships the semicircular deviation is generally represented by the effect of a magnet at the part of the ship which was south in building, with its blue end turned to the compass.

Armour-plated ships are generally plated after launching; the semicircular magnetism is greatly affected by the position in which they are plated. If they are plated in the direction opposite to that in which they are built, the deviation is generally diminished; when they are built, the semicircular deviation is generally increased.

Change of Deviation from Time.—What we have called the permanent magnetism is in truth only sub-permanent, and changes much, particularly if the ship is exposed to blows or strains, so that the semicircular deviation generally alters very much in the first year after building. The alteration is generally a diminution, although it might be an increase if the compass had by accident or choice been placed in a position where the semicircular deviation from induced magnetism exactly counteracted that from the permanent magnetism.

In consequence of this change the Government has, on the recommendation of the Superintendent of the Compass Department, laid down a rule that no iron ship shall be taken up as a transport till it has made one long voyage.

There is a very remarkable change in the capacity of the soft iron for receiving magnetism by induction, which seems to indicate some molecular change in the iron, viz., that it becomes less susceptible of induction by the lapse of time. The effect of this on the strength of the iron is one of the most important points to which attention is now directed.

Change of Deviation from Change of Place.—When a ship sailing south reaches the magnetic equator, the earth's magnetism acts horizontally. The vertical soft iron rod which I have imagined will then have no magnetism, and the semicircular deviation arising therefrom will disappear. When she goes into south magnetic latitudes, the upper end will now become red, and will repel the north end of the needle, and change the direction of the semicircular magnetism caused by the rod.

There will be no corresponding change in the semicircular magnetism caused by the permanent magnetism, except that near the magnetic equator the directive force of the earth's magnetism being greater than in England, the amount of deviation which the same disturbing force produces will be proportionately diminished.

Careful observations on the changes which take place in the deviation of iron ships in different latitudes are much wanted. They are being made in some of Her Majesty's ships now in the south, but there are no means of procuring such observations from merchant ships.

No change is produced in the quadrantal deviation by a change of the ship's geographical position.

Effects of Special Arrangements of Iron.—The upper or lower ends of all vertical masses of iron produce powerful effects on the needle.

The stern post, iron stanchions, funnels, gun turrets, generally produce large deviations, but if the place of the compass is judiciously selected, they or some of them may be used as correctors.

Horizontal masses of iron, such as deck-beams, produce a great effect, generally increasing the quadrantal deviation and diminishing the directive force. Both causes of error may be reduced by having as little iron as possible immediately below the compass, or within a cone traced out by a line passing through the compass, and making an angle of 54° 45′ with the vertical.

History of the Science.—What has been said will make a short account of the history of the science intelligible. Captain Flinders, in his voyage to Australia in the beginning of the century, was struck by the fact of the north end of the compass being drawn to the ship's head in northern, and the stern in southern latitudes. He, with great sagacity, compared it to the effect produced by a vertical rod of soft iron, and corrected it by introducing such a rod abaft the compass. Afterwards, attention was drawn to the same subject in the voyage of Ross and Parry to Baffin's Bay, to which expeditions General, then Captain, Sabine was attached as astronomer. The very large deviations which were found in high latitudes attracted attention, and were carefully observed and discussed.

The observations made in these voyages attracted the attention of Poisson, the great French mathematician, who, in his memoirs on magnetism, published in the year 1824, first gave the general formulæ for the effect of iron, which we have already adverted to, and applied them to the observations made in these voyages with much success.

About the year 1840, the British Admiralty, on the report of a committee of scientific officers, comprising General Sabine, Sir J. Ross, and the late Captain Johnson, adopted the system ever since followed in the Royal Navy, of having a standard compass distinct from the steering compass, placed in a position selected, not with reference to the convenience of the steersman, but for the small and uniform amount of magnetic force at and around it, and of having the deviations of that compass carefully observed by the process of "swinging" the ship, and the deviations of every ship recorded. They also appointed an officer, whose sole or principal duty was the superintendence of the compasses. This office, which has been filled first by Captain Johnson, and since his death by Captain Evans, has done more for the advancement of the science than anything else.

No ships in the Royal Navy have ever been lost from the errors of the compass; and the magnetic history of every ship is so well known that, in case of the loss of a ship, there would be no difficulty in arriving at a confident opinion as to the effect of the compass error in causing it.

At the same time the attention of Mr. Airy, the Astronomer Royal, was directed to the particular question of the deviation of the compass in iron ships. Mr. Airy proposed a mode of correcting the semi-circular deviation by the application of magnets, and of correcting the quadrantal deviation by the application of soft iron cylinders analogous to the soft iron rods we have supposed, which has been subsequently extensively adopted in the mercantile marine.

In the year 1858 the Liverpool Compass Committee commenced those labours which, principally carried on by their able secretary, Mr. Rundell, have produced three valuable reports, which have contributed greatly to the advancement of this science. These labours are, however, now discontinued.

Practice in the Royal Navy.—In the Royal Navy, as we have said, each ship has a standard compass in a selected position. A ship is swung or turned round, and the deviation observed in a certain number of positions, either by comparison with a compass on shore or by a comparison with a celestial body, or by observing a distant object. A table of errors is thus observed and recorded—they are reduced by obtaining from them the co-efficients of the semicircular and quadrantal deviation. Observations of horizontal force and of vertical force are also made, from which the amount of heeling error is obtained—and if the amount is large, the heeling error is corrected by the application of a vertical magnet.

The whole process is described, and all the mathematical formula and arithmetical processes, and a number of convenient graphic methods, are given in the "Admiralty Manual for ascertaining and applying the Deviations of the Compass caused by the Iron of a Ship." (London: Potter, 1863.)

Practice in the Mercantile Marine.—In the mercantile marine there is no regular superintendence of the adjustment of the compass; it is left to the professional compass adjusters. In many cases there is no separate standard compass, but the steering compass is used for the navigation of the ship, and is often placed so near the stern post and steering gear that it has originally very large and very irregular deviations. These are corrected by powerful magnets. The consequence is, that the slightest change in the magnetism of the ship produces a large error, which is the more dangerous that the captain believes his compass to be free from error.

This great disadvantage, from the indiscriminate use of the method of correction by magnets, is, however, an abuse of the method, and not necessarily attendant on it.

DESIDERATA.

I. *Royal Navy.*—The only desiderata seem to be that greater attention should be paid to the preparing a place for the standard compass, and to the position of the ship in building and plating. The position of the standard compass should be shown in the drawings of every ship, which, before being finally settled, should be submitted for the observations and suggestions of the Superintendent of the Compass Department.

Ships should be built as much as possible head south, and should be plated in the opposite direction to that of building.

Careful recommendation as to the special points to be attended to have been submitted to the Admiralty by the present superintendent of the Compass Department, and we may hope that much benefit will be derived from them.

A proof of what may be effected in this way has already been given in the case of several of the ships of the Imperial Russian Navy, in which the arrangements made under the superintendence of Captain Belavenetz have greatly reduced the amount of deviation.

II. *Mercantile Marine.*—This a more difficult question, from the want of any general superintendence, or any mode of establishing a uniform system, or any opportunity of receiving, recording, reducing, and discussing the observations made.

Till some change takes place in this respect, it is not probable that much improvement will be introduced, or that merchant ships will make their due contributions to the advancement of science.

What seems desirable is—

1. That in all iron steam passenger ships there should be a standard compass distinct from the steering compass, placed in a position selected for the small and uniform amount of the deviation at and around it.
2. That the deviations by the standard compass should be ascertained and returned to a department of the Government.
3. That these deviations should be carefully recorded, reduced, and discussed by a competent superintendent.

Many indirect advantages might be expected to flow from following, in these respects, the example of the Royal Navy.

Foreign Countries.—The "Admiralty Manual" has been translated with more or less modification, and in some respects improvement, by M. Darondeau into French, Captain Belavenetz, into Russian, and Dr. Shaub (of the Austrian Hydrographic Department) into German. In Russia, in particular, the great zeal of Captain Belavenetz, and above all, the appointment of a person of his energy and ability, charged exclusively with the superintendence of this branch of nautical science, has produced, and promises to produce, most important results. In the French and other navies it is not understood that there is any officer charged exclusively with the duty, and we cannot therefore at present look for any contributions from them to the science of the deviation of the compass.

ACADEMY OF SCIENCES.

March 5.

The last sitting of the Academy of Sciences was devoted to the annual distribution of the prizes conferred by the Academy. As we have announced, the Lalande Astronomical Prize (a gold medal of the value of about 20*l.*) was allotted to Mr. Warren De la Rue, whose name is so familiar to English chemists as well as astronomers. We make some extracts from the report made on the occasion. Eighteen years ago Mr. De la Rue established his private observatory at Cranford, and for the last fifteen years he has made celestial photography his especial study. The instrument he employs is a telescope of 16-inch aperture, mounted on a parallactic stand, moved by a clock, and constructed under his own direction and from his own designs. The beautiful lunar photographs obtained with this instrument show the degree of perfection, optical and mechanical, arrived at in the apparatus. By the aid of the clockwork, he is able to follow exactly the movements of the moon, and by perfecting the chemical processes employed for the preparation of a sensitive surface, he has been able to reduce considerably the time of exposure. At once optician, chemist, mechanician, and astronomer, Mr. De la Rue has had the satisfaction of seeing his efforts crowned with perfect success. His photographs of the moon are so perfect that they may be enlarged to a diameter of three feet, and at the same time they allow of micrometric measurements so exact that they have furnished data for the measure of the moon's libration. They have also been employed as the bases of the large map of the moon drawn under the directions of the British Association. Mr. De la Rue's lunar stereoscopic views also show the relative heights and depressions of the ravines, plateaus, and undulations with which the surface of the moon appears to be furrowed. It must be added that Mr. De la Rue has with equal success obtained photographs of Saturn, Jupiter, Mars, and of some stars. He has been no less successful with the sun. On the occasion of the great solar eclipse of 1860, it will be remembered he travelled to Spain, and there took a series of views before, during, and after the total disappearance of the sun, which proved that the luminous prominences observed in such eclipses belonged to the sun. In 1859, Mr. De la Rue obtained stereoscopic pictures of the sun, showing the spots and faculæ which are available for studying the relative position of the parts which compose the photosphere. Lastly, Mr. De la Rue has shown the possibility of producing, by the action of light alone, plates from which photographic proofs of the sun and moon may be printed with ordinary printers' ink.

The Jecker chemical prize of 5000 francs was this year divided among three chemists. Three thousand francs were allotted to M. Cloez for a collection of works: 1. On the organic bases obtained by the reaction of ammonia on Dutch liquid. 2. On the state of sulphur in various combinations. 3. On a compound having the composition of the cyanic ether of Wurtz, but differing from it, inasmuch as potash reduces it into cyanic acid and alcohol. 4. The recent labours of the author, On oleaginous seeds, and the influence of light on the absorption of oxygen by drying oils. In studying the action of the air on drying oils, M. Cloez determined that the following products were formed:—

Volatile . .	Formic, acetic, butyric, acroleic, and carbonic acids; acroleine.
Fixed residue .	Magaric and oleic acids (not absorbing oxygen), and an acid of a resinous appearance.

Glycerine for the most part disappears.

One thousand francs were allotted to M. Friedel, for his researches on the acetones, and the compounds of silicium with carbides of hydrogen, made in co-operation with M. Crofts. The remaining thousand francs were given to M. De Luynes, for his researches on orcine and erythrite, mentioning particularly the reaction of hydriodic acid on erythrite. These two bodies distilled together give hydriodate of butylene, decomposable by potash into butylene C_8H_{16}.

The Barbier Prize "for the most important discovery in surgery, medicine, pharmacy, or botany, in connexion with the art of healing," was also divided. One part was allotted to MM. Baillet and Filhol, for their "*Researches on the Darnel Grass* (*Lolium Temulentum*)." Our readers may remember that these authors have discovered that the Darnel contains two poisonous substances, differing greatly in their physical and chemical properties, as well as in their action on the body. One is soluble in ether and insoluble in water; the other is soluble in water and insoluble in ether. Neither is volatile. The one soluble in ether exerts a special stimulating action on the nervous system, something like that of strychnine. That one soluble in water produces a stupefying effect, somewhat like the effect of too much alcohol, followed by remarkable prostration, but leaving the mind unaffected. The chemistry of these two bodies has not been settled, and the authors of the essay are recommended to go on with their studies.

The other share of the prize was conferred on MM. Vée and Leven, for their "*Investigations on the Extract of Calabar Bean.*" We published these at length when they were first made, and need not refer to them here.

We may mention an unsuccessful memoir "*On the Action of Poisons on Plants,*" sent in by the late M. Reveil for the prize in experimental physiology. The author shows from a great number of experiments that certain substances exert a much more deleterious influence on plants than animals. Mineral acids, and even citric and tartaric acids in very dilute solution, very soon kill the plant that absorbs them. So do many saline solutions, and even very dilute mixtures of alcohol and of ether—all substances which are taken with impunity by animals. Organic alkalies, on the contrary, are for the most part harmless to plants. The salts of quinine, and especially of cinchonine, alone seem to be hurtful to vegetation. These stop the growth of, and often kill, a plant. But salts of morphia, codeia, narcotine, strychnia, and nicotia, which act so energetically on animals, have no influence on vegetables; and atropia, so far from being hurtful, seems, in fact, to be in a double sense a valuable manure.

The Bordin Prize, for a memoir relative to the theory of optical phenomena, the exact subject left to the choice of the competitor, was divided, 1500 frs. being allotted to M. Janssen for a memoir "*On the Terrestrial Lines of the Solar Spectrum.*" This memoir is thus alluded to in the Report of the Commission which allotted the prize:—Sir David Brewster many years ago discovered in the solar spectrum certain dark bands which become more and more marked as the sun descends towards the horizon. These bands, considered as to their real constitution and origin, have been the subject of long and persevering researches by the author, the principal results of which are contained in the memoir submitted. The bands have been resolved into fine and well-defined lines, visible in different degrees at all heights of the sun. A variety of proofs allow of distinguishing with much probability these particular or *telluric* lines from the lines pre-existing in solar light. Lastly, if the whole of these lines appear to have the terrestrial atmosphere for a common origin, a certain number of them would appear to be caused by the presence of the vapour of water in the atmosphere. The memoir gives a special account of the author's experiments on the Faulhorn—that is to say, at a height of 2683 metres—where he found that these telluric lines were much less visible than in the plain. It contains also an account of an experiment made at Geneva, which seems to show more conclusively that the cause of these lines resides in the atmosphere. The author made a large bonfire at night, and examined the light first close by, and then at a distance of twenty-one kilometres. In the first case the spectrum remained continuous; but at the distance just mentioned the telluric lines were clearly seen.

Several essays "*On the Mechanical Theory of Heat*" were sent in to compete for the Bordin Prize, but no one was adjudged worthy of the whole sum, and the subject is now withdrawn.

NOTICES OF BOOKS.

The Year-Book of Pharmacy; a Practical Summary of Researches in Pharmacy, Materia Medica, and Pharmaceutical Chemistry during the Year 1865. Edited by C. H. Wood, F.C.S., and C. Sharp. London: Churchill and Sons. 1866.

This is the second year of this useful publication, and the volume now noticed is quite equal to its predecessors. As we said before, the chemist and druggist will find it a very useful book of reference, since it contains in a short space all the most noteworthy facts relating to pharmacy and materia medica published during the past year.

Chemical Handicraft: a Classified and Descriptive Catalogue of Chemical Apparatus, suitable for the performance of Class Experiments, for every Process of Chemical Research, and for Chemical Testing in the Arts. Accompanied by copious Notes Explanatory of the Construction and Use of the Apparatus. By J. J. Griffin, F.C.S. London: J. J. Griffin and Sons. 1866.

This book will supply a want long felt by all chemists. Its contents are so well described in the Preface that we cannot do better for our readers than transcribe a portion of it—"The work is, in the main, a Price Current of chemical apparatus. But a slight examination will show that it is something more than that. If, indeed, its commercial character were separable, the residue of the work might fairly be considered *a report on the apparatus which the philosophical chemist has at present at command to aid in his original researches, or to demonstrate the truths adduced in his teachings.* In fact, much of the work is of the nature of a treatise on what is called *chemical manipulation.* The materials for it have been collected for it from all parts of Europe, with much cost and labour; and considerable time has been spent in trying the instruments one against another, and in making modifications and improvements. Under the heads of *Air Pumps, Lamps, Furnaces, Gas Furnaces, Blast Furnaces, Blowpipe Apparatus, Volumetric Analysis,* and in many other places, the reader will find the results of numerous original experiments of the above character."

All of this we are happy to endorse, and cannot do better than recommend every one engaged in chemical pursuits to provide himself with this work. We may refer the reader more particularly to the accounts of furnaces, and the apparatus for volumetric analysis, as furnishing especially useful information.

We see with much pleasure that the editor intends to publish a series of works, on the same plan, relating to apparatus suitable for the experimental illustration of the sciences of light, heat, electricity, &c., &c. These will be even more welcome than this on "Chemical Handicraft," and we may predict for them a great success.

We need only add that this book is illustrated with upwards of 1500 engravings on wood, and is, moreover, exceedingly cheap.

Preservation of Vinegar.—It was an observation made by Scheele, but the fact has recently been published as a new discovery, that ordinary brown vinegar will keep bright and clear for any length of time if heated to the boiling-point for a few minutes.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

386. J. Townsend, Glasgow, N.B., "Improvements in preparing size or stiffening, and in applying the same to textile materials or fabrics."—Petition recorded 8, 1866.

414. V. T. Junod, Old Cavendish Street, Cavendish Square, Middlesex, "Improvements in vacuum apparatus employed for the cure or relief of inflammatory diseases."—February 10, 1866.

444. M. R. Leverson, Bishopsgate Street Within, London, "Improvements in the manufacture of gas suitable to be used for illumination or for obtaining heat or motive power." A communication from G. L. Malherbe, Rue Trokay, Liege, Belgium.

447. S. Marland, W. H. Smith, Clayton, near Manchester, and W. Wells, Manchester, "Improvements in obtaining and applying artificial heat, for producing light, and for other purposes, and in the apparatus employed therein."—February 13, 1866.

484. P. Ward, Cloud's Hill Villas, St. George's, Bristol, "Improvements in preparing materials for preventing and removing incrustations in steam boilers, for lubricating machinery, and for scouring cloth and other substances."—February 15, 1866.

497. W. Clay, Liverpool, "Improvements in economising the heat of gas producers."

500. W. Wood and J. W. Wood, Monkhill, near Pontefract, Yorkshire, "Improvements in the manufacture of Pomfret or liquorice cakes, rolls, and pipes, and of lozenges and other similar articles of confectionery, and in apparatus to be used in the manufacture of such articles."—February 16, 1866.

540. B. W. Richardson, M.D., Hinde Street, Manchester Square, Middlesex, "Improvements in the means of, and apparatus for refrigerating or freezing liquids, and for producing ice."—February 21, 1866.

545. J. D. Brunton, Leighton Crescent, Kentish Town, Middlesex, "Improvements in the manufacture of peat fuel, and in the machinery employed therein."—February 22, 1866.

565. R. Millburn, jun., Tulse Hill, Brixton, and W. H. Baxter, Elm Cottage, Brixton Hill, Surrey, "Improvements in the treatment of brewers' and distillers' grains."—February 23, 1866.

595. W. P. Le'Keux, Seymour Street, New Town, Deptford, and F. A. Wishart, Ivy Cottage, Upper Lewisham Road, New Cross, Kent, "Improvements in detonating and light signals for railways and other uses."

603. H. Robertson, Motherwell, Lanarkshire, N.B., "Improvements in the manufacture of oil and other products from bituminous substances, and in the machinery or apparatus employed therein; which improvements or parts thereof are also applicable to the manufacture of white lead or other pigments."—February 27, 1866.

615. H. A. Dufrené, Rue de la Fidelité, Paris, "Improvements and new applications in the manufacture of beer and alcoholic liquids." — A communication from C. Tellier, Rue Bohllonnvilliers, Passy, Paris.

617. W. E. Newton, Chancery Lane, "An improved process of, and apparatus for extracting tan, bark, and other vegetable materials."—A communication from S. W. Pingree, Lawrence, Mass., U.S.A.—February 28, 1866

Notices to Proceed.

2768. S. Sequelin, Camden Town, Middlesex, "Improvements in the purification and preparation of animal and vegetable wax, stearine, spermaceti, paraffin, and other solid waxy or fatty substances."—Petition recorded 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.

2793. E. Meldrum, Bathgate, Linlithgow, "Improvements in the distillation of coal and shale, and in the apparatus employed therein."—October 30, 1865.

2810. J. Sellars, Manchester, "Improvements in the manufacture of artificial gum size or stiffening matter."—November 1, 1865.

2934. J. T. A. Mallet, Boulevart St. Martin, Paris, "A new or improved process for the manufacture of oxygen."—November 14, 1865.

3002. S. A. Bell, Epping Villas, Stratford, Essex, "An improvement in the manufacture of friction matches and tapers."—November 22, 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."—November 23, 1865.

3099. T. Bell, Plaistow, Essex, "Improvements in treating the oxide of iron residues of gas purifying, in order principally to extract sulphur therefrom."—December 2, 1865.

3355. E. V. Gardner, Berners Street, Middlesex, L. A. Israel, and H. A. Israel, junior, Crescent, Middlesex, "Improvements in compounds for deodorising and disinfecting."—December 28, 1865.

CORRESPONDENCE.

Continental Science.

Paris, March 10.

You published some time ago an account of a number of poisonings in the United States by some calomel sent from England which contained a considerable proportion of corrosive sublimate. You no doubt saw in the last number of the *American Journal of Pharmacy* the name of the firm by whom the calomel was manufactured; but I suppose a knowledge of the glorious uncertainty of the law of libel prevented you from taking further notice of the matter. I only refer to it now to mention that the subject is referred to in the *Journal de Pharmacie*, which makes the curious observation that such "accidents are the consequence of the liberty of pharmacy in England"! Pharmacy in France is said not to be free, and certainly is not in some respects; but the restrictions under which it is laid have not, so far as I know, prevented the exportation of such sulphate of quinine as that examined by Mr. Stoddart, which contained only ten per cent. of quinine; nor the sale of sugar of milk for solid cod-liver oil; nor the manufacture of pepsine from starch and cheese with a little lactic acid; nor, indeed, many other things just as creditable to our ingenuity, but not saying much for our honesty.

In this same Journal of Pharmacy I read that at the last meeting of the Society of Pharmacy M. Roussin exhibited some samples of falsified pepper composed of ground husks of pepper, rye-flour, and linseed meal, made up into small pills to resemble whole pepper. As much as 1800 quintals of this precious mixture had been seized, as it would most certainly have been by your excise.

The proceedings of the Society, as contained in the minutes here published, offer very little of interest. M. Roussin suggested that tartar emetic for pharmaceutical use, instead of being ground to powder, should be precipitated from a saturated aqueous solution by means of alcohol. The powder so obtained is, he says, lighter and more easily dissolved than the ground powder.

M. Baudrimont showed a sample of jalap—of what origin is not stated—which contained fourteen per cent. of resin. He also remarked that on incineration the amount of ash in a jalap is always in an inverse proportion to that of the resinous principles. In another part of the *Journal of Pharmacy* I read the assertion of M. Andouard that fusiform jalap often contains much more resin than the officinal tuberous root of *Exogonium purga.*

On the "Law of Octaves."

To the Editor of the Chemical News.

Sir,—Will you allow me to make a few remarks in reply to the objections which were offered to my paper, read at the meeting of the Chemical Society on the 1st inst.?

The rule followed by the elements when arranged and numbered off, in the order of their atomic weights, was expressed as follows:—"The numbers of analogous elements, when not consecutive, differ by 7, or by some multiple of 7." The clause "when not consecutive" was introduced for the purpose of embracing certain analogous elements whose atomic weights are consecutive—*e.g.*, the series containing chromium No. 19, manganese No. 20, iron No. 21, nickel and cobalt No. 22, copper No. 23, and zinc No. 24.

Now, it appears to be difficult to construct any arrangement, founded upon numerical data, which could bring the above-named elements into closer connexion than the one which I have adopted; yet it has been condemned on the score of its placing "so far apart manganese and chromium, or iron from nickel and cobalt." I readily grant "that any arrangement may present occasional coincidences;" but, at the same time, take leave to observe that the coincidences which I have pointed out are the rule, and not the exception.

I have endeavoured to describe relations actually subsisting among the atomic weights of the elements at present known, but am far from thinking that the discovery of new elements (or the revision of the atomic weights of those already known) will upset, for any length of time, the existence of a simple relation among the elements, when arranged in the order of their atomic weights.

The fact that such a simple relation exists now, affords a strong presumptive proof that it will always continue to exist, even should hundreds of new elements be discovered. For, although the difference in the numbers of analogous elements might, in that case, be altered from 7, or a multiple of 7, to 8, 9, 10, 20, or any conceivable figure, the existence of a simple relation among the numbers of analogous elements would be none the less evident.

As a proof, however, that new discoveries are not very likely to destroy such relationship, I may mention that when the existence of the "Law of Octaves" was first pointed out (Chem. News, August 20, 1864) the difference between the numbers of P and As was 13 instead of 14, as between As and Sb, and also between Sb and Bi. Since then, by the determination of the atomic weight of indium, the difference of the numbers of P and As has been made to be 14, as in the other cases adduced.

I am, &c.

John A. R. Newlands, F.C.S.

Laboratory, 19, Great St. Helens, E.C., March 12.

Carbolic Acid and the Cattle Plague.

To the Editor of the Chemical News.

Sir,—The public papers appear to give to the Royal Commissioners, or their referees, the credit of suggesting carbolic acid as a means of preventing the spread of the cattle plague. May I be permitted to refer to my own much earlier suggestions and experiments?

In the early part of last August, a few weeks only after the plague appeared in England, I gave a lecture before a local agricultural association—that of Kingscote, Gloucestershire,—on "Disinfectants, with Special Reference to the Cattle Plague." I then described the nature and mode of using carbolic acid. Shortly afterwards my plans were tried in Gloucestershire, Wiltshire, Staffordshire, in the neighbourhood of London, and in Forfarshire. The reports generally were very satisfactory. I then wrote to the *Times*, but my letter did not appear, although that journal had just before printed same rather ignorant remarks on the efficacy of dead-oil.

A local druggist afterwards obtained some directions from me, and had them printed and distributed; while I communicated my suggestions and their results to the *Agricultural Gazette* of November 11, 1865, to the *Wilts and Gloucester Standard*, and other papers.

I beg to refer any one who wishes to become acquainted with the mode of using carbolic acid recommended by me in August last, to consult my note in the *Agricultural Gazette* of last year; it will be found on page 1066.

I am, &c., A. H. Church.

R. A. College, Cirencester.

Dr. Smee and Worthing Well Water.

To the Editor of the Chemical News.

Sir,—The attention of the Worthing Local Board of Health has been drawn to a report of a recent meeting of the Chemical Society, which appeared in the Chemical News of February 9 last, wherein it appears that Dr. Smee spoke as follows:—"At Worthing, where an outbreak of fever was reported, the sewage operations had, he believed, impregnated the subsoil by leakage, and the water drawn from the chalk, formerly so bright and clear, was now slightly turbid." Of course Dr. Smee had received some information from some one upon the subject on which he spoke, because he states he believes the statement he put forth; but whoever was his informant, he has greatly misled him; and as Dr. Smee's statement (especially coming from such a man) is calculated to inflict great injury (entirely undeserved) to the town of Worthing, the Local Board beg you will give this communication a place in your next publication.

It is not very clear what Dr. Smee means by "sewage operations," but as the subject under discussion was the "Utilisation of Sewage to Land," and Worthing had been named as a place where the system was being tried, it is presumed that Dr. Smee referred to the system of sewage operations for the utilisation of sewage going on at Worthing.

It is assumed that what Dr. Smee said is correctly reported, and this being so, the inference to be drawn from the language is, that he believes the sewage irrigation works at Worthing had impregnated the subsoil by leakage, whereby the water drawn from the chalk, formerly so bright and clear, was made slightly turbid. There is not a particle of truth in this statement. Now for facts:—The sewage is carried to the land through iron pipes bored and turned, and jointed in lead, and every pipe before being laid was tested and found free from flaw, and not a drop of sewage escapes or can escape by leakage. No sewage therefore can impregnate the subsoil by leakage. The land irrigated with the sewage is about one or two hundred yards short of a mile from the clear water well in the town, and the sewage after passing over the land, falls at once into a stream which empties itself into the sea; so that it is very plain that these operations have certainly not had the effect of making the "water drawn from the chalk, formerly so bright and clear, slightly turbid." The water still possesses these fine properties, as is shown by Professor Redwood's analysis, made as late as December last. The Professor's report of the result of his analysis is enclosed in this letter. It is there stated that "the water received was free from colour—perfectly bright and well aërated;" that "the organic matter present in one gallon was oxidised by 0·0077 gr. of oxygen," and that "the most valuable character of this water in a sanitary point of view is its comparative freedom from organic impurity. In this respect it will bear comparison with the best potable waters known." An analysis such as this ought to be accepted by Dr. Smee. But further, if a chemical analysis could require confirmation, it is found, in the present case, in the fact that the town clear water well, which is supplied from a boring 365 feet deep, is actually lined to a depth of 70 feet (full into the chalk) with iron cylinders, which must necessarily—and does, in fact,—protect the well from the reception of all surface or extraneous water. Beyond this, it is impossible for any sewage to penetrate the pure water well or water-bearing strata from any point. The true chalk beneath the town of Worthing is covered by alluvium impervious to water at the depth of the sewers—in other words, the subsoil water cannot flow down below the level of the sewers, and we know by experience that in all the sewers and drains any flow of water through joints is from the subsoil into the drains and sewers, because the daily volume of water pumped by the sewage pumps is some three to five and six times the daily volume of water supplied and used by the inhabitants; and, under these conditions alone, irrespective of the other conditions mentioned, sewage at Worthing cannot in any manner affect water pumped from the true chalk for use.

It is plain, therefore, that Dr. Smee spoke from very imperfect information, and it is hoped that that gentleman will have sufficient sense of right to take the first opportunity of acknowledging that he did so, and of repairing, as far as in him lies, the great mischief he may have occasioned to the town of Worthing.

Requesting you will have the goodness to give insertion of this letter in your next publication,

I am, &c.,
Wm. Hugh Dennett,
Clerk to the Worthing Local Board of Health.

Worthing, March 12.

Intermitting Springs.

To the Editor of the Chemical News.

Sir,—It may interest your readers to know that the River Bourne, which makes its appearance at intervals of about six or eight years, is just now flowing past Croydon at a rate calculated to be between twenty and thirty millions of gallons daily. Its chemical quality I find to be that of an ordinary chalk water. The source of the river is a mile or two from the Caterham Railway Station.

I am, &c., John Attfield.

17, Bloomsbury Square, March 13, 1866.

MISCELLANEOUS.

Royal Institution of Great Britain.—The following are the lecture arrangements for the ensuing week:—Tuesday, March 20, and Thursday, March 22, at 3 o'clock, Professor Frankland, "On the Non-Metallic Elements." Friday, March 23, at 8 o'clock, Dr. Bence Jones, F.R.S., "On the Existence in the Textures of Animals of a Fluorescent Substance closely resembling Quinine." Saturday, March 24, at 3 o'clock, Rev. G. Henslow, "On Structural and Systematic Botany."

A School of Chemistry at Naples.—We have had forwarded to us the prospectus of a college of chemistry opened at Naples on the 20th of last month by Signor Cassola. All the arrangements appear to be most complete. Besides the study of general chemistry, under Professor Carlo Cassola, there are particular classes superintended by special professors for all branches of applied chemistry. The founder makes an eloquent appeal to his countrymen to support him in his enterprise, and we hope they will heartily respond to it. We wish him every success.

New Test for Potash.—Bitartrate of soda is recommended by M. Plun Rett as a precipitant of potash. The solution is made by dissolving tartaric acid in water, dividing the solution into two parts, saturating one of these with carbonate of soda, and then mixing the remaining acid solution. The liquor containing potash must be slightly acidulated before the reagent is added.

The Royal Society Soiree.—On Saturday evening last the President, Lieutenant-General Edward Sabine, R.A., received at Burlington House a distinguished circle of visitors at this the first of two receptions for which invitations have been issued. The apartments of the Royal Society were as usual decorated by a vast number of objects of art and scientific novelties. Her Majesty the Queen lent some magnificent original drawings by Nicholas Poussin and other early illustrations from the Royal collection. Mr. Baines contributed some large water-colour representations of Murchison's Falls and other African scenes lately described by Mr. Baker. Photography was well represented by a fine collection of full-length portraits—mostly of medical celebrities—taken by Messrs. Wilson and Beadell, of New Bond-street. Specimens of the new graphotype process were shown, and also some good lithographs and photographs from the United States of America. Messrs. Samuda, Brothers, exhibited a large and very beautiful model of a 3500 ton double-turret war-vessel, on Captain Coles' principle, which from recent Parliamentary considerations seemed to engage a large share of attention throughout the evening. Among the large collection of scientific apparatus the following objects appeared to be the most prominent:—Dr. Frankland exhibited a large Oersted's apparatus for showing the condensation of cyanogen, sulphurous acid, air, and water under similar pressures. Mr. G. F. Ansell, of the Royal Mint, showed a series of instruments (Marratt and Short, makers, King William-street, City,) which are intended to indicate the existence and proportion of "fire-damp" in the atmosphere of coal mines. The electric alarums and other apparatus sketched at pages 281 and 282 of our last volume, were shown in action, likewise the india-rubber ball and barometric indicators, including a very ingenious adaptation of the pocket aneroid to these purposes by the substitution of a porous diaphragm at the back for the usual metallic outer case. Mr. W. Ladd exhibited the power of two thermo-electric batteries of improved construction, in inducing magnetic effects, and showed the discharge in Geissler's tubes through the agency of Mr. Gassiott's large American coil. A plate electrical machine, without rubbers, which, once charged with an excited glass rod, gives sparks for a considerable time afterwards, was sent by Dr. H. Bence Jones. This instrument, made by W. Schultz, of Berlin, appears to be a kind of revolving electrophorus, in which the resin plate is represented by a glass disc varnished with shellac. Mr. Ladd produced the magnetic figure from one of Mr. Beardsley's large "star magnets," and exhibited by the aid of his microscopes several specimens of the pork trichinæ. Mr. W. H. Preece exhibited his electrical system of railway signals; and Messrs. Elliott, Brothers, showed a very delicate Thomson's electrometer, Commander Arthur's self-recording ship's-compass, and Howlett's patent anemograph. A dynamic colour-top was shown by Mr. Maxwell. Lastly, the objects displayed by Mr. John Browning included a magnificent right-angled reflecting prism, prepared for Dr. W. De la Rue; a new mode of mounting the same for telescopic use upon a slender triangular framework, and a large silvered-glass speculum; spectroscopes in great variety, and an exceedingly delicate aneroid barometer with scale so open that the one-inch mercury variation occupied eighteen inches on the dial of the instrument. We must not omit to notice the fact that Mr. Frank Buckland illustrated the natural history and development of the oyster by an immense collection of specimens of various ages up to six years.

Liver Ketchup.—This case came before the magistrate again on Friday last, and Mr. Woolrych, still holding that ketchup is not "food," dismissed the summons, but granted a case for the Court of Queen's Bench. The judges of that court will, therefore, have to decide, after elaborate argumentation, whether an article which is swallowed in considerable quantities every day is, or is not, food in the legal acceptation of that term. Should the judges agree with the magistrate, it will be time to think of amending the Act of Parliament under which these proceedings are taken. In the mean time, the public will be able to form their own opinion as to the merits of "Pure Leicestershire Ketchup." Livers, we are informed, are largely used in popular cookery. They are said to form the basis of "hare soup."

The Truth about Antozone.—The following letter from Mr. Allnatt appeared in the *Times* a few days ago:—

"Will you favour me by publishing the following extract from an important communication recently received from Professor Schönbein? It will set at rest the controversy raised by some persons in this country, who, in utter contravention of facts, have denied the very existence of antozone.

"M. Schönbein's letter was addressed to Dr. Fred. D'Alquen, a gentleman well versed in German literature, who kindly furnished me with many of the scientific details contained in a report of mine to *The Times*, which gave rise, on the part of Professor Roscoe, to a flat contradiction "that antozone has any existence."

"Dr. D'Alquen having forwarded to Schönbein an account of the various rumours which have recently appeared in this country, the professor replied as follows:—

"'I certainly accept two antagonistic modifications of oxygen—viz, ozone, and antozone, and believe also to have succeeded in isolating both, not recently, but years ago. However, what I never asserted, and could not assert, is, that I have obtained ozone or antozone in a pure state, as up to this day I have not been able to obtain either the one or the other, otherwise than with an admixture of ordinary oxygen. For this reason it was not possible for me to determine their physical properties, as specific gravity, &c. But, as it has been stated that those and other wonderful properties have been discovered by me, my reported denial, given privately, on being questioned, had only reference to those idle and unfounded statements, but by no means to the existence of antozone in an isolated state, of which I am as certain as of the existence of ordinary oxygen.'

"My assertion, therefore, respecting M. Schönbein's discovery is completely confirmed by the professor himself."

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.

Our Correspondent, "Chemicus," who made some inquiries respecting umber, is requested to communicate with Mr. John Wade, 100, York Street, Westminster, who will give him all the information he requires.

Professor Church.—Received with thanks.

C. H. B. L.—Pass sulphurous acid into a solution of ammonia in two or three Woulf's bottles.

R. M.—It would be impossible to account for the change in the colour of the paper without knowing the nature of the dye used for the stuffs. Gamboge might perhaps be used for the paper, and would remain unaffected.

J. F. C.—A smaller quantity is most easily prepared by the direct combination of chromic acid and ammonia. Divide a solution of chromic acid into two equal parts, saturate one with ammonia, then mix the other part of the acid solution and evaporate. If a solution of bichromate of potash in sulphuric acid is used, the only way to separate the sulphate of potash is by successive crystallisations.

Books Received.—"Chemical Handicraft," by J. J. Griffin, F.C.S.; "On Inhalation," by H. Biegel, M.D., &c.; "The Alkaline Permanganates and their Medicinal Uses," by John Muter; "An Introduction to Practical Chemistry," by John E. Bowman, F.C.S., edited by Charles L. Bloxam, F.C.S.

Errata.—Page 119, lines 8 and 18, for "power" read "powder."

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Separation of Cobalt from Nickel, and of Manganese from Nickel and Cobalt, by M. A. TERREIL.[*]

I HAVE the honour of submitting to the Society a new method for completely separating cobalt from nickel, and manganese from nickel and cobalt.

The method I propose for effecting these separations is founded—1, on the insolubility of roseocobaltic hydrochlorate in acid liquids and ammoniacal salts, discovered by M. Fremy; 2, on the rapid transformation of ordinary salts of cobalt into roseocobaltic salts, under the double influence of ammonia and oxidising bodies—such as permanganate of potash and alkaline hypochlorites; 3, on the complete precipitation of manganese in ammoniacal liquids by alkaline hypochlorites, and permanganate of potash.

To separate cobalt from nickel, operate in the following manner:—To the solution of the two metals add an excess of ammonia, which re-dissolves the two oxides; add to the hot ammoniacal liquid a solution of permanganate of potash, sufficient to cause the liquid to remain coloured violet for a few instants by the excess of permanganate. Boil the liquid for a few minutes, then add a slight excess of hydrochloric acid, to re-dissolve the oxide of manganese which will have formed. Heat the liquid gently for twenty or twenty-five minutes, then let it stand for about twenty-four hours. All the cobalt will then be deposited in the form of a beautiful red-violet crystalline powder; the precipitate is roseocobaltic hydrochlorate, collect which on a weighed filter, wash it on the filter with cold water, then with diluted hydrochloric acid, or with a solution of ammoniacal salt, and then with ordinary alcohol, which frees it from ammoniacal salt. Dry it at 110°, and weigh. 100 parts of roseocobaltic hydrochlorate correspond to 22·761 of metallic cobalt, or to 28·959 of protoxide of cobalt.

It is, however, better to take a given quantity of the roseocobaltic salt, and reduce it by dry hydrogen; this leaves perfectly pure cobalt to be weighed.

Next boil the solution containing nickel to expel the alcohol which has been introduced in washing the cobaltic salt; saturate it with ammonia, add another small excess of permanganate of potash, and boil. All the manganese will be precipitated; filter the liquid, and all the nickel will be found in the filtrate, from which it may easily be separated in the state of sulphide, and then transformed into oxide.

By this process the presence of a ten-thousandth part of cobalt in a salt of nickel may be ascertained.

In this operation an alkaline hypochlorite may take the place of the permanganate of potash, but then the deposit of roseocobaltic salt takes place with extreme slowness, and several days are required to complete it. This reagent is preferable to permanganate when manganese is to be separated from nickel and cobalt.

Should the substance to be analysed contain at the same time cobalt, nickel, and manganese, the latter may be estimated by operating as above, but using given quantities of permanganate and potash estimated beforehand. Lastly, the precipitate of oxide of manganese should be collected, washed, dried, and calcined; from the weight of red oxide obtained, subtract the amount of manganese added in the state of permanganate.

The separation of manganese from cobalt or nickel is extremely easy; it may be effected equally well by means of alkaline hypochlorites or permanganate of potash, which completely precipitate manganese from ammoniacal solutions, and which, under the same conditions, precipitate neither cobalt nor nickel, which remain in the filtered liquids. The method of operating is exactly the same as that above described.

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[*] *Bulletin de la Société Chimique*, February, p. 88

On Amorphous Phosphorus, and a New Variety of Phosphorus, by M. HITTORF.[†]

ACCORDING to M. Hittorf, it is not, as M. Schroetter says, at 260° C. that red phosphorus returns to the state of ordinary phosphorus, but about 447° C. At a lower temperature red phosphorus may volatilise, and its vapour acquire a high tension without ceasing to belong to the red modification.

The author found that the transformation of ordinary into red phosphorus may easily be effected by heating in a closed vessel[‡] at a temperature above 300° C. Iron vessels may be used in this operation, as this metal unites with phosphorus only at red heat.

The researches of M. Favre and others (*Journal de Pharmacie et de Chimie*, xxiv., 320) having determined that this transformation is accompanied by disengagement of heat, M. Hittorf has attentively studied this phenomenon, operating at a temperature above 260° C., maintained constant by vapours of

Benzoic acid,	of which the	boiling point is	255	degs.
HgCl	”	”	307	”
HgBr	”	”	324	”
HgI	”	”	358	”
S	”	”	447	”
PS_5	”	”	530	”

We give the most striking results. The author has found that 447° is not the highest temperature which red phosphorus is capable of bearing; at 300° C. he has also observed in white phosphorus a great tendency to pass into the red modification.

In vaporising amorphous phosphorus it does not melt, in this resembling its congener arsenic, which resemblance induced M. Hittorf to endeavour to crystallise this variety of phosphorus,[§] which he believed would take rhomboidal forms like arsenic, and his experiments proved him to be right.

Of the numerous attempts made by M. Hittorf, we will cite only that which was successful; it consists in heating red phosphorus and lead in a closed vessel; the lead dissolved the phosphorus, and then deposited it in a crystallised state. The operation was performed in a fusible green glass tube, a quarter filled with ordinary phosphorus, and the rest with lead; the tube was first cleared of air by means of a current of carbonic gas, then exhausted and afterwards sealed. It was now introduced into an iron muff and the spaces filled with calcined magnesia pressed round the whole of the glass tube.

After ten hours' heating, the lead was covered with brilliant flakes of metallic looking phosphorus, the finest appearing red when held to the light.

No polyhedric form could be recognised in these crystals, but the lead retained some, which were isolated

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[†] *Ann. der Physik und Chem.*, cxxvi., 195. *Journ. de Pharm. et de Chim.*, Jan., 1866.

[‡] Heating in a closed vessel is necessary on account of the volatility of ordinary phosphorus; the boiling point of this simple body is, in fact, 290° C.

[§] It is an established fact that iodine facilitates the transformation of ordinary into red phosphorus (Brodie). M. Hittorf finds that selenium has the same effect.

by treating by nitric acid of 1·1, which has no action on phosphorus, while it readily forms nitrate of lead.

The crystalline powder accumulated at the bottom of the vessel was metallic phosphorus, which was then in the form of a mass of microscopic rhombohedra resembling crystals of arsenic.

In this state phosphorus is a conductor of electricity; at 15·5° C. its density is 2·34.

The following are the maxima of vapour tensions of the three varieties of phosphorus:—

	230° C. mm.	358° C. mm.	447° C. mm.	530° C. mm.
P. ordinary (white) .	514	1696	2504	8044
Amorphous (red) .	000	31·5	1636	6139
Metallic . . .	000	undeter'd.	928	4130

M. Hittorf classes the new modification of phosphorus in the same category with red phosphorus, and gives to the two the generic name of metallic phosphorus, which he subdivides into metallic crystallised and metallic amorphous phosphorus. We will only add that commercial amorphous phosphorus is often in the crystalline state.

On the Properties of Acetylene, by M.* Berthelot.

Considerable differences have been observed between the properties of acetylene prepared by various reactions. Thus, according to M. Reboul, acetylene prepared by means of bromide of ethylene furnishes tetrabromide $C_4H_2Br_4$; while that which I obtained by the decomposition of ether vapour formed a bibromide $C_4H_2Br_2$.

According to one observer, whose name has escaped me, the acetylene contained in coal gas is not absorbed by bromine.

Hence the opinion that there existed various isomeric carbides of the formula C_4H_2, capable of precipitating ammoniacal cuprous chloride red.

The facts above cited are correct; but they do not show the isomerism of the carbides experimented upon. In fact, the same acetylene, prepared by means of ether vapour, will furnish, with bromine, these three reactions, as shown by my observations:—

1. Sent in a rapid current, and without being perfectly purified, through liquid bromine, acetylene causes the formation of tetrabromide, provided the action takes place at a high temperature. Light perhaps plays some part in this reaction.

2. A few litres only of carefully purified acetylene, sent slowly, and at a low temperature, through bromine placed under a layer of water, produce a bibromide $C_4H_2Br_2$.

3. Pure acetylene, decanted on water into a small flask, then shaken in the flask with liquid bromine, often remains mingled with the bromine vapour for several minutes without reacting. Then the reaction takes place suddenly, and the acetylene is absorbed.

Under other circumstances the absorption is not delayed.

Thus, acetylene behaves in this respect quite differently to ethylene and especially to propylene, which are always attacked immediately by bromine.

Hence it will be seen that acetylene mixed with a considerable volume of a foreign gas, and directed in a rapid current through bromine, may traverse the reagent without being absorbed. But this is not an instance of isomerism.

The action of chlorine, moreover, reproduces the same anomalies. Generally, gaseous chlorine, mixed on water, with acetylene, detonates almost immediately, producing hydrochloric acid and carbon.

But it sometimes happens that the reaction is delayed for several minutes, when the explosion takes place, apparently without the intervention of any fresh circumstances. This explosion occurs quite as well with acetylene diluted with several times its volume of hydrogen or carbonic acid, as with pure acetylene, and quite as well with an excess of chlorine or an excess of acetylene. The presence of diffused light is requisite, for I have kept the mixture for several days in the dark, but it detonated the instant the lid of the box in which it was kept was removed.

Nor is this all; the mixture of acetylene and chlorine instead of reacting suddenly and with a deposit of carbon may be made to react gradually, with formation of a chloride $C_4H_2Cl_2$.

I have also, in certain instances, observed the commencement of the absorption and formation of liquid chloride, when the experiment has ended with an explosion and deposit of carbon.

Finally, the explosive combination being produced after some delay, sometimes the carbide is entirely separated into carbon and hydrochloric acid, sometimes a portion of the carbide causes the formation of a vapour spontaneously inflammable on contact with the air, and which seems to be chlorinated acetylene C_4HCl.

All these observations have been made with acetylene prepared by means of ether.

In spite of numerous attempts, I have not succeeded in determining with sufficient certainty the conditions which determine the differences I have described in the reactions of chlorine on acetylene. But I believe these differences to be caused by a kind of molecular inertia on the part of the acetylene, preventing the reactions being determined at the very moment the mixture is made. Thus, all depends on the condition which is to overcome this inertia—that is to say, on the presence of a trace of foreign vapour, or on the variable intensity of the temperature produced at the point where the attack commences.

According to my researches the true formula of well-washed cuprous acetylide is—

$$C_4Cu_2H,Cu_2O,$$

with traces of foreign matters; that of argentic acetylide

$$C_4AgH.AgO,$$

agreeing with M. Max Berend's recently published analyses.

TECHNICAL CHEMISTRY.

Memoir on the Utilisation of Chlorine Residues and Soda Waste, by M. E. Kopp.†

(Continued from page 111.)

The next point treated by M. Kopp is the utilisation of the liquor left in the apparatus after the disengagement of H_2S from soda waste, by the action of the acid chlorine residue. This liquor is a nearly neutral solution of ferrous, manganous, and calcic chlorides. The author proposes to run this solution into cisterns and treat it with the coarse lime which was rejected for the manufacture of chloride of lime. The lime precipitates some manganous and ferrous oxides, with a small quantity of ferrous and manganous sulphides. The liquor from which these will be deposited is now quite neutral, and cannot be harmful to vegetation. Furthermore, the ferrous chloride still in solution by contact with air

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* *Bulletin de la Société Chimique*, February, 1866, p. 97.

† Abridged translation from the *Bulletin de la Société Chimique*, p. 335, 1865.

deposits an insoluble ferric salt, and after this only chlorides of manganese and calcium remain in solution.

But if it be impossible to run even this liquid into a stream, the author proposes to effect a complete decomposition by one of two processes. In the first the solution is evaporated to dryness and fused in a reverberatory furnace. The product is a mixture of chlorides of manganese and calcium, which M. Kopp proposes to use as a purifying flux in puddling iron or steel, or in improving bad cast iron. This application, however, being limited, and not receiving the attention it merits, the author proposes in the second place to take the liquid back to the sulphuretted hydrogen apparatus previously described, and then boil it with soda waste. By this all the iron and manganese will be precipitated as sulphides, and only chloride of calcium will remain in solution, with, perhaps, a little bisulphide of calcium, if too much soda waste has been employed. The last, however, will quickly oxidise to hyposulphite in the air and become quite inoffensive.

The deposit of sulphides of iron and manganese mixed with some carbonate of lime, and a small excess of soda waste is removed from the apparatus and exposed to the air, where the sulphides quickly oxidise, sulphur being set at liberty, and the mass becoming reddish. There will now be a mixture of oxides of iron and manganese, with nearly insoluble basic salts of these metals, some sulphur and carbonate of lime. This mass will be equally inoffensive.

M. Kopp next comes to "*Methods of Utilising Soda Waste without the Use of Chlorine Residues.*" The author shows that the methods of utilisation already described are, in fact, only able to use up a very small portion of the immense amount of waste which accumulates in large alkali works. The mountain which remains, he states, in dry weather, is quite inoffensive, and only in foggy and moist weather gives off a slight smell of sulphuretted hydrogen. The liquor which continually drains from the heap is, however, a real nuisance. It is a yellow, strongly alkaline liquid, rich in sulphur (polysulphides of calcium and sodium), which, in contact with air, gives off a strong odour of sulphuretted hydrogen, and which, when run into a river, destroys fish.

When a heap which receives no addition is left to itself for some years, it undergoes a gradual and complete transformation. The liquor which drains from it ceases to be yellow, sulphuretted, and alkaline, and becomes clear, colourless, and neutral, containing now only sulphate of lime. The heap itself from blackish grey changes to a yellowish white colour, and is found to consist mainly of sulphate and carbonate of lime, with traces of sodic sulphate, chloride, and hyposulphite, oxide of iron, alumina, silica, &c., and a very small amount of free sulphur. In this state M. Kopp says it is an excellent ameliorator for siliceous or clay soils in which lime is deficient. The author gives here a long account of the series of chemical changes that soda waste undergoes in contact with air, which result finally in the production of the mixture just mentioned. We pass over these to come to the practical conclusions.

The oxidised waste being, as we have said, an excellent improver of some soils, the only part remaining for chemical treatment is the liquor draining from the heap. In warm and dry seasons the author proposes to run this liquor into large and shallow pits. In these oxidation goes on very rapidly. The polysulphides of calcium and sodium are changed into hyposulphites, with the precipitation of some sulphur and carbonate and sulphate of lime. When the sulphides have quite disappeared, the clear solution is removed, and the hyposulphite of calcium is decomposed with sulphate of soda to form hyposulphite of soda, the solution of which is crystallised and purified in the usual way.

The liquor of drainage may also be treated directly with sulphurous acid as before mentioned, to furnish free sulphur and hyposulphites. The current of sulphurous acid is stopped while the liquor has still a slightly alkaline reaction. The sulphur and sulphate of lime is separated by filtration from the solution of hyposulphites.

We conclude with the results of some experiments made by M. Kopp last year at Dieuze. A cubic metre of drainage liquor of 14° B. required for complete neutralisation 380 litres of original chlorine liquor. The washed and dried precipitate weighed 108 kilos., and contained 37 kilos. of free sulphur.

Another cubic metre of the same liquor neutralised by chlorine residue, previously dechlorated, but still acid, required 460 litres, and gave a dried precipitate weighing 104 kilos., and containing 38 kilos. of free sulphur.

Lastly, a third cubic metre, treated with dechlorated and nearly neutral chlorine liquor, required 450 litres, and gave a precipitate weighing 120 kilos., which contained 39·8 kilos. of free sulphur.

In this short abstract of M. Kopp's valuable memoir we have necessarily confined ourselves to the practical results of the various operations he has proposed. Chemists engaged in large practical operations can, for the most part, imagine for themselves the arrangements by which these operations can be carried on; but we may add in conclusion that in the *Annales de Chimie et de Physique* for January of this year any reader about to start alkali works will find a plan for the disposition of such works, and all the arrangements necessary for carrying on the operations we have mentioned. M. Kopp deserves the thanks of all manufacturers for his endeavours to solve the difficult problem of the utilisation of soda waste; and if the end can hardly be said yet to be satisfactorily achieved, it must be confessed that the author has made a great advance.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 15.

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

The minutes of the previous meeting were read and confirmed. Mr. Charles N. Ellis was formally admitted a Fellow of the Society, and Mr. Samuel Crawley, St. Peter's College, York, and Mr. C. Patmore Phillips, Fenchurch-street, London, were balloted and duly elected. The names of candidates read for the second time were:—Mr. Robert McCalmont, Belfast; Mr. William Carr Stevens, 34, Mark-lane; and Mr. Thomas Vosper, Nightingale-street, Manchester. The following candidates were also proposed for election into the Society, viz.:—Mr. J. T. Brown, Oxford Villa, Sudbury; Mr. James Gale, Belsize Park, Hampstead; Mr. William Huggon, Park Row, Leeds; Mr. Joseph Richardson, Dawson Street, Manchester; and Mr. Wm. Marshall Watts, B.Sc., Glasgow University.

Dr. Hugo Muller read a paper "*On Hydrocyan-Rosaniline,*" a new colourless base, which the author has succeeded in forming by the action of cyanide of potassium upon the salts of rosaniline. For its preparation the aqueous solutions of magenta (acetate of rosaniline) and cyanide of potassium are mixed, when, after standing some time, the red colour gradually disappears, and a white crystalline precipitate—the base in question—is formed. Dr. Müller described also another mode of preparation in which the same substances are brought into contact through the medium of alcohol, and the crude product first obtained is purified by dissolving in hydrochloric acid and reprecipitating the warm solution by dilute ammonia, with which a small proportion of cyanide of potassium is mixed. The pure substance is but sparingly soluble in boiling alcohol, and almost insoluble in water, being precipitated from its salts, such as the hydrochlorate, in the form of a white curd or milky turbidity, like chloride of silver, and which assumes a rosy tint on exposure to sunshine. The ordinary reactions of cyanogen are entirely masked. Several salts have been prepared, but the base does not appear to enter into combination with acetic acid. Analysis gave numbers leading to the formula, $C_{21}H_{20}N_4$, and the author pointed out the relation between the new base and a very similar substance—the leucaniline of Dr. A. W. Hofmann—which latter differs only by containing one atom of hydrogen in the place of cyanogen. Dr. Müller concluded his paper by referring to some interesting theoretical considerations, which give promise of the discovery of additional members of this class of compounds; and, finally, stated that cyanide of potassium was without action upon Perkin's aniline-purple.

In reply to Dr. Odling and to a remark of the President's,

Dr. **Muller** further stated that by the action of heat and of strong alkalies upon the colourless base aniline could be regenerated, but only with difficulty; and with respect to the mode of production of the new compound, he believed that a quantitative method of determining the commercial value of samples of rosaniline might be founded upon the treatment with cyanide of potassium, etc., as described. Already he was persuaded that the crystalline character of the rosaniline salts was no test of purity.

Dr. **Frankland** was then invited to favour the Society with some "*Observations on the London Waters.*" That gentleman responded by pleading short notice as an apology for the somewhat incomplete sketch which he was about to offer. In the three diagrams exhibited were shown, by series of curves, the alternations of quality observed during the period of twelve months in waters constituting the metropolitan supply. The earlier results were obtained by Dr. A. W. Hofmann, and the investigation had been continued for the remainder of the year under the direction of the speaker; they commenced with the examination of samples collected in February, 1865, and terminated with those obtained in January of the present year. The sources of the water were Grays (South Essex), Kent, River Lea (East London), Thames, and New River, and the respective headings of the tables were "Solid Matter in 100,000 parts of the Water," "Organic and other Volatile Matters," and lastly the "Amount of Oxygen required to Oxidise Organic Matter in 100,000 parts of the Waters supplied to London." The conclusions established by the analytical results were thus stated:—1stly. That the supplies drawn from the artesian walls of Kent and South Essex varied but little throughout the year, whilst all the rivers showed a marked increase in the amounts of solid matter and organic impurities during the winter months, and a rapid decrease to the minimum in April or May. At this latter season, and during the summer all waters continued in the state of great purity until October, or, in the case of the Thames, November, when the organic matters and total impurities rose to a maximum. There was, however, an exception in the river waters, which during the wet season immediately preceding the fine summer of last year showed a notable increase in the amount of organic impurity, and the rain, instead of diluting the streams with pure water, had the contrary effect, introducing matters both in solution and suspension. Dr. Frankland concluded by referring to the fact that the amount of oxygen (or permanganate of potassium) required for the destruction of the organic impurities furnished no indication of the amount of organic matter actually present in the water, but merely proved the existence of several kinds of organic matter, and he believed the most pernicious were those which were most easily oxidised. He was somewhat surprised to find that the soft water supply from Loch Katrine required more of the permanganate than any of the waters of the metropolitan district.

The **President** considered that the increase in the amount of organic matter in river waters corresponded with the fall of the leaf in autumn.

Professor **Way** rather attributed the sudden influx of organic matter into the river in October or November to the circumstance of this being exactly the season for manuring the land in its vicinity. He had come to the conclusion that sewage from the drainage of towns was by no means the only source of organic and other impurities in the river, but that much solid matter was derived from the drainage off meadows on its banks. With regard to the influence of rainfall upon the purity of river waters, the speaker did not believe they were so intimately or immediately connected as had been represented; thus, six inches of rain gave nothing to the river last summer, the land being so dry, but the real influence came later, and often three or four months would elapse after a rainy season, when, by the reappearance of the water in the shape of springs, a dilution of the river would occur, and consequently the autumn and winter rains would have their effect in the following spring. Professor Way gave some details respecting the flow of the Thames through Teddington Lock, and the proportion taken by the water companies, and stated his belief that the Thames embankment would prove a great benefit in preventing the stagnation of the water between the bridges.

Dr. **Attfield** made an interesting announcement relative to the river Bourne, an intermittent stream which may now be seen flowing through Croydon with considerable force.*

Mr. **Robert Porrett** said that about eleven years ago he had occasion to examine a leaden pipe taken from a house near the London Docks, the interior of which at first sight appeared to be very much corroded. The roughened surface was, however, due to its having become lined with a calcareous incrustation, about one-tenth of an inch in thickness, which contained, besides carbonate of lime, a very appreciable quantity of oxide of manganese, derived no doubt from the Thames water—a fact which suggested the propriety of searching for this metal in all critical analyses of the water in question.

Dr. **Frankland** considered that he was justified in stating that the immediate effect of rain was to augment the proportion both of soluble and suspended impurities, and there could be no doubt that the after effect of the land springs proved beneficial as means of dilution. The weather of last year was altogether exceptional, and the speaker hesitated in basing his conclusions on that year only. With regard to the increased amount of oxygen required, in November, for the destruction of the organic impurities, Dr. Frankland remarked that the comparative absence of oxidating sources and influences (vegetation, sunlight, &c.) at that season would account for the observed augmentation.

The **President** offered some further remarks upon the state of the Thames in 1859; and said that a long period of drought seemed to have the effect of bringing the salts to the surface of the land, from whence they were again dissolved off by the first succeeding rains. After proposing a vote of thanks to Drs. Frankland and Müller, the meeting was adjourned until the 29th inst. (the anniversary), and the next ordinary meeting would be on April 5.

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* Some further particulars may be gathered from Dr. Attfield's communication to our pages last week.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

Course of Twelve Lectures, by Dr. Percy, F.R.S.

Lecture No. I.

Geology has for its object the study of the nature and mode of formation of the exterior of the earth. That exterior is usually spoken of as the crust of the earth. I adopt that designation because it is well understood, and not as indicating my views of the hypothesis on which the term is founded. That hypothesis is that the earth was once molten, but has gradually cooled and become solid on the surface. The expression "crust" would imply that the interior of the globe is in a state of greater or less liquidity. It is not my intention to examine the ground of this theory.

As far as the investigations of chemists have at present extended, all matter with which we are acquainted, in whatever form it may present itself, or under whatever conditions it may occur, may be resolved into about sixty elementary or simple substances. These bodies are regarded as the ultimate forms of matter, as they are believed to be incapable of being divided or split up into any substances more simple than themselves, no matter what agency may be employed with that object. They therefore constitute the components of all natural objects, whether solid, or liquid, or gaseous. But notwithstanding the large number of these elements, it is wonderful how few of them are concerned in the composition of the great bulk of the solid crust of the earth. These are but five in number, namely—silicon, aluminium, calcium, oxygen, and carbon. The silicon, aluminium, and calcium occur in combination with oxygen in the forms of silica, alumina, and lime. Magnesium must probably be ranked as the next element in abundance in the earth's crust, but there is no certain knowledge on this point. After this we must, perhaps, regard the order of the other chief constituents as hydrogen, iron, sodium, potassium, manganese, chlorine, sulphur, and phosphorus. The hydrogen of which I am speaking as forming part of the earth's crust is in combination with oxygen in the form of water, and in that state it occurs in all clay. Water is one of the essential constituents of clay, and is present in it, not as mere moisture, or, as it is termed, hygroscopic water, which may be driven off from the clay at a low temperature; but it enters into actual chemical combination with the other constituents of the clay, and may therefore be fairly classed among the substances forming the solid crust of the earth.

The science of geology is a most comprehensive one, and, to be studied in its integrity, demands knowledge so varied and so extensive that perhaps no living geologist has mastered the subject in all its details. There are geological problems of the highest interest which can be solved only by chemistry. The conquests which remain to be achieved in geology will unquestionably be best attained by the application of the various sciences asso[illegible] geology, but certainly there is no branch [illegible] will better repay investigation than [illegible]

[illegible] to which I shall direct your atten[illegible] the various bodies which concern the [illegible] geology is silicon. This substance is [illegible] elements, if not the most abun[illegible] crust. It is very widely dif[illegible] in sand, in all clay, and [illegible] rocks. In combination with [illegible] body known as silica, [illegible] quartz. An extraordinary [illegible] to separate silicon from its [illegible] of silica, and it is not long [illegible] with anything like satis[illegible] found to exist in three dis[illegible] or formless state, in the graphitoidal state, so called from its resemblance to graphite, a variety of carbon, and in the state of octahedral crystals. The appearance of silicon in these three states greatly differs. It occurs as a chocolate-brown powder when in the amorphous state. In the graphitoidal state, as I have said, it closely resembles graphite, and is frequently found in small hexagonal plates, such as are produced in the process for preparing aluminium. In this state it is more blue than graphite, and more metallic in lustre. In the crystalline state it is octahedral, having the same form and belonging to the same crystalline system as the ordinary diamond. On the lecture-table there are specimens of silicon in its various forms.

In combination with oxygen, silicon forms the compound silica, which consists of about forty-eight parts of silicon and fifty-two of oxygen. The formula SiO_3 is that used to represent the compound, and signifies that there are three atoms or equivalents of oxygen to one of silicon. This formula was suggested by Berzelius, but there is reason to believe that silica would be more precisely represented by the symbol SiO_2—that being one atom of oxygen less than supposed by Berzelius.

Silica occurs in two very different states, in one of which it is crystalline, and in the other of which it is apparently non-crystalline, or amorphous. This is a fact which was long ago determined by Schafgotsch. The crystalline variety has the specific gravity of 2·6, and is met with as quartz, which is distinctly crystallised, and also as chalcedony, hornstone, and flint, in which the crystalline structure, as regards their outward appearance, is not recognised. Gustave Rose, however, contends that these apparently non-crystalline substances, chalcedony, hornstone, and flint, are made up of an aggregation of excessively minute crystals, which cannot be detected. There seems to be some ground for this view. These forms of silica he calls crystalline, in distinction from the ordinary quartz or rock-crystal, in which the crystals are clear and unmistakable. Silica in the crystalline or crystallised state always has a specific gravity of 2·6. In the amorphous form of silica the specific gravity varies from 2·2 to 2·3, and never rises above the latter number.

There are other differences between the two varieties of silica besides the differences in their forms and their specific gravities. The crystallised silica polarises light, while the amorphous variety will not produce that effect. The crystallised or heavy silica always has the same chemical properties, whether occurring as quartz, chalcedony, or flint; and the powder of these bodies will resist the action of boiling alkaline solutions. The amorphous silica, on the contrary, is dissolved with great readiness in such solutions.

As far as has been ascertained, crystallised silica can be produced only in the wet way, that is, through the agency of solutions containing silica. It cannot be obtained crystallised by fusion. Extensive series of experiments on the artificial production of minerals were made by the late M. Senarmont, and he was successful in forming microscopic crystals of quartz by dissolving silica in very dilute hydrochloric acid, and submitting the solution to a temperature of between 200° and 300° centigrade, in closed tubes. The silica, when submitted to the acid, was in the nascent state; that is, the state in which it exists at the moment of its being detached from a state of combination. The crystals thus obtained were found to be identical in all essential respects with those occurring in nature. They were six-sided prisms, terminated by the usual pyramid, and having hexagonal faces, which presented the transverse striæ so constantly observed on the natural crystal. The artificial crystals were exceedingly minute, but the experiment of M. Senarmont was a positive demonstration of the crystallisation of silica in the wet way. The smallness of the crystals he obtained does not in any way affect the conclusion that natural crystals of quartz have been formed by the agency of liquids, and not by means of fusion at high temperatures. Silica, not definitely crystallised, but still crystalline in structure, was obtained by Sorby. By the aid of a microscope he was able to clearly distinguish the forms. He produced this crystalline silica by passing chloride of silicon into a tube, together with the vapour of water. More distinct crystals were afterwards procured by him by decomposing glass, which is an alkaline silicate, by the agency of water at a high temperature, and, therefore, under great pressure. Glass may be boiled in water at the ordinary atmospheric pressure for any length of time without any sensible decomposition or solution taking place; but if submitted to the action of water at a much higher temperature than the ordinary boiling point, rapid corrosion takes place. Sorby exposed glass consisting of silica, lime, and potash to the influence of water at a high temperature in a close vessel, and in that way obtained the well-known silicate of lime called wollastonite, and also perfectly transparent quartz-crystals two millimetres long. This is a confirmation of the result arrived at by M. Senarmont, and affords further experimental evidence of the production, by the agency of water, of crystals of quartz similar to those formed in nature. It may be inferred that the less distinctly crystallised form and heavy silica has been produced in nature under the same conditions as quartz, from the fact that the two varieties are often met with in association with each other.

Silica has been distinctly fused into small globules. That may be done without much difficulty, but, as I have before remarked, all attempts to crystallise it by that means have failed up to the present time. Several experiments were made on this subject some years ago, the oxy-hydrogen blow-pipe being employed to effect the fusion. More recently Deville, who has paid special attention to the application of high temperatures to metallurgical operations, has fused silica in large masses, and subjected it to slow cooling. There has not been, however, in a single instance, the slightest appearance of crystallisation, in addition to which the fused silica, when cold, has always been of the low specific gravity of 2·3. Quartz of the high specific gravity is converted by fusion into a substance resembling the amorphous silica, and has the same low specific gravity of 2·3. That fact, though apparently a trifling one, is one of great interest in a geological point of view, and has an important bearing on the question of the natural formation of granite and other so-called igneous rocks. The specific gravity of silica, as determined by temperature, was made the subject of some important experiments by Gustave Rose. He ascertained the curious fact that, when perfectly transparent, entire rock crystal underwent exposure in a porcelain furnace to a temperature of about 2000° centigrade, for about eighteen hours, the specific gravity was unaltered; but when the same substance had been previously reduced to powder, and was exposed to the same conditions, its specific gravity was lowered from 2·6 to 2·3. Common flint, which, owing to the intermixture of impurities, had a specific gravity of only 2·591, had its specific gravity reduced to 2·237 by long exposure to this high temperature. These are additional examples of the effect of high temperature in the reduction of the specific gravity of silica.

I will next direct your attention to amorphous silica. This is the form to which the term "colloidal," or jelly-like, silica has been applied by Professor Graham, the Master of the Mint. It may be obtained by the decomposition of silicates, or by means of acids. If we take a properly diluted solution of silicate of soda or silicate of potash, and add a certain quantity of acid to it, we immediately obtain the silica separated in the form of a jelly. This jelly might be mistaken for ordinary jelly, and the vessel containing it may be inverted without the jelly being dropped. If the solution had been more dilute the silica would have been separated, but it would have been retained in solution instead of appearing as a jelly. On being evaporated to dryness, this silica forms an amorphous white powder.

The solubility of silica is a matter of considerable importance in a geographical point of view. In an aqueous solution of potash one part by weight of the extremely fine amorphous silica obtained from fluoride of silicon is dissolved for every two parts of potash in the solution. When in the state of quartz the quantity of silica dissolved is only ·009 parts by weight for every two parts of potash dissolved. Of silica in the state of fluid there is dissolved ·038. The difference in the solubility is mainly due to the difference in the state of aggregation of the particles. When the rock crystal has been melted, and then pulverised, it is as soluble in the alkaline solution as the fine amorphous powder obtained by the decomposition of the gas fluoride of silicon. The light silica is much more soluble than the heavy variety. Bischoff states that one part of silica dissolves in 769,230 parts of pure water.

The phenomenon of dialysis to which attention has been called by Professor Graham within the last three or four years may possibly hereafter be found to throw light upon many obscure geological phenomena. The operation of dialysis by means of a membranous septum enables us to obtain pure silica in a jelly-like state, which, when dried *in vacuo* at the ordinary temperature, forms a beautiful, transparent, glassy mass of great lustre, insoluble in water, and which reminds one greatly of that beautiful variety of opal termed hyalite. The mass so formed may retain as much as 21 or 22 per cent. of water. It is interesting to inquire whether there is any reason to suppose that a similar process to that by which this has been formed has played any part in the operations of nature. The condition required is that there should be a soluble silicate. There is no difficulty in explaining how this may have been produced in nature. There must be a soluble silicate dissolved in water, and the decomposition of that silicate by some such agent as hydrochloric acid. Now for the apparatus. Does nature present us with any apparatus which can take the place of the dialyser? All that is wanted is the porous bed of a rock like sandstone, in a convenient position, and that sandstone will act exactly as the dialysing apparatus devised by Professor Graham. It remains for practical geologists to look out for these conditions, and to see how far an application can be made of the phenomena discovered by Professor Graham. Very probably in nature we may find conditions exactly suitable for dialysis. If that be the case, we shall be at no loss to understand how, in many instances, silicification has occurred. It has occurred in nature to an enormous extent.

The mineral termed opal, to which I have made a reference, is an amorphous silica containing a little water. The proportion of the water is variable, the extremes being somewhere about 3 per cent. and 13 per cent. Sometimes opal exhibits most beautiful colours, and then it has the name of "precious" opal. These colours are due to a peculiar arrangement of the structure, and may be explained by the laws of optics. The natural opal closely resembles the substance prepared by the evaporation *in vacuo* of the jelly-like mass produced by the process of dialysis. The mineral termed hyalite is a kind of opal met with in basaltic rocks. It is another form of amorphous silica, and contains an amount of water, the extremes of which are 3 per cent. and 6 per cent.

I will now direct your attention to a white, delicate, fibrous substance, to which the name of fibrous silica has been given. It is found in the hearths of our blast furnaces or iron-smelting furnaces. There is reason to believe that the various smelting and other furnace operations which are practised on so large a scale in different parts of this country may furnish indications of great importance to the geologist. This fibrous silica has been carefully examined, especially by Gustave Rose, and he has found that it consists essentially of silica. It is in the amorphous state, and being the result of a high temperature, its specific gravity does not exceed 2·3. We are not clear as to the precise conditions under which it has been formed, but most likely it may have resulted from the oxidation of silicon. Sorby states that he obtained fibrous silica exactly similar to that occurring in the hearths of blast furnaces by passing fluoride of silicon, together with the vapour of water, through a porcelain tube heated to red-whiteness. By introducing the fluoride of silicon at one end of the tube and the aqueous vapour at the other he obtained silica, but it was in small vitreous grains.

The facts which I have brought before you in this lecture have an important bearing on the formation of certain rocks of a supposed igneous origin. For a long time it has been the received notion that all granite which occurs so abundantly in the crust of the earth has been the result of fusion at a very high temperature; but those persons who have been accustomed to make experiments on the fusion of mineral substances at high temperatures have been familiar with certain difficulties which stand in the way of accepting that view of many of the so-called "igneous" rocks. For instance, granite consists of quartz, mica, and felspar. Quartz is crystallised, and always has the specific gravity of 2·6. There is not a single instance known to the contrary. There is, therefore, reason to believe that that quartz never could have been fused, for we have seen that the moment we fuse silica, no matter in what state it was previously, we obtain an amorphous, non-crystalline mass, having a specific gravity never exceeding 2·3. I think that you will admit that in this simple fact we have a foundation for the inference that granite could not have been produced under the condition of a high temperature.

ACADEMY OF SCIENCES.

March 12.

Father Secchi sent an account of the spectra of some stars, as seen by him recently in a new spectrometer by Merz, with a prism by Hofmann, of Paris. A drawing of the spectrum of *a* Orionis accompanied the communication. The spectrum of Sirius is described by the learned author as resembling that of sulphur.

M. De Vergnette-Lamotte sent a long memoir "*On the Preservation of Wines by the Employment of Heat.*" M. Pasteur, reviving an old suggestion of Appert, proposes to heat wine for a few minutes to 75° or 80° C. The author objects to this, and says it is better to submit the wines for some time to a temperature not exceeding 45°. He seems to admit, however, that Appert's or Pasteur's plan answers well with the more saccharine and alcoholic wines, like ports and sherries, &c.

M. Fouqué presented a memoir "*On the Chemical Phenomena of Volcanoes.*" Only the general conclusions of the author are given in the *Comptes Rendus*, and the most interesting of these is the last. The author wished to demonstrate that the contact of sea-water with the molten mass on which the solid crust of the earth rests is sufficient to account for all the eruptive phenomena. With this view he made some synthetical experiments, having for their object the reproduction of some of the substances he had found in the fumaroles of Mount Etna. In the course of his experiments he found that steam alone decomposes chloride of sodium, forming caustic soda and hydrochloric acid; and, further, that sulphate of lime and chloride of sodium react on each other in the presence of the vapour of water, producing sulphate of soda, and many other compounds he has noticed in volcanic emanations. Is it possible that the first of these observations may lead to the simplification of the soda process?

M. Berthelot presented a continuation of his memoir "*On a New Class of Compound Metallic Radicals.*" In this part the author describes a compound of gold, *oxide of aurosacetyle*, which is obtained when a solution of the double hyposulphite of soda and gold, with some ammonia, is treated with acetylene. It is precipitated in the form of yellow flocculi, which, when dry, detonate violently on being touched with a hard body. A chromium compound, *oxide of chromosacetyle*, is obtained when a solution of chromous sulphate in a mixture of sal-ammoniac and ammonia is treated with acetylene. M. Berthelot next shows that allylene forms a series of compounds analogous to those formed by acetylene, and ends his memoir with the mention of some facts concerning the action of the alkali metals on the carbides of hydrogen. Sodium, he states, attacks acetylene when the two are gently heated, forming a monosodic acetylide, and setting free hydrogen.

$$C_4H_2 + Na = C_4HNa + H.$$

The hydrogen is mixed with small quantities of ethylene and hydride of ethylene. At a red heat the decomposition of the carbide is more complete. Potassium gently heated in an atmosphere of acetylene ignites and forms an acetylide. These acetylides are decomposed by water, acetylene being reproduced. Acetylene the author believes to be the first example of a carbide of hydrogen directly and regularly attackable by metals at low temperatures. Formene and ethylene did not furnish the author with similar results. Allylene is attacked by sodium at a gentle heat, undergoing a complete decomposition, being resolved in sodic acetylide, carbon, and hydrogen. In this and the former communication the author draws a parallel between the compounds furnished by acetylene and those of ammonia.

M. Saintpierre presented a note "*On the Formation of Trithionic Acid by the Spontaneous Reduction of Bisulphite of Potash.*" The author shows that when a strong solution of bisulphite of potash is heated for several weeks in a sealed tube, and then left for some years, sulphur separates and trithionic acid is formed, together with sulphuric acid. The following is the probable equation:—

$$5(SO_2)_2KO,HO = 5SO_3,KO + S_3O_5,HO + 2S + 4HO.$$

M. Jungfleisch presented a memoir "*On the Chlorinated Derivatives of Benzine.*" This is a systematic study of these compounds, all prepared by the action of chlorine on benzine holding iodine in solution. The author has compared the densities, boiling points, and melting points of mono-, bi-, tri-, quadri-, and quinti-chlorated benzine.

M. Kolb presented a memoir "*On the Manufacture of Soda by Leblanc's Process.*" It is printed at length in the numbers of the *Annales de Chimie et de Physique* for January and February. The *resumé* printed in the *Comptes Rendus* gives the practical results of the author's researches in a short space, and we shall give it in an early number.

M. Weltzien communicated some "*Researches on Peroxide of Hydrogen,*" detailing the action of various metals and salts on this compound. The paper is not susceptible of condensation, and we shall give it at length.

Chemical Society.—The Anniversary Meeting of this Society will take place on Thursday evening next at 8 o'clock, when the election of officers, &c., will take place.

A Curious Experiment.—Into a bell-glass full of air a central tube is made to carry a slow current of hydrogen. At the end of the tube, which is carried nearly to the dome of the bell-glass, electric sparks are made to pass. The hydrogen is immediately ignited, taking the form of small luminous spheres, which rush about in all directions. After a few seconds there are an infinite number of these little luminous globes, which seem to play at hide-and-seek without ever coming into contact.—*Causeries Scientifiques, H. Parville*, 1866.

NOTICES OF BOOKS.

Report of Experiments Undertaken by Order of the Board of Trade to Determine the Relative Values of Unmalted and Malted Barley as Food for Stock. By JOHN BENNETT LAWES. Presented to both Houses of Parliament by command of her Majesty. 1866.

OUR readers will remember the excitement and discussions which ended in the abandonment of the duty on malt used for feeding stock. Most of them also will be aware that feeders of stock have not largely availed themselves of the privilege of obtaining duty-free malt under the restrictions prescribed. The reason for this will be found in the admirable and exhaustive report we now notice.

This is not the first Government report on the relative advantages of malted and unmalted barley as food for cattle. In 1845 and 1846 Drs. T. and R. D. Thomson made a report which was, however, founded on few experiments continued for a very short time, and was necessarily inconclusive. For many reasons, therefore, to ease the mind of the Chancellor of the Exchequer, as well as to procure sound information for agriculturists, it was advisable to have the subject thoroughly investigated, and the Government did the best that was possible in placing the matter in the hands of Mr. Lawes. No doubts can now remain. The experiments were made on such a scale as to allow of arriving at general conclusions. Instead of the two cows and two oxen experimented upon for a few days by Dr. Thomson, Mr. Lawes took lots of 10, and continued the comparative experiments, some for 10 and some for 20 weeks, and those conducted with sheep and pigs were on a similar scale. As regards the results of the feeding, we need only give the general conclusion arrived at by the author—"that a given weight of barley is more productive, both of the milk of cows and of the increase of live-weight of fattening animals, than the amount of malt and malt dust that would be produced from it." We must add that these results are consistent with those obtained in the limited experiments of Drs. T. and R. D. Thomson, and also agree with those obtained in a previous inquiry by Mr. Lawes himself.

For further information on this part of the subject we must refer the reader to the report, and go back to the account of "the loss and chemical changes which the grain undergoes by malting," which will interest a larger number of our readers.

The preliminary experiments on malting appear to have been executed with the same care, but, unfortunately, the results as stated do not afford us a ready means of comparing them with those obtained by other chemists. On one point, however, they are sufficiently explicit. Dr. Thomson, who has always been considered an authority on this matter, states that the loss of weight which barley undergoes in the process of malting is about 8 per cent. In the experiments of Mr. Lawes, however, the loss was found to be very much greater. He states the loss with barley of fair malting quality to amount to as much as 19 per cent., two-thirds of this loss being moisture, and one-third solid substance. The loss of solid substance consists chiefly of non-nitrogenous matters, but includes also a small amount of nitrogenous and mineral matters. The last consists chiefly of soluble salts removed in the steeping, and it must be added that Mr. Lawes found that some sugar was also removed from the grain by the steeping.

Beyond this the analytical results are hardly so complete as could be desired. Mr. Lawes enumerates as the constituents of barley and malt (exclusive of moisture) sugar, starch (and dextrine), woody fibre, albuminous matters, and ash. The amount of these he estimated in the original barley, and also at various stages of the malting process, in order to trace the progressive changes which take place in the grain. From several tables we take one which shows the results with the barley of fair malting quality, leaving the moisture out of consideration:—

	Barley before steeping.	Growing.					Screened malt.	Malt dust.
		As thrown from the couch.	4½ days on floor.	8 days on floor.	12½ days on floor.	14½ days on floor.		
Sugar	2·56	1·56	8·16	10·19	11·67	12·14	11·01	11·55
Starch (and dextrine)	80·42	81·12	74·72	72·16	70·73	70·09	72·03	[illegible]
Woody fibre	4·69	5·22	4·96	5·18	4·98	5·03	4·84	9·67
Albuminous matters	9·83	9·83	9·89	10·14	10·27	10·39	9·95	26·90
Mineral matter	2·50	2·27	2·27	2·33	2·35	2·35	2·17	3·70
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00

Some of the above results differ a little from those obtained by Thomson and Proust. The former gives the amount of sugar in barley as 4 per cent. and in malt as 16 per cent., and Proust's numbers nearly agree with these. It is, however, impossible to say how far the experiments are comparable. Mr. Lawes' results, we have no doubt, are those usually obtained in large maltings.

With regard to diastase, Mr. Lawes states, on the authority of Mr. Phillips, of the Excise Laboratory, that diastase acts upon starch at ordinary temperatures when ground malt is mixed with water. This fact will be of interest to the brewers of pale ales.

Our readers will see from this short notice that Mr. Lawes' Report contains useful information for the maltster and brewer as well as the stock feeder.

In conclusion, we must notice the methods adopted by Mr. Lawes for the determination of the sugar in the barley and malted products. In these experiments the author was assisted by a chemist from the Excise Laboratory. As it is possible that some of our readers may at some time or other be engaged on similar investigations, we shall quote at length (although there is nothing novel in them) the methods which have thus received a sort of official sanction, and content ourselves now with recommending this report to the perusal of all interested in the subjects of which it treats.

Annales de Chimie et de Physique. February, 1866.

IN this number we find the conclusion of M. Kolb's *Theoretical Study of the Manufacture of Soda by Leblanc's Process.* The results of the author's researches are as follows:—When one equivalent of sulphate of soda, one equivalent of chalk, and three equivalents of carbon are submitted to a high temperature in an atmosphere of carbonic acid, the following reactions take place:—

$$\text{I.—}NaOSO_3 + 2\,C = CO_2 + NaS.$$

$$\text{II.—}CaOCO_2 + C = 2\,CO(^*) + CaO.$$

$$\text{III.—}NaS + CaO + (CO_2 \text{ in excess}) = NaOCO_2 + CaS.$$

These three reactions take place, so to speak, simultaneously. The above theoretical proportions, equal to 100 parts of sulphate of soda, 70·4 of chalk, and 25·5 of carbon, ought to give 74·6 $NaOCO_2$. In reality, however, they only yield 62 $NaOCO_2$, in the form of carbonated or caustic soda, because some of the carbon is burnt and lost, or because the mixture has been imperfectly made, or because the temperature is not always what it should be. The author goes on to show the effects of increasing the doses of chalk and coal, and gives the following mixture as producing practically the best yield of soda:—

$$\left.\begin{array}{rl} & 100\ NaOSO_3 \\ \text{Excess of chalk} & 94\ CaOCO_2 \\ \text{,, carbon} & 44\ C \end{array}\right\} = \left\{\begin{array}{l} 64{\cdot}20\ NaOCO_2 \\ 4{\cdot}72\ NaO \end{array}\right\} = 72{\cdot}2\ NaOCO_2$$

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[*] This carbonic oxide is burnt in the furnace, and contributes to raise the temperature.

M. Kolb states, however, that the excess of chalk and carbon is a delicate matter to treat generally. It must be left entirely to the discretion of the manufacturer, and will depend in a measure on the form of his furnace, on his method of stirring, and a number of other things.

The author's views, we may say, appear to agree with those of Mr. Gossage.

M. Kolb refers to the processes which have been suggested for superseding this second step in Leblanc's method, and states that the only one of these which deserves any attention is that of M. Kopp, who fuses the sulphate of soda with oxide of iron and charcoal, and exposes the mass to the action of air and moisture, when it crumbles to powder, and yields on lixiviation a very pure carbonate of soda, leaving a residuum of sulphide of iron. This process, the author says, is really practicable.

The other chemical papers in this number are, a memoir "*On the Sulphides*" by M. Pelouze, noticed in our report of the Academy of Sciences; M. Roux's "*Observations on the Preservation of Water on Board Ship*," in which our readers will remember the author recommends that ships' tanks should be tinned on the inside and galvanised with zinc on the outside; and a paper by M. Gal, entitled "*Researches on the Chlorinated and Brominated Derivations of the Chloride and Bromide of Acetyl.*" In this paper the author gives a new process for the preparation of bromide of acetyl, which will be found in another place. He then describes the compounds produced by successive additions of bromine, the bromides of mono-, bi-, and tribromated acetyl, the chlorides of monochlorated and monobromated acetyl, and also the bromide of monochlorated acetyl. The author concludes his paper with the caution that any chemist engaged on those bodies must avoid touching them, or he will get his fingers severely burnt.

A paper "*On Ground Ice*," by M. Engelardt, and some abstruse papers "*On the Mechanical Theory of Heat*," by M. A. Dupré, together with a translation of Professor Thompson's Royal Institution lecture "*On Atmospheric Electricity*," make up the other contents of the number.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

233. E. Turney and J. Turney, Sneinton, Nottinghamshire, "Improvements in preparing and treating hides and skins in the manufacture of leather."—Petition recorded January 24, 1866.

550. C. de Cæsaris, Grange, Bermondsey, "Improvements in preparing hides and skins for tanning."—February 22, 1866.

582. J. L. Pulvermacher, Oxford Street, Middlesex, "Improvements in means and apparatus for producing and applying galvanic currents."—February 24, 1866.

594. W. E. Gedge, Wellington Street, Strand, Middlesex, "An improved process for extracting the juice from sugar-cane, beetroot, and other plants."—A communication from F. J. V. Minchin, Aska, Madras Presidency, India.

606. W. E. Newton, Chancery Lane, "An improved process of, and apparatus for distilling petroleum and other liquid substances."—A communication from J. P. Vincent, J. S. Richards, O. Noble, C. H. Lovein, and H. Rawle, Erie, Penn., and L. S. Fales, New York, U.S.A. —February 27, 1866.

616. W. E. Newton, Chancery Lane, "Improvements in the process of, and apparatus for the distillation of tar and other substances."—A communication from J. P. Vincent, J. S. Richards, O. Noble, C. H. Lovein, and H. Rawle, Erie, Penn., and L. S. Fales, New York, U.S.A. —February 28, 1866.

Notices to Proceed.

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." —Petition recorded October 30, 1865.

2825. L. Schad, Warrington, Lancashire, "Improvements in the manufacture of colouring matter for dyeing and printing."—November 2, 1865.

2838. J. B. Elkington, Newhall Street, Birmingham, "Improvements in the manufacture of copper from copper ores."—November 3, 1865.

2859. A. Paraf, Manchester, "Improvements in printing and dyeing textile fabrics and yarns."—November 6, 1865.

5. T. Prideaux, Sheffield, "Improvements in furnaces." —January 1, 1866.

65. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "A new or improved detergent to be used in the washing or cleansing of wool."—A communication from C. D. Reinfeld, Paris.—January 9, 1866.

191. A. F. Mineur, Treguier, France, "A new or improved description of manure."—January 20, 1866.

386. J. Townsend, Glasgow, N.B., "Improvements in preparing size or stiffening, and in applying the same to textile materials or fabrics."—February 8, 1866.

449. C. Gilpin, M.P., Bedford Square, Middlesex, "Improvements in the production of copper or other metallic plates for the purpose of printing therefrom."—A communication from F. Kossuth and L. T. Kossuth, Turin, Italy.—February 13, 1866.

483. A. H. Hassall, M.D., Wimpole Street, Middlesex, "Improvements in the preparation of meat for food."—February 15, 1866.

525. J. Barry, J.P., Ballyclough, county Cork, "An improved dye."—February 20, 1866.

CORRESPONDENCE.

Continental Science.

Paris, March 18.

Encore le goitre. M. Lager announces to the Academy of Sciences that he has produced a number of thyroid enlargements in rats by injecting metallic sulphates under the skin. He has discovered that the use of sulphates will produce abortion, a fact, I believe, long known in England, where large doses of sulphate of potash have been employed for the purpose.

Rats are as plentiful in Paris as London, and they are often the victims of physiological experiments. M. Bert, for example, gained the prize in experimental physiology for removing their tails from their natural position, and grafting them upon all sorts of odd places—the middle of the back of the animal, for instance, and even in the cavity of the peritoneum. M. Bert made one very curious observation. He succeeded in uniting the small end of the tail to the body, and found out that the large extremity, which was free, recovered its sensibility, thus showing that the nerves will convey sensation in a direction inverse to that in which they act under normal circumstances.

By the use of endoscopes, laryngoscopes, and ophthalmoscopes the medical man is enabled to get a sight of many things shut out from ordinary view. M. Houdin has added another to these ingenious instruments—the *iridoscope*—by the aid of which an individual is able to see all that is going on in his own eye. It is simply an opaque shell to cover the eye, pierced in the centre with a very small hole. On looking through steadfastly at the sky, or at any diffused light, the observer may watch the tears streaming over the globe, and note the dilatation and contraction of the iris, and even see the aqueous humour poured in when the eye is fatigued by a long observation. It is needless to say that with the aid of this instrument a man can easily find out for himself whether he has a cataract or not. If he has, he will only see a sort of veil covering the luminous disc, which is seen by a healthy eye. The instrument is certainly simple and curious, and will no doubt excite attention in those who are anxious to know more of themselves. An "iridoscope" may be readily extemporised by making a hole in the bottom of a pill-box with a fine needle.

An unusual thing happened at the last sitting of the Academy. That learned body received a peremptory note from Mr. Smith, a Belfast solicitor, demanding the immediate delivery of the Bréant Prize to his client, Mr. Wallace, who believed he had a right to it. The Academy considered the note impertinent (*conçue dans des termes peu convenable*), and decided that it should remain unanswered. What will Mr. Smith do next, seeing that it will be of no use to file a bill in Chancery or bring an action for the money?

You published some time ago the statement of Obernetter that actinic rays might be excluded from a room by covering the windows with paper saturated with dextrine and a solution of sulphate of quinine. At the February meeting of our Photographic Society, M. Davanne said he had tried the plan, and had found that it did not succeed—a result that might have been expected. M. Girard, however, suggested a new experiment—namely, making a double pane of glass, and filling the interspace with a solution of quinine. This will probably answer no better than Obernetter's plan, but may be worth a trial.

We have had here two or three cases of poisoning in young men who have been occupied in making up Pharaoh's serpents. No one has died, but one has been seriously ill. [We believe similar cases have been received at St. Bartholomew's Hospital.]

New Electrical Machine.

To the Editor of the Chemical News.

Sir,—Since my last communication to you I have turned my attention from chemical to electrical science, and seem to have discovered an inexhaustible magazine of electricity in wood! Not that I imagine for a moment that I have made any "discovery," but rather the application of one; for who is there that does not know that dry wood insulates? while how few, if any, are aware that sparks may be drawn from its surface equal in quantity and intensity to those from "ebonite"—and even longer! If this be so, it ought to make a revolution in the price of electrical machines, for wood would only cost a twentieth the price of any other electric.

Besides cheapness, wood presents many other advantages — viz., stiffness, lightness, portability, surprising power, and size; for it is evident that if this material can be put together so closely as to form but one piece, and as easily taken asunder, there can be no limit—save the growth of timber—to the construction of the most powerful machines. Enormous electrical "jars" also might readily be constructed of this material if they should ever be required. But the great value of wood consists in its being rendered capable of remaining permanently electrical, and, therefore, permanently dry, without which its great power would count for next to nothing.

Brown paper, which, while hot and dry, exhibits equal powers, is nothing directly it is cold; while wood, which appears equally porous, retains indefinitely its electric properties. How is this? I have by me pieces of different kinds of wood, which, to my certain knowledge (after baking) have not been near any fire for two months, and yet they exhibit all the intensity of recent dessication. This great power seems to reside in the woody fibre; for if while still hot from the oven we coat the wood with copal varnish, on drying it does not show near the same power, and what is rather difficult to understand after the lapse of a few days, seems no more electric than wet wood, while the simple wood remains so. Oil, I believe, is supposed to attract a small quantity of moisture from the atmosphere, but how can it do so when the varnish is dry and the oil solid? Machines formed of wooden discs coated in this manner were described in the time of Ingenhouz, and that was my original intention when, on taking the piece of wood from the fire, I thought I would just see if it were capable of itself (before varnishing) of showing attraction on rubbing, when lo! a strong spark flies off. I recollect some ten or twelve years ago, when at school (reading of the power of brown paper), attempting to form a cheap machine of wood, covered with brown paper, and thought i very hard I couldn't get the slightest spark, heat or rub how I might, little imagining at the time that the wood only wanted drying to form itself the best substance. As a rubber I employ catskin; but either (unvarnished) silk, or still better, "vulcanised indiarubber," answer equally well. I have lately mounted my machine with wooden discs, in the place of ebonite ones, and the effects must be seen to be believed. Now, if this is anything new to you, Sir, perhaps you might wish to see such an instrument, in which case you might call any day between ten and four o'clock, or else it might be sent to your address. Can you suggest any means of rendering wood permanently as well as absolutely dry? I carry on the "baking" or drying till the surface is slightly coloured, but not "carbonised," in which case, at the end of two months, it appears equally electric as the first day, and that in spite of a small quantity of steam when put before the fire.

I am, &c.
F. E. S. Jerningham.

52, Cambridge Terrace, March 19.

The New Test for Potash.

To the Editor of the Chemical News.

Sir,—In the last number of the Chemical News you mention a *new* test for potash suggested by M. Plun Rett. Permit me to inform you that the bitartrate of soda test is recommended in Galloway's Analysis, third edition, published in 1859 (whether contained in an earlier edition I cannot say); and in a note on the test the author informs us that it was suggested by his friend Mr. Plunkett in the *Chemical Gazette*, vol. xvi. p. 217.

I am, &c., A Student.

Royal College of Chemistry, March 17, 1866.

MISCELLANEOUS.

Table of Chemical Elements.—Mr. J. Carter Bell, F.C.S., has just published a table of chemical elements, showing the name of the element, symbol, atomic weight (old and new theory), specific gravity, specific heat, principal oxides, melting points (Fahr. and Cent.), and many other facts concerning the elements. It will be found a very useful table, convenient to refer to.

Pyrophosphate of Iron and Soda.—Mix a solution of six parts of pyrophosphate of soda in 120 parts of water, with a mixture of 13 parts of perchloride of iron solution sp. gr. 1·44, and 78 parts of water. Well wash the precipitate to remove all the chloride of sodium. Dissolve the precipitate in a solution of 4 parts of $2NaO,PO_5$ in 36 parts of hot water; evaporate until a pellicle forms, and scale in the ordinary way, drying the plates at the ordinary temperature. The concentrated solution may also be precipitated with four times its volume of strong alcohol (95 per cent.). In this way a thick, cheesy, transparent precipitate is obtained. Pyrophosphate of iron and soda forms hard, yellowish, transparent scales. Dried in the air the composition answers to the formula—

$$2(2NaOPO_5) + (2Fe_2O_3,3PO_5) + 20HO.$$

—*Pharm. Zeitsch. f. Russland, and Zeitsch. f. Chemie*, 1866. 28.

"Scientific Opinion."—Under this title a new weekly journal is to make its appearance on April 4. It will be conducted upon the plan of *Public Opinion*, and will contain extracts on all branches of science selected from the various English and foreign journals. Notices and lists of all the new English and Continental books, correspondence, reports of the scientific societies, and "notes and queries," form also a part of its scheme. If the terms of the prospectus are fulfilled, *Scientific Opinion* will be a most interesting summary of the progress of general science.

Tests for Carbolic Acid.—The Editor has made the following communication to the *Times* :—"The Cattle Plague Commission have recommended carbolic acid as a disinfectant, and it is now extensively used as such. A spurious article composed of oil of tar, utterly valueless as a disinfectant, is now being imposed on the public. The iniquity of this fraud claims exposure, and I beg through your assistance to direct public attention to the fraud, as well as to the means by which it may be detected. Commercial carbolic acid is soluble in from 25 to 70 parts of water, or in twice its bulk of a solution of caustic soda, while oil of tar is nearly insoluble. To apply these tests:—1. Put a teaspoonful of the carbolic acid in a bottle; pour on it half a pint of warm water; shake the bottle at intervals for half an hour; when the amount of oily residue will show the impurity. 2. Dissolve one part of caustic soda in ten parts of warm water, and shake it up with five parts of the carbolic acid. As before, the residue will indicate the amount of impurity. These tests are not given as having any pretension to scientific accuracy, but as affording persons who are desirous of using carbolic acid a rough and ready means of seeing whether or not they possess the right article."

Protected Lead Pipes.—A correspondent writes from Germany that the Waterworks of Leipsic have recently been completed, and adds that the leaden pipes employed for house service have been protected by Schwartz and De Wilde's process. Our readers will remember that this is a process for obtaining on the inside of the pipe a coating of sulphide of lead, which is unacted on by water, that attacks lead itself.

The Medical Council.—The Parliament of Medicine is summoned to meet in London on May 15, and will probably sit through the Whitsun week. The Medical Council is a highly-paid deliberative body, respecting the Colleges of England, Scotland, and Ireland. Each member receives ten guineas a day during the session. Its deliberations have generally lasted a week, and cost over 1500*l.* pounds in fees. Fortunately for the fund which has to provide the fees (they are drawn from the pockets of the Medical Profession), most of the members are in lucrative practice, and lose by the arrangement; otherwise speeches costing some twenty-five pounds an hour might be unduly prolonged, and would be open to even more severe criticism than they now receive.—*Pall Mall Gazette.*

Action of Gelatinous Phosphate of Lime.—M. Collas dissolved some isinglass in water, and divided the solution into two parts. With one he mixed a little gelatinous phosphate of lime; the other he set aside as it was. Each as it cooled became a jelly; but that containing the phosphate soon liquefied, and in thirty-six hours began to putrify; while the simple solution of isinglass remained sweet for six days. The author made a corresponding experiment with fresh beef, and found that the admixture of phosphate accelerated putrefaction. The author is of opinion that the value of phosphate of lime as manure must be in part attributed to this action. Buried in the soil it comes in contact with nitrogenised matters, and decomposes them, rendering them soluble and easy to be absorbed by plants. It must not be considered as a passive body simply necessary for the organisation of the plant; it is also a powerful stimulant to vegetation, preparing itself the nutriment of the plant. The easy digestibility of fish the author considers to be owing to the presence of phosphate of lime, and he suggests that beef and mutton may be rendered much more digestible by adding gelatinous phosphate of lime to them. M. Collas believes, in fact, that an immense amount of good may be done by administering phosphate of lime in the form of gelatinous hydrate.—*Les Mondes*, 443.

Air in Wine Tuns.—M. Camille Saint Pierre opened a large wine tun, the air in which would not support the combustion of a candle. As, however, the tun contained some quick lime, it was clear that the effect could not be attributed to carbonic acid. He therefore removed some of the air for analysis, and found it to consist in 100 parts of oxygen 11·85, and nitrogen 85·15. The author remarks that the excess of nitrogen may be attributed to one of two causes—either nitrogen must have been generated or oxygen must have been absorbed. The former hypothesis he rejects, and considers it more probable that the walls of the tun, under the influence of moisture, become capable of absorbing oxygen; and he asks whether this action is due to mycoderms or the oxidation of certain matters soaked into the wood of old tuns.—*Les Mondes*, 1866. 440.

Ingredients of Atmospheric Air.—H. Reinsch stretched eighteen square feet of carefully washed linen cloth upon poles, so as to form a sort of roof. Over one such roof he allowed very dilute hydrochloric acid to trickle for fourteen days, and over another a 1 per cent. soda solution for the same time. The collected liquors were then evaporated and examined. The acid liquor was first distilled. A beautiful violet coloured (an aniline?) compound passed over first, then sal ammoniac, and last some pyrogenous products arising from the organic substances absorbed by the acid. The residue was then completely carbonised, and the ash examined. It contained traces of metals precipitable by H_2S (Pb, Sn, or Cu?). The aqueous extract of the ash contained Na, considerable traces of Ca and K, and doubtful traces of Mg. The hydrochloric solution of the ash contained Ca, Fe, Mn, Al, and traces of SO_3. Silica remained behind insoluble. In the collected soda liquor the author found much Cl and CO_2, with decided traces of PO_5 and SO_3. There were also traces of Ca, and much organic matter, with Fe, Mn, and SiO_2.—*N. Jahrb. f. Pharm.*, 24, 193, *Zeitsch. f. Chem.*, 1866, 31.

The Transmutations of Metals.—The alleged discovery of the grand *rêve* of alchemists of olden times—the philosopher's stone—whereby silver, mercury, and copper can be transformed into gold, has been just announced in a memoir entitled "*The Transmutations of Metals presented to the Academy of Sciences*," by MM. Henry Favre, Doctor of Medicine, chief editor of *La France Medicale*, and Juste Frantz, metallurgist; and on the evening of the 17th ult. M. Favre delivered a most interesting lecture on this subject to—as may have been expected—a densely crowded audience. The following is a *resumé* of their doctrines:—Hitherto the science of chemistry has been founded upon two terms essentially distinct—extraction and combination. Analysis represents the first and synthesis the latter. Now, to these two terms we must add a third—transmutation, always suspected to exist, but never proved. To do this it must be understood that all bodies in Nature owe their respective properties solely to the fixations of forces passing momentarily to a static state, but always "evolutive" in a disposable field of action. These substances are then all produced by the action of one original and common principle brought into action. Their transmutation is effected by condensation, or by the displacement of the forces which hold them for the moment in equilibrio. It is an exchange between the dynamo-statical properties of each metal and the dynamotensional efforts exerted by the agent employed; and, since the metals, simple in their chemical order, are compound in their dynamo-static state, it follows that the transmutation of metals can always take place, provided they are in media, in which the suitable elementary conditions will exist to effect the different changes. Such are the principles on which depend the operations of metallic transmutation. They have their laws. The first is that of solutions. It is on the difference of solubility of the metals that all the secret of transmutation empirically depends. The decisive experiments by which the authors of this discovery demonstrate the transmutation of silver into gold, show that it depends on two distinct operations —the first is to change the state of the silver, producing another substance which is not yet gold; the second consists in bringing the condition of this new undetermined substance to the state of pure gold. The process is thus described:—A certain quantity of chlorhydrate of ammonia is dissolved in liquid ammonia: this salt should be reduced to a fine powder. If the solution be turbid it is to be filtered; chloride of silver, perfectly white and humid, is then added, and the bottle well shaken up. The chloride of silver is dissolved, the solution becomes yellow, and deposits a precipitate of the same colour, which must be collected most carefully. The characters of this powder are —1. When introduced into aqua regia it is completely dissolved, and a new addition of ammonia precipitates it; 2. It is not fulminating; 3. Lastly, it furnishes gold by the galvanic pile—that is to say, when placed between the two poles of one of Bunsen's elements. Here is produced the most remarkable phenomenon—a transformation and a separation simultaneously. The ammonia is the dissolvent of the chloride of silver, and at the same time the reactive of the metal transformed by the chlorine.—*Mining Journal*, 10, iii., 66.—[We quote the above for the amusement of our readers. Will any reader take the trouble to make the experiment, and let us know the result? He can forward a few pounds weight of the gold at the same time.]

The Compass in Iron Ships.—The Astronomer Royal has published a letter in reply to certain statements made in the lecture we pnblished last week, from which we make the following extract:—

"Royal Observatory, Greenwich, March 5, 1866.

"A printed account has been circulated of a lecture given by Mr. Archibald Smith at the Royal Institution, 'On the Deviation of the Compass in Iron Ships.' Two passages in this lecture, taken in conjunction, appear likely to introduce erroneous ideas on the history of this science, and I request your permission to correct them in the columns of the *Athenæum*.

"The passages to which I refer are the following:—

"Page 127 of the Chemical News.—'About the year 1840, the British Admiralty, on the Report of a Committee . . . . adopted the system of having a standard compass. . . . and of having the deviations of that compass carefully observed,' &c.

"*Ibid.*—'At the same time, the attention of Mr. Airy, the Astronomer Royal, was directed to the particular question of the deviation of the compass in iron ships. Mr. Airy proposed a mode of correcting the semicircular deviation by the application of magnets, and of correcting the quadrantal deviation by the application of soft iron cylinders,' &c.

"The inference which any reader must draw from these passages is, that Mr. Airy's work was certainly not anterior, and was probably posterior, to the work of the Admiralty Committee; and that the result of Mr. Airy's work was simply 'to propose a mode of correcting,' &c.

"How stand the facts?

"In the summer of 1838 I examined the *Rainbow* and the *Ironsides*. From these, I established for the first time, the general laws; that there was a quadrantal deviation certainly produced by induction; that there was a transversal magnetic force certainly caused by magnetism of permanent character; that there was a longitudinal magnetic force, probably caused by a combination of induced and of permanent magnetisms, for the separation of which under appropriate circumstances rules were given; and that there was a loss of directive power caused by induction. The correctness of this theory was proved by computing, from the observations, the force of the permanent magnet and the circumstances of the mass of soft iron, which would produce antagonistic effects exactly equal to those mentioned, and by introducing those antagonistic materials, and by showing that in observation the compass then was perfectly correct. Attention was called to the forces which are brought into action by the heeling of a ship, but that part of the theory was not verified. (The only additions which have been made to this theory, in twenty-seven years, are, a refinement of the theory of induction, by Mr. A. Smith, which does not alter a single letter of my results; and an important investigation by Mr. Smith on the heeling forces, which has not yet, I believe, been sufficently verified.)

"The theory being thus established, I devised a method of practically applying it without calculation, for the correction of a ship's disturbing force, by separating the magnetic force of permanent character into two parts, each of which could be corrected separately by a very easy tentative process, the quadrantal deviation being also corrected by an easy tentative process. And I pointed out the nature of the correcting apparatus (a vertical magnet) to be used for the heeling error. (The only additions which have been made to this corrective process are, screw-adjustments of the magnets, first proposed by myself, and Mr. Rundell's excellent introduction of a vertical iron bar, to neutralise the effect of a sternpost, &c., when the compass is very near to it.)

"Lastly, I suggested that, probably, the direction of the ship's permanent magnetism might depend on some position of the iron while under manipulation, that it might be expected that this magnetism would not be absolutely permanent in changes either of locality or of time, and that the state of a ship's magnetism ought to be examined from time to time, and registered. (Since that time, a great number of ships have been examined, and the results of the examinations have been to support these suggestions in every particular.)

"The whole of this work was printed in the First Part of the *Philosophical Transactions* for 1839. Before that time, one of the ships had gone into southern latitudes and had returned, having her compasses correct all the time."

Cure for Damp Walls.—The *Builder* gives the following remedy for damp walls:—Three-quarters of a pound of mottled soap to one gallon of water. This composition to be laid over the brickwork steadily and carefully with a large flat brush, so as not to form a froth or lather on the surface. The wash to remain twenty-four hours, to become dry. Mix half a pound of alum with four gallons of water; leave it to stand for twenty-four hours, and then apply it in the same manner over the coating of soap. Let this be done in dry weather.

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.

The Chemical News will be published on Thursday next week.

W. P. P.—Declined with thanks.

A Reader.—Received. Next week.

M. P. S.—We are promised a communication on the subject shortly.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Note on the Purification of Platinum, *by Mr.* E. Sonstadt.

The tendency of platinum to alloy with other metals at a temperature far below its fusing point is sufficiently well known to every user of platinum crucibles. It is equally well known that iron, &c., which has been absorbed by platinum cannot be removed, except superficially, by the action of hydrochloric acid for instance, nor even by heating in acid sulphate of potassium. Stas, in his memoir on the atomic weight of silver, &c., states that he purified his platinum vessels from iron by causing them to come in contact, at a red heat, with the vapour of chloride of ammonium. The process had to be repeated as often as any yellow sublimate was formed. This process is less effectual, or less conveniently and speedily effectual, than the modification of it that I have to propose; because, if the vapour of the sal ammoniac is generated from the solid salt in the vessel to be purified, the heat absorbed in the vaporisation of the salt tends to keep the vessel at a temperature below that at which volatile metallic chlorides are most readily formed. Instead of chloride of ammonium, I put dry double chloride of ammonium and magnesium in the platinum vessel intended for purification. The vessel is then heated to about the fusing point of cast iron for about an hour. I find a Gore's furnace convenient for this purpose. In this process, not only is chloride of ammonium vapour given off for a long while with the double salt, at a temperature much above that at which chloride of ammonium alone volatilises, but when that salt is completely expelled, the chloride of magnesium remaining is perpetually being decomposed with evolution of free chlorine, and, frequently, the formation of a crystalline crust of periclase lining the crucible. Platinum thus purified is softer and whiter than ordinary commercial platinum. The method is not available solely for the removal of iron, but retrieves crucibles that have become dark coloured and brittle from exposure to gas flame, as well as crucibles that have been attacked by silicates during fusion of these with carbonate of sodium. I cannot conclude this note without remarking on the extreme facility with which platinum becomes impure by heating in contact with matters containing only a very small proportion of substance capable of attacking the metal. Thus, a platinum crucible becomes sensibly impure after prolonged ignition at a high temperature, bedded in commercial magnesia. On the other hand, I have kept a platinum crucible at a constant weight to the tenth of a milligramme over a series of intense ignitions, when the precaution has been taken to bed it in chemically pure magnesia.

On Silicium in Cast Iron, by Edmund G. Tosh.

Some time ago Dr. Phipson (*Comptes Rendus*, t. lx., p. 1030) announced his opinion that silicium, like carbon, existed in two modifications in pig iron; as α Si combined with the iron, and as β Si in the free or graphitoidal condition. He gave at the same time, a method by which these two varieties of silicium might be estimated separately.

It is well known that in pig irons, which may be successfully used in the manufacture of steel by the Bessemer process, most of the carbon must exist in a free state as graphite, and Dr. Phipson concludes that in such irons the silicium must also occur uncombined with the iron. The analyses of three specimens of iron A, B, and C are given, which in their ultimate constitution are almost identical, yet the steels obtained from these irons vary widely in character from each other. A yielded a tolerably good steel, B an inferior one, and that from C was so bad that it could not be worked. According to Dr. Phipson the silicium existed in these irons as indicated below:—

	A.	B.	C.
α Si . . .	·98	1·81	2·60
β Si . . .	3·22	2·15	1·63

A yielded a good steel because it contained very little combined silicium, and for the opposite reason the steel from C was of inferior quality.

For some time back I have been engaged in a somewhat extensive series of investigations of the "hematite" pig irons of West Cumberland, particularly of those varieties best adapted for the manufacture of Bessemer steel. Before meeting with Dr. Phipson's paper I had sought carefully for graphitoidal silicium yet never obtained the slightest evidence of its presence. In these experiments about twenty grammes of the metal in borings were treated with dilute hydrochloric acid till most of the iron was dissolved, the black insoluble matter was collected on a filter, washed, dried, placed in a porcelain boat, and ignited in a stream of oxygen. Carbon was thus got rid of, and only a small ferruginous residue remained behind. This residue was first freed from iron and manganese by boiling with aqua regia, and then from silica by evaporating to dryness twice with hydrofluoric acid. After these operations I always obtained a small quantity of a light brown substance, which, examined under the microscope, displayed none of the physical properties of graphitoidal silicium, but which on testing proved to be titanic acid. As graphitoidal silicium is quite insoluble in all acids, (with the exception of a mixture of HFl_3NO_5), and further may be exposed to a red-white heat in a stream of oxygen without being in any way affected, I should have detected it had it been present.

Dr. Phipson's results being so directly opposed to mine, I turned my attention to that chemist's process of estimation, which is shortly as follows:—

A weighed portion of the iron is treated with aqua regia; both varieties of silicium are oxidised, the silica resulting from combined silicium is dissolved by the acid, while that from the free silicium remains insoluble. It is a well-established fact that any variety of silicium which has once been exposed to a full red heat (as free silicium in cast iron must certainly have been) is quite unaffected by aqua regia—a fact which Dr. Phipson has evidently overlooked.

Admitting, however, the principles of the process to be correct, I made a few experiments to ascertain whether the amount of silica in the insoluble residue, after treatment of the iron with aqua regia, was a constant quantity. In the following three experiments, the details of which I give, the same variety of iron was used:—

First experiment: 2·409 grammes of iron in borings were heated with aqua regia ($3HCl+NO_5$) diluted with one-fourth its bulk of water, till solution was as far as possible complete. The acid solution was then diluted, the insoluble matter collected, and silica estimated in it. SiO_2 weighed ·0565 grm. = 1·094 per cent. silicium.

Second experiment: 2·39575 grammes of the metal treated with strong aqua regia in considerable excess. A

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gentle heat applied till solution was effected. Water was then added, the insoluble collected, and silica estimated as before. SiO_2 weighed ·038 grm. = ·740 per cent. silicium.

Third experiment: 2·336 grms. iron dissolved in aqua regia. Before filtering most of the excess of acid was expelled by careful boiling. Silica estimated in the insoluble gave SiO_2 ·06775 grms. = 1·353 silicium.

These determinations show very great discrepancies, the amount of insoluble silica varying with the strength of the acid used, and the quantity of free acid present previous to filtration. Thus in No. 2, where a large excess of free acid was employed the quantity of silica precipitated is only about half of that in No. 3, where most of the excess of acid was expelled. Resting, as this process does, on a false basis, more concordant results could not be expected.

The occurrence of free silicium in cast iron is contrary to the general opinion and to the results of experience. It may exist combined with various bodies. Schafhautl mentions the occurrence of sulphide and also carbide of silicium in a specimen of iron he examined. Hahn[*] prepared a silicide of iron containing as much as 20·29 per cent. of silicium. By treatment of this compound with dilute hydrofluoric acid, it was in a great measure dissolved, only a small crystalline residue remaining unaffected. These crystals proved to be a definite compound, $FeSi_2$. Now with this enormous percentage of silicium, none of that element separated in the free state. In the preparation of this compound only pure materials of definite composition were used, and it may be urged that in the presence of the numerous substances which make up the constitution of cast iron, the deportment of silicium might be modified. But Caron[†] has shown most conclusively that these various elements are without material effect upon silicium, or its state of combination. On account of its superior affinity for iron, its tendency is to expel other substances from combination with that metal. Carbon particularly is affected in this way, hence a highly silicious iron is never rich in carbon, and what little it does contain mostly exists as graphite.

Chemical Laboratory, Göttingen, March 19, 1866.

TECHNICAL CHEMISTRY.

New Process for Indigo Dyeing, by M. J. C. Leuchs[‡].

Before it can be used for dyeing indigo must be rendered soluble in alkaline and caustic solutions by being treated by a reducing body; by this reaction indigo loses its colour, but after being fixed on stuff and exposed to the air it absorbs fresh oxygen and returns to its original colour. This process, theoretically so simple, is practically complicated by serious difficulties, and requires, on the part of the dyer, much practice and great dexterity. Thus, for instance, with indigo reduced by fermentation with vegetable matters, in a caustic solution, the various acids produced during the fermentation combine with the alkali, the liquid soon ceases to be caustic, and loses the property of dissolving the reduced indigo. To remedy this a fresh quantity of alkali (soda, potash, or lime) must be added from time to time; but should an insufficient quantity be added, a portion of the reduced indigo remains undissolved, and soon decomposes under the fermenting matter. If, on the contrary, an excess of alkali be added, a certain quantity of white indigo is lost by its combining with potash, and forming an insoluble product.

According to M. Leuchs (of Nuremberg), all these objections are obviated by effecting the change from blue to white indigo by pectine. Pectine exists in considerable quantities in the turnips of different species, in pumpkins, melons, &c.; it may be extracted from these fruits, or they may even be directly used to reduce indigo. The most simple process consists in heating 45 or 50 kilogrammes of the caustic ley to 75° C., adding half a kilogramme of well pulverised indigo, then suspending in the vat a kind of basket of iron wire, containing from 8 to 10 kilogrammes of fresh turnips, cut into small pieces. Then heat gradually to boiling point; the indigo soon loses its colour, and the solution, decanted into special vats and diluted with water freed from air, will be ready for dyeing purposes. Contact with air must of course be, as far as possible, avoided.

When the dye bath is exhausted it may serve for a fresh operation by adding indigo, a little caustic soda, and boiling it as above with a certain quantity of turnips.

On the iron wire trellis there will remain hardly 5 or 6 per cent. of the original quantity of turnips. This residue may be used in paper making.

The simplicity of this new process may easily be proved by introducing into a closed tube a small quantity of indigo mixed with a few drops of soda or caustic potash, adding a small piece of turnip, and boiling; the indigo will rapidly lose its colour, and re-dissolve and return to its original colour by exposure to the air.

As turnips are not everywhere cultivated, and during certain seasons are not to be procured fresh, the author has found that the active principles may be extracted by boiling the turnips with water, under a pressure of two or three atmospheres. C. Leuchs and Co., of Nuremberg, now manufacture on a considerable scale an extract of turnips, 1 kilo. of which will dissolve cold 4 kilos. of indigo.

PROCEEDINGS OF SOCIETIES.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, by Dr. Percy, F.R.S.

Lecture No. II.

Ladies and Gentlemen,—This morning we shall continue the subject of silicon, about which I have something further to say, and we will then take up that of equal interest, aluminium, the basis of alumina, and various important compounds in a geological point of view.

Silicon, as I said, forms a very large part of the earth's crust. It combines with oxygen, constituting the well-known body silica, or, as chemists term it, silicic acid. They call it an acid, because it has the property of combining with bases, such as lime, magnesia, and so on, not because it has any acid taste to the tongue. Formerly the term "acid" was restricted to certain bodies which were characterised by this acid taste, as well as possessing the property of combining with bases; but now we are acquainted with a number of bodies which, to all intents and purposes, act the function of an acid, but which have no acid savour. You will understand, therefore, that the term "acid," although retained, is now entirely conventional. There has been a great discussion of late as to whether it ought to be continued or not.

Silicon we find on every side—sometimes as quartz, well crystallised, and sometimes in a state of fine division, as

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[*] *Annalen Chem. und Pharm*, bd. cxxix., p. 57.

[†] *Mémoire sur les Aciers.*

[‡] *Bulletin de la Société Chimique*, February, p. 153.

in silicious sand. Then there is the chalcedony, of which I showed you specimens on the last occasion. We have also the amorphous variety of silica, to which I called your special attention, and which is represented in that most beautiful mineral opal, sometimes possessing a remarkable optical structure, whereby the magnificent colours of opal are produced.

On this occasion I have great pleasure in presenting to your notice some very fine specimens of gems, including an opal, kindly lent for the purpose of illustration by Mr. Emanuel, of Bond-street. In this small collection is a very choice specimen of opal surrounded by diamonds. This is an amorphous variety of silica, as is also hyalite, and that infusorial earth about which we have heard so much within the last few years. We saw masses of this earth on the last occasion.

This so-called amorphous silica, you will remember, is especially distinguished from the other well-marked variety by its ready solubility in alkaline reagents.

It is a remarkable thing about silicon, which combines with oxygen, and retains that oxygen with immense force—in other words, which has a strong affinity for oxygen—that when we have contrived to separate the two elements, which we can now readily do by various means, obtaining the silicon in a separate form, it is, so to speak, extraordinarily impassive to oxygen under ordinary circumstances. We might take the silicon we saw on the last occasion, and expose it to oxygen without any combination taking place—nay, it might be submitted to a comparatively high temperature, and yet not lay hold of the oxygen; but when once combination has taken place, then the two elements adhere to one another with immense tenacity.

I will, in passing, say something concerning the combinations of silicon with the metals, and I will do so very briefly. These compounds play an important part in art. Silicon has the property of combining with various elementary bodies, especially metallic elements. We have here some specimens illustrating this fact. For instance, silicon combines with copper, forming a substance very similar to the well-known bronze, which is a valuable metallic compound consisting of copper and tin. Here is a specimen consisting essentially of copper and silicon. It contains about 2 per cent. of silicon. It was made by heating copper at a very high temperature in contact with silica and carbon. If you were to take copper, or even a metal which has a more powerful affinity for silicon than copper has, and heat it in contact with silica at the highest temperature of our furnaces, or even at higher temperatures than we can attain in our furnaces, you could not effect any combination between the silicon and the metal. Of this fact we have a very capital illustration here—a small one, it is true—in connection with the metal platinum. Platinum is an exceedingly infusible body, though by means of certain gas arrangements we can melt it without difficulty. If we heat it to a very high temperature indeed in contact with silica it undergoes no change whatever; but if we add to the mixture a third body which has a powerful affinity for oxygen at a high temperature, then, under the influence of this third body, the silica is reduced, and the silicon thus set free combines with the platinum. A convenient body to effect this reduction is carbon—common charcoal, for example. In this tube is a specimen of platinum which was melted at a comparatively low temperature simply by heating it in contact with silica and carbon, the carbon serving only the purpose of laying hold of the oxygen, and tending to set free the silicon. We have here a two-fold affinity in play—that of the oxygen for the carbon, and that of the silicon for the metal; and we obtain thus, by exposing platinum to this mixture at a comparatively low temperature, a well-fused globule of platinum containing silicon. This is a fact which has no very strict bearing upon our subject, but still it has a collateral interest, and may possibly be useful if not important in time.

We frequently find silicon in iron. Most of the pig-iron of our furnaces at the present day contains a notable quantity of silicon, which has been produced exactly in this way by this conjoint action—the reduction of the silica under the combined influence of the carbon and the metal. Frequently we find it to a very large extent in certain kinds of pig-iron, varying from 2 to even 8 per cent. Here is some containing 13 per cent. It is singular that in certain cases as the pig-iron cools from a state of liquidity the silicon separates in a crystalline form. Of that there is no doubt. It is very difficult to give you evidence of it experimentally, but you may take my word for the fact.

Perhaps a few words further on the solubility of silica may be interesting. Bischoff, who has written a work on chemical geology, so well known a few years ago, has made experiments on the solubility of silica in various liquid reagents, and of the solubility of various bodies of geological interest generally. In an aqueous solution of potash, for two parts by weight of solid potash in solution, there is dissolved one part by weight of the extremely fine silica obtained from the gas called fluoride of silicon. Of silica, in the state of quartz, there is dissolved ·009—that is, only nine thousandths—for two parts by weight—a wonderful difference truly—and of silica, in the state of flint, there is dissolved ·038.

A description of the various silicious minerals, although extremely interesting, would be foreign to the object of these lectures, except so far as an allusion to them will tend to illustrate geological phenomena. These minerals have a very high interest in many respects, and frequently constitute a very large part of a mineralogical cabinet; they comprise various forms of quartz, amethyst, coloured quartz of various sorts, chalcedony, opals, jaspers, and agates.

I will mention one or two circumstances which are interesting in relation to our subject. One is the fact of silica or quartz containing certain foreign bodies. There is the well-known mineral aventurine—a red variety, which contains crystals of mica, micaceous scales produced from the mass. Here is the more precious variety, which is of a green colour. This peculiar effect is due entirely to the distribution, or the retention, of these small scales from the mass. These matters, in the agglomerate, are matters of great geological interest generally. We find silicious pebbles, for instance, firmly agglutinated—soldered together—by a silicious cement, forming a hard, compact, solid mass. The various kinds of pudding stones with which, I have no doubt, many of you are familiar, have been thus formed. There is a curious fact also which should not be omitted—namely, the occurrence of globules of water occasionally in quartz crystals. They are rarely met with, but sometimes they are found, and the globules may be very distinctly perceived. Here is a piece of quartz containing a globule, but, of course, the water can be seen only on close inspection. I have put a mark on the specimen to show the position the globule assumes. On turning the crystal the water is distinctly seen. When we come to consider the modes of formation of mineral substances, it is specially important to examine into the nature of these included matters. It is very possible that in many instances we may receive indications as to the precise conditions which have occurred in their formation by taking account of the foreign matters with which they may be associated.

I shall have a great deal to say of the most important compounds of silica hereafter; but, to conclude the subject of silica as such, let me summarise the facts concerning the mode of formation of silica in the crystallised state.

I pointed out to you, and laid great stress upon, the fact of the difference of specific gravity between the crystallised silica and the amorphous silica. The difference should be borne in mind. The specific gravity of the crystallised is considerably higher than that of the non-crystallised, being as 2·6 is to 2·3. We saw, further, that when crystallised silica, or quartz, is exposed to a temperature sufficiently high to fuse it, we obtain a glass-like bead, which then has ceased to possess any crystalline structure, and has been reduced in specific gravity from 2·6 to 2·3. Now I think you will admit that it is most certainly proved—*most certainly proved*, I say—that rocks in which silica in the form of crystallised quartz largely exists, such as granite, never have been exposed to a very high temperature, a temperature sufficient to fuse the silica. If they had been, we should not have had the silica there as quartz: we should have had it there as molten silica, or rather silica which had been molten, of the low specific gravity variety; but that is never the case. We have, on the other hand, positive proof of the aqueous formation of silica in nature from the fact of the minerals frequently associated with it—actually included in the silica. If we found these minerals merely on the surface of the quartz crystals then the conclusion would not be justified; but when we find in the very centre of a quartz crystal a matter which we know cannot exist at a high temperature, then, I think, we are justified in coming clearly to the conclusion that the quartz crystals themselves never could have been strongly heated. There is another proof which, perhaps, may be regarded as the most satisfactory of all, and which certainly establishes the fact of the aqueous formation of crystallised silica. It is none other than the direct production of such crystallised silica by chemical means. Several experiments upon this subject have been made, especially of late years. A well-known French mineralogist, who died about two or three years ago, and whose loss we deeply regret, devoted particular attention to this kind of inquiry—the artificial production of certain mineral compounds. He found that when silica was separated from a state of combination, from a silicate, by hydrochloric acid in excess, and then exposed to a high temperature in water in a glass tube hermetically sealed—and by a high temperature I mean one ranging between 200° and 300° centigrade, a pretty high one, and implying very strong pressure—by this simple means an amorphous silica under these conditions became crystallised. It is true the crystals were only microscopic, but still they were large enough to admit of being carefully examined and satisfactorily recognised. They were proved by him to be microscopic crystals of quartz, and on his observations I think we may place absolute reliance. Perhaps some here might say, "But is this a proof that the same kind of agency has been at work in nature in producing those magnificent specimens—specimens of large dimensions—such as were exhibited at the last lecture?" Here, ladies and gentlemen, comes into play perhaps the most important, or certainly one of the most important, of all elements in a geological sense—that of time. Time works wonders, truly, in the geological world. That which appears to us, in relation to our ephemeral existence here, a very long time, is an infinitesimally small portion of time in the history of the formation of this our world. Nature has command of this great power in conducting her operations. It may be that crystals of quartz, and other natural crystals, when of large dimensions, may have required for their production a very long time; and it is further possible, nay, probable, that under no other condition would it be possible to produce such fine specimens of crystalline bodies as we meet with naturally. If by the action of liquid reagents we can produce microscopic crystals of quartz in a very short time, it surely is easily conceivable that in the course of ages—interminable ages to us—nature would be able, by the operation of the same causes, to engender those fine specimens of large dimensions to which your attention has been called. We cannot lay too much stress upon this element of time in the production of these things.

There is another French observer, Senarmont, a member of the Academy, who has paid great attention to this department of our subject. He also has succeeded in producing crystals of silica—still microscopic, but certainly crystallised quartz. If we take common glass, which is a silicate of an alkali and lime, you would say that it is an exceedingly durable body. Well, so it is, under ordinary conditions, but still it yields to the influence of time. Here, for instance, is a specimen of some glass hundreds of years old. It is scooped out in spherical cavities in all directions. If glass is reduced to powder it may be acted on by water, and although it resists cold water for a long time, still, when exposed to the action of very hot water—I mean under high pressure—it is rapidly attacked, and speedily becomes corroded throughout. If you perform the experiment under pressure, so as to get the requisite temperature, you obtain, amongst other products, crystallised silica. I shall have occasion to refer to this again.

We have, then, two distinct classes of proofs concerning the formation of crystallised silica in the wet way—the indirect, which I have placed first, and the direct, which I have placed last, and to which I have just called your attention.

I have not gone into the subject of the formation of silicon. That is a purely chemical, or rather, I might say, metallurgical process. It would carry us rather too far out of our subject to discuss that matter, and would occupy too much time. Moreover, I must give you credit for the knowledge.

I must call your attention to a statement which was made with reference to the vaporisation of silica. That phenomenon was alleged by Mr. Julius Jeffreys to have occurred in a potter's kiln in India, but I have failed to discover anything like certain proof of such volatilisation, although it is certainly true of boracic acid, which is an analogous body, that volatilisation does take place at comparatively low temperatures.

Let us now pass on to the examination of another body which forms a very large part, indeed, of the earth's crust, namely, aluminium. This also is a metal. In fact, we may be said to be a world of metals. Almost everything about us and around us is metallic. Every bit of brick we behold contains this white, shining metal, aluminium; every bit of sand contains that metal-like body silicon; every bit of lime contains the bright, shining metal, calcium; and every dose of magnesia swallowed contains the white metal magnesium. We are, so to speak, more or less an oxidised, burnt-up, metallic world.

Now, then, with regard to aluminium, about which a great deal has been learned of late. Aluminium is the basis of clay. It exists in all clay, and in various other minerals. It combines with oxygen to form alumina, and it is this alumina which we find in clay and other aluminous compounds, as we will call them henceforth. Alumina and oxygen combine with the most powerful affinity, and it requires the exercise of the strongest chemical force to detach one from the other when once the combination has taken place. Hence for a very long period of time, in spite of all efforts, it was found impossible, in a chemical point of view, to effect a separation. It is only of late years, since we have been acquainted with the chemical production of sodium on a large scale, that we have been enabled by means of that body to effect the separation of aluminium from oxygen. I will tell you the principle of this process directly. Let us first inquire into the properties of the metal.

There has been a good deal said about aluminium of late. Many ornamental applications of it have been made, but what has been stated by interested parties has not always been correct. It is a white metal, nearly approaching tin in whiteness, according to my eye, but still, I think, being somewhat inferior to tin. Perhaps its hue is midway between tin and zinc, which has a bluish tint; but on the point of colour every individual must judge for himself. It is an exceedingly light metal.

its specific gravity being, in round numbers, 2·5—that is to say, two and a half times that of water. Whatever measure of water will weigh one, the same measure of aluminium would weigh two and a half. It has about a fourth of the specific gravity of silver. It is a malleable metal—that is to say, it is capable of being extended by the operation of rolling or crushing between two powerful cylinders. You see some of the metal rolled out into sheets almost like tea-lead. It can also be drawn out into wire; hence it is a ductile metal, ductility implying the property of being drawn out. It can be not only rolled out into thin sheets, but further extended by means of a hammer into fine leaves almost equal to gold leaf in thickness. It is perfectly opaque. It melts at about a red heat. It tarnishes but slightly when exposed to the action of the air under ordinary conditions, but when exposed to the air in the melted state it oxidises, forming alumina, which covers the surface of the molten mass, and protects the subjacent metal from further oxidation to a great extent, the alumina thus formed being excessively infusible. Aluminium is acted upon by certain dilute acids. We are told that it is a very indestructible metal, and so forth; but you must not give credence to all these statements. Hydrochloric acid and sulphuric acid will act upon it. It resists the action of certain oxidised acids—that is, acids containing an excess of oxygen—using the old nomenclature—such acids as nitric acid. Aluminium is attacked by alkaline bodies, such as potash, and that is a serious drawback to it. It has the property of combining with various other metals, but hitherto only one alloy of importance has been discovered; that is the alloy of aluminium and copper. When alloyed with about 5 per cent. of copper it produces a gold-like metallic body, which, when properly treated, is so like gold in point of lustre and colour that I have seen an experienced eye puzzled to detect this alloy from gold placed side by side with it. Here is an alloy of aluminium and copper—the first specimen ever made. Of late, it has been the custom to put in about 10 per cent. of copper, by which a metal of high tenacity is obtained—that is, a strong power of resisting rupture by tearing asunder: that is what I mean by the term "tenacity." I believe I am correct in stating that the demand for this aluminium is at present far inferior to the supply. It might be made in any quantity, and now at a comparatively moderate price. Hitherto it has been used chiefly for ornamental purposes, but it has not attracted the public eye. One can hardly be surprised at that. There is not much in the colour to attract the eye, and, as I said just now, it is inferior to tin in whiteness; but that is a matter of taste, in which every one must judge for himself.

Aluminium is made indirectly. You cannot take alumina, as you can an ordinary metallic oxide, and heat it in contact with a body having a strong affinity for oxygen, and so separate the aluminium; at all events, you cannot do so economically. But we can succeed in effecting the separation by an indirect process. We will take some alumina—that is, the compound of aluminium and oxygen—and mix it intimately with charcoal. We will then moisten the mixture and fashion it into small pellets or large pills. Well, we know that charcoal at a high temperature will tend to combine with oxygen, and we might expect that it would do so in this case, and set free the aluminium; but if I heat one of the pellets of alumina and charcoal alone, even to the highest temperatures of our furnaces, we cannot succeed in setting free the aluminium. It holds the oxygen with such tenacity, that, notwithstanding the high affinity of carbon for oxygen at a high temperature, no reduction takes place. But if we heat these pellets, and then pass over them a gaseous body which has a strong affinity for aluminium, then, by means of this twofold affinity—the affinity of the gaseous body for the aluminium, and that of the carbon for the oxygen in the alumina—we effect a disruption, if I may use the expression: we separate the aluminium from the oxygen, but we do not yet obtain the aluminium in a metallic state. Now, the gaseous body to which I allude is chlorine gas. Chlorine is an element which exists, you know, in common salt—chloride of sodium, which is nothing more than the metal sodium combined with chlorine, that wonderful disinfecting gas. Well, we take these pellets, put them into a porcelain or glass tube, and expose them to a high temperature, and pass over chlorine gas. We thus get chloride of aluminium and carbonic oxide gas; and the chloride of aluminium, being volatile, passes forward, and may be condensed in any suitable receiver. Here is some chloride of aluminium which has been prepared exactly in that way. Now, you will observe that we have succeeded in replacing the oxygen of this alumina by the analogous element chlorine. That is the first step in the process. Having done this, we have now no difficulty whatever in separating that chlorine from the aluminium by a direct means. We have only to heat the chloride of aluminium in contact with sodium, and the thing is done at once. The sodium having a high affinity for the chlorine, combines with it, forming common salt, and the aluminium is set free in a metallic state. It is necessary to employ certain precautions—such, for example, as an atmosphere of hydrogen. Into this, however, I need not enter now. Such is the manner in which aluminium is produced on the large scale at the present time.

The compound of chief interest to us is alumina, *i. e.*, the compound of aluminium and oxygen. It contains, in round numbers, 53·3 of aluminium and 46·7 per cent. of oxygen. When dry it forms a perfectly tasteless, white, insoluble powder, and undergoes no change by exposure to the air. It is excessively infusible, but still we can succeed in melting it under certain special conditions. I have here a very small specimen of alumina which has been fused, to which I will call attention directly. It has the property of combining with water, and forming several well-known definite mineral bodies. I will mention two of them, which are extremely interesting, in consequence of their association with certain other mineral bodies in nature.

The first of these is diaspore. It is nothing more than a combination of alumina and water, in the proportion of equivalent to equivalent. Here is a specimen of diaspore, but not the usual variety. The usual variety is dark brown and very manifestly crystalline. Then there is another body which I might take for an example, but of which I have not a specimen to place before you—the mineral gibbsite. It is a most uninteresting looking thing. It is nothing more than alumina combined with a large quantity of water. Here we have it artificially made. There is no difficulty in throwing it down from solution in combination with water, and then we have it in the gelatinous state, like the silica which you saw on the former occasion. We have here a solution of a salt of alumina—that is, alumina combined with an acid—in water. We will add to that solution another, which will displace the acid from the alumina: it will lay hold of the acid by virtue of which that alumina is retained in solution, and we shall see the alumina precipitated in the form of a pasty, gelatinous mass.

Sometimes the mistake is made—I have seen it made in print even recently, and by men whose interests were deeply concerned in the matter—of confounding alumina with clay. Not long ago I saw in a leading journal the wonderful announcement of the discovery of a bed of alumina. No such thing! it is a bed of *clay*. The two things are as different as chalk and cheese. Clay contains alumina: it is a compound of alumina and silica, but it is not alumina, as such.

This precipitated alumina, when collected upon a filter and dried, forms an insipid white powder. Here it is. You may heat that powder to a very high temperature indeed—the highest we can command in our furnaces—and yet not melt it. Still, alumina has been melted. I will give you the facts which bear upon this point.

Alumina in the crystallised state constitutes those magnificent gems of which you have very fine specimens before you, thanks to Mr. Emanuel. These are the sapphire, the ruby, the oriental topaz, or the yellow sapphire. It also forms the oriental emerald, which I believe is very rare; I have not a specimen of that. The ordinary emerald is a very different thing. There is the green sapphire; this is crystallised alumina coloured green. Here are three varieties—very beautiful specimens they are. The tint of the ruby and the sapphire are very magnificent. The well-known corundum, an opaque, most uninteresting-looking body, which forms the basis of emery, is nothing more than crystalline alumina. Emery owes its property to the same body. It is a curious thing that by taking that white substance, drying it, and crystallising it, we should produce these magnificent gems. It does not become me to enter upon their mineralogical properties. I may state, however, that crystallised alumina is excessively hard. The sapphire and the ruby are about the hardest minerals in the world except the diamond. Only the diamond will scratch them. You will perhaps be startled at first when I tell you that the sapphire and the ruby have been artificially made—the true things, undoubtedly, but unfortunately they are very, very small—microscopic and of no value whatever. The experiments have been made especially by M. Deville, of Paris, whose name is well known, particularly in connexion with aluminium. He has succeeded in producing both ruby and sapphire on a very small scale, the crystals being entirely microscopic. How does he do it?

He takes a common crucible and lines it with charcoal. At the bottom of it he puts a little of the compound called fluoride of aluminium. Then above that, and separated from it by a little shelf of charcoal or carbonaceous matter, he places boracic acid—that is, the acid existing in borax, and which, like silicon, is a compound of a base and oxygen. Both are volatile. The crucible, previously covered, is exposed to a strong heat. We then get the vapour of boracic acid coming in contact with that of the fluoride of aluminium. An interchange takes place. The fluorine leaves the aluminium and goes over to the boron of the boracic acid. It goes as a gas, very similar, or rather analogous to, fluoride of silicon. There will remain the aluminium and the oxygen, which unite, and under these conditions you obtain the alumina crystallised in the form of the sapphire; and when a little chloride of chromium is added you get it sometimes red like the ruby and sometimes blue like the sapphire, and even in the very same experiment you get both red and blue.

Now, this is a hopeful experiment so far, but if this element of time should have much to do as regards producing gems of sufficient size to be worthy of consideration, I am afraid it is a very hopeless one. The first time that alumina was ever obtained crystallised, as far as I know, was some years ago, and the experiment was due to the late Professor Ebelmen, who was formerly Director of the Sevres porcelain works, near Paris. In this tube there is a small specimen of alumina clearly and unmistakably crystallised, which I received from him many years ago.

I will tell you the manner in which the crystallisation was accomplished. You know how salts are crystallised under ordinary conditions. Take common salt, for instance. We dissolve it in water, and then we proceed to evaporate off the water. The water goes, and the salt appears at length in the crystalline form. Being deprived of water, it separates in definite geometrical forms or crystals. Now, what water does with regard to salt at the ordinary temperature, boracic acid does to alumina at a higher temperature. We take boracic acid, or a compound of boracic acid, melt it at a high temperature, mix it with alumina, and expose the mixture to a very high temperature for a comparatively very long time—for some days. The alumina will be dissolved, the silver will gradually evaporate at this high temperature, and the alumina will be left in a crystallised state. There is here placed for your inspection a specimen so obtained. This is a most interesting experiment, both of Deville and of Ebelmen. There is no mistake about these crystals obtained by Deville being actually true sapphire and true ruby. They were submitted to a minute microscopic examination, and they presented all the qualities of those minerals which are essentially nothing more than crystallised alumina coloured by various agents—oxide of chromium in this instance. It is a singular thing that the same colouring agent should produce these two different colours, red and blue; but there are many facts of this kind, the truth of which we are satisfied of, but the reason of which we are not able to explain satisfactorily. And so it is throughout the whole range of science. By increasing the quantity of chromium, Deville obtained a fine rich emerald green—that rare form of sapphire, the green sapphire. From oxide of chromium and chloride of chromium he obtained three distinct colours—red, blue, and green.

There is also the yellow sapphire, or oriental topaz, as it termed, of which we have here a specimen. There is a particular form of sapphire which is very highly appreciated—not in this country, but in India—called "star-sapphire," or asteria, as they term it. On looking down you see a six-rayed star most distinctly. There is no great beauty, I think, in the mineral apart from this star, and I see it is not very much appreciated by people in this country.

Daubrée, another French observer, informs us that he has succeeded in making crystallised alumina by calcining phosphate of alumina with three or four times its weight of sulphate of soda or potash. He gets a distinctly crystallised alumina by this means. A good many years ago, another French observer, of the name of Gaudin, made experiments on the production of alumina crystallised; and what he prepared was especially recommended for polishing purposes. It was sold as "*poudre de saphir.*" Here is a little bottle of it which I brought over from Paris many years ago. He tells us that by the addition of a very little chromate of potash to alumina during fusion, he obtained a more or less deeply coloured red product similar in colour to the natural ruby. I give his results as I find them recorded. I know nothing of them myself.

It is interesting to inquire into the mode of the occurrence of ruby or sapphire in nature. It frequently occurs, I believe, in limestone, forming the so-called stratified granite, in New Jersey and New York, and in gneiss, which is a metamorphic rock in the Isle of Naxos and in the Isle of Lemnos, and at Magnesia, Asia Minor. It occurs in combination with diaspar in the dolomite of St. Gothard, and near Ephesus. In a finely divided state it is well known to us as emery, which is so useful in polishing and grinding. In some analyses of this body a little water is found to be present. It is a chemically pure body, but containing, no doubt, a foreign body in mixture.

In speaking of aluminium, I ought to call your attention to another source of that body in nature—one from which aluminium has been manufactured on a large scale. It is a singular mineral occurring on the coast of Greenland, and is known to us under the name of cryolite. It exists in very large quantities, and might be imported into this country at a very moderate cost. It is a compound of fluorine, sodium, and aluminium. It may be called a double fluoride, to use the old expression. After seeing what takes place when chlorine is heated in contact with fluoride of aluminium, it may occur naturally to any one who thinks over the matter, that the same would be the case when sodium was heated with fluoride of aluminium or any compound containing it; and such is the fact. If we take that cryolite and heat it, the sodium lays hold of the fluorine, forming fluoride of sodium, and sets free the metal aluminium. By simply taking this substance and heating it with sodium, we get the aluminium at once.

Alumina acts the part of a base combining with various acids, and forming well-known salts. Common alum, for instance, is a double salt of alumina and potash, consisting essentially of sulphuric acid, alumina, potash and water. These salts do not much interest us at present, in a geological point of view. But alumina is not only capable of acting the part of a base, it is also capable of acting the part of an acid. We have, as the result of such action, minerals of great interest to us. It combines, for example, with magnesia. When the two are mixed together and exposed to a high temperature combination is effected. You obtain an aluminate of magnesia, and if you use such a solvent as boracic acid or borax, just in the same way as that solvent was used in the production of the alumina crystals, we obtain this combination of alumina and magnesia crystallised. In fact we have spinel, similar in all respects to natural spinel, the well-known balas ruby. You can get the same colour by adding a little chromium. You get then minute red crystals, having the same composition and the same physical characters completely as the natural spinel. Here is a specimen crystallised in this way prepared many years ago—in the year 1849—by M. Ebelmen, from whom I received it direct. Then, again, we have an aluminate of magnesia compound—spinel—coloured blue by means of oxide of cobalt. We can directly produce this beautiful gem by strongly heating a mixture of alumina and magnesia. Here are one or two other samples of these spinels. Here is the balas ruby. That is a very widely different gem from the true ruby, which is one of our brightest gems after the diamond. The one is alumina coloured by chromium; the other is a combination of alumina and magnesia, and therefore a totally different thing.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.—*March* 6.

R. Angus Smith, *Ph.D., F.R.S., President, in the chair.*

Mr. G. Sonstadt read a "*Note on the Purification of Platinum,*" which will be found in another part of our columns.

After this a paper was read "*On the Liassic and Oolitic Iron Ores of Yorkshire and the East Midland Counties,*" by Messrs. Edward Hull, F.G.S., and William Brockbank. In this paper the authors gave the results of their observations on the nature, geological position, and qualities of the iron ores which are now being worked at intervals from the banks of the Tees to that of the Evenlode in Oxfordshire, extending through the counties of York, Lincoln, Rutland, Leicester, Northampton, Warwick, Oxford, &c.; at the same time embodying the opinions of previous observers. Remarking that just at the time when some of the older iron-producing districts were giving evidence of approaching exhaustion, the enormous stores of iron ore in the newer formations were discovered; the authors commenced by a description of the geological position of the strata from which the ores are extracted, referring them to the middle lias or marlstone and the base of the great oolite; and it was shown that the ores of Cleveland in Yorkshire, Lincolnshire, and Oxfordshire are derived principally from the lias, while those of Northamptonshire are extracted from the basement beds of the great oolite, called by the Government geological surveyors "the Northampton sands." The first district described was that of the East Riding of Yorkshire and the Cleveland hills, which, within the space of about sixteen years, has given birth to the iron trade of the Tees-side, of which Middlesborough may be considered the centre. The ore is here quarried in open and tunnel-works, and brought down by rail from the hills to the furnaces, which are erected along both sides of the river, and which are supplied with fuel from the Durham coal-field. The production of this district in 1865 was stated to be nearly one million of tons of pig-iron annually, drawn from 105 furnaces in blast. The ores in the valley of the Esk, near Whitby, and those of Guisborough were then described, and particularly the Rosedale ore, which is the richest in the district, and is magnetic. A branch railway is opened to the quarries, which in 1864 yielded nearly 300,000 tons of ore, having a per centage of 35·94 to 49·17 of metallic iron. The iron-stone was then traced to the banks of the Humber, near Hull, by Stokesley, Swainby, Northallerton, Easingwold, and Market Weighton. The ores of North Lincolnshire were stated to be spread over a wide expanse of country—an area of not less than 100 square miles—having been proved to be quite close to the surface, and their local and geographical position in reference to the seaports on the one hand, and the South Yorkshire coal-field, together with the excellent quality of the iron they produced, satisfied the authors that this district was destined to rise in importance as a centre of iron manufacture. The pig-iron from North Lincolnshire is highly tenacious and fusible, and commands a higher price in the market than the Cleveland brands. This superiority appears to arise from the spathic nature of the ironstone, and from the presence of manganese in considerable quantities interstratified with the ores, and which is mixed in the furnaces. The ore, with its accompanying strata, is very finely shown along the line of railway at Frodingham; its thickness in different parts of the district varies from twelve to thirty feet. It is being smelted at three works in North Lincolnshire, and it is also carried largely by rail to the Park Gate Iron Company's furnaces, near Rotherham, and other works in the Yorkshire and Derbyshire coal-fields. From North Lincolnshire the ironstone may be traced southwards along an indented line running parallel to the western margin of the great oolite into Northamptonshire. At the base of the oolite a series of yellowish sands occur—and, in these there are at intervals beds of iron ore—sometimes extending for miles with considerable regularity, at other times thinning away rapidly. From these beds, the Northamptonshire iron is smelted. The furnaces and quarries are situated at Gayton and Blisworth, Blakesley, Maidford, and Litchborough, at which place they are more than usually ferruginous. At Duston, where it is extensively worked and smelted, it is more consolidated and is coarsely oolitic. The metal produced is similar to that of the Cleveland district in quality. Large quantities of this ironstone are sent by rail and canal into South Staffordshire and even South Wales, where it is valued for mixing with the argillaceous carbonates of the coal measures. The Oxfordshire district is as yet almost unopened, but promises one day to be productive of iron on a large scale, similar in character to the Lincolnshire brand. In the neighbourhood of Banbury and Chipping Norton, the ore occupies considerable areas—sometimes in the form of tabulated hills, intersected by valleys of no great depth. It occurs here (as already stated) in the middle lias, precisely the same formation as that to which the ores of Cleveland and Lincolnshire belong. The ironstone, however, is generally more calcareous than in the former district, and its richest portions are limited to a tract, of which the vilage of Bloxam may be considered the centre. As yet the ore has only been worked at Fawler, near Charlbury, and at Steeple Aston, to a very limited extent; but the railways, now in course of construction, will probably have the effect of bringing it within easier reach of the coal-fields of South Wales and Staffordshire. The authors remark, in conclusion, that every day's experience enlarges our acquaintance with the great mineral resources of our country, and that, in the case of coal and iron, it becomes a question which is more largely distributed and likely to outlast the other.

ACADEMY OF SCIENCES.

March 19.

M. Daubrée continued the account of his "*Synthetical Researches relative to Meteorites.*" In this part he shows that the siliceous constituents of meteorites are, for the most part, basic silicates, differing from the silicates constituting the superficial crust of the earth, but closely resembling the eruptive rocks. He supposes the masses to have been formed originally at a very high temperature, but for several reasons believes that they have crystallised at a lower temperature than in his own experiments to reproduce them. He supposes also that the fragments which reach our earth have been detached from much larger masses probably at a far distant period of time. But although long circulating in space, it is only when they reach our atmosphere that they suddenly become incandescent, by which their exterior becomes vitrified, while the interior remains unchanged. The interior, therefore, represents the state of the mass as it circulated in space. In his previous papers the author has shown that the composition of the more common meteorites may be imitated by fusing peridote Cherzolite in a reducing atmosphere. It is clear, however, that oxygen has played an important part in the formation of meteoric stones, and also, thinks the author, in the formation of all planetary bodies. This part of M. Daubrée's paper is very long, and we have only indicated the principal point. The memoir is a valuable contribution to chemical geology, and deserves a longer notice at a future time.

Signor Bizio sent a note "*On the Existence of Glycogen in invertebrate Animals.*" The author has found this substance in the oyster and other edible molluscs. Oysters yielded 9½ per cent. of their dry weight. Signor Bizio made the curious observation that the amylaceous substances in these animals undergoes fermentation with such rapidity that the lactic acid formed is sufficient to preserve the body from putrefaction. He placed a few bodies of Cardium ediole in a stove heated to 30°, and found them in full fermentation in a few hours, giving off a good deal of gas. They soon became strongly acid, and smelt like cheese. After having been kept more than a month above 16° they were perfectly fresh. He tried a similar experiment with human and bullock's liver. The former soon became strongly acid, and after seven days gave off no smell; the latter, however, soon stank. The author considers this fact of the rapid change of the amylaceous substance into lactic acid as worthy the attention of physiologists.

M. Pisani presented a note *On a New Cornish Mineral*, which he names *Chenevixite*. It is a hydrated arseniate of iron and copper.

M. Friedel described in a note *A New Mineral, Adamine*, a hydrated arseniate of zinc. The crystalline form and optical properties are described in a subsequent note by M. Des Cloiseaux.

M. Maumené contributed a third memoir "*On a General Theory of Affinity*," in which he announces the discovery of the following law, viz.,—Whenever two bodies mix or dissolve in each other before chemical action, their densities change into a common density; but the real action or affinity is always exerted between equal volumes, and consequently equal weights of the body. The author quotes a few examples in support of his law. We extract one. Millon made two mixtures:—

$$1\left\{\begin{array}{lr} \text{2 equivs. of } SO_3HO \quad . \quad . \quad . & 98 \text{ grammes.} \\ \text{1 equiv. alcohol } C_4H_6O_2 \quad . \quad . & 46 \quad ,, \end{array}\right.$$

$$2\left\{\begin{array}{lr} \text{2 equivs. } SO_3HO \;.\quad . \quad . \quad . & 98 \quad ,, \\ \text{2} \quad ,, \quad \text{alcohol} \;.\quad . \quad . \quad . & 92 \quad ,, \end{array}\right.$$

The two mixtures were exposed for a few moments to a temperature of 100°. According to ordinary notions the first should have been entirely converted into sulphovinic acid, but it only gave 54 hundredths of the acid. The second mixture, however, gave 77. M. Maumené says his theory explains this otherwise unaccountable fact, and, moreover, shows that the result was simple and inevitable.

M. Gerardin sent a note "*On a Battery of Iron Turnings*," which he thus describes:—I replace the zinc of a Bunsen's battery by iron borings: an iron bar placed in the middle of the borings serves as a réophore. The iron is placed in common water. In the porous vessel I place a solution of perchloride of iron with *aqua regia* added. The electricity of this solution is collected by a carbon serving as the positive pole. The carbon is made of powdered coke agglomerated with paraffine. Such a battery may be made of large dimensions, and a great deal of electricity obtained at small cost.

NOTICES OF BOOKS.

On the Nature, Cause, and Treatment of Tuberculosis. By Horace Dobell, M.D., &c., &c. London: Churchill and Sons. 1866.

The nature and cause of tuberculosis are beyond our province. We need only mention that Dr. Dobell considers that the cause is "defective pancreatic action" or "perverted pancreatic action," by reason of which the system is deprived of the power of properly absorbing and assimilating fat. The author's plan of treatment, therefore, consists in administering "pancreatic emulsions of solid fat, or fats acted upon by pancreatic juice, in the hope that some absorbing power for such matters may yet remain in the digestive tract;" and it seems that such treatment has been, in a large majority of cases, followed by remarkable and most favourable results. For an account of the treatment which must be conjoined with the administration of the emulsion, we must refer the reader to Dr. Dobell's book.

Pancreatic emulsion is now an article of large consumption, and its preparation by Mr. Schweitzer at Messrs. Savory and Moore's has led that gentleman to the discovery of a new and interesting fact. Lard treated with fresh and acid pancreatic secretion is readily miscible with water, so forming an agreeable emulsion. When this emulsion is treated with ether, the fat is completely separated; to all appearance unchanged. But this separated fat retains its power of emulsifying on the gradual addition of water—not with great effort, and the aid of a pestle and mortar, but by simply stirring the two together with a glass rod.

This is a most curious fact, which well deserves the attention of the chemist and physiologist. It lends a strong support to the opinion of Dr. Dobell that the pancreatic juice is a most important agent in the digestion of fat—an opinion contrary to that expressed by some physiologists, Schmidt, for example, who has stated that the pancreatic fluid is without action on fat. It proves, on the contrary, that the constitution of the fat undergoes an essential change by contact with the pancreatic secretion, the exact nature of which, however, we have yet to learn. It is not saponification, for the fat globules in the emulsion, though very minute, are clearly distinguishable and fairly uniform in size.

We mention this fact as the distinguishing character of a true pancreatic emulsion, which has, moreover, a marked acid reaction that serves to distinguish it from an emulsion made with the assistance of an alkali.

Beyond this we need only state that Dr. Dobell recommends an emulsion of beef fat or lard with the pancreatic juice of the pig. It is to be made of about the consistence of Devonshire cream, and half an ounce is to be taken as a dose three or four times a-day, or even oftener. About two ounces of fat are said to be necessary for the daily nutrition of the body, and the amount of emulsion to be taken must be regulated in conjunction with the patient's ordinary diet.

We must recommend our medical readers to study Dr. Dobell's book for themselves.

NOTICES OF PATENTS.

Crookes's Improvements in Separating Gold and Silver from their Ores. February 11, 1865. No. 391.

This invention relates to certain improvements in the method of treating the ores or substances containing gold and silver by amalgamation, and whereby those metals can be more perfectly and completely extracted and separated therefrom than by the processes hitherto adopted. A solid amalgam of sodium is in the first place formed by combining about one part of sodium with about thirty parts by weight of mercury. The solid amalgam thus formed is then added to the mercury employed for the purposes of amalgamation, the proportions varying according to the quantity of metal contained and the state in which it occurs in the ore or matrix. If, however, the proportion of the alkali metal exceeds that of one part to from 120 to 150 parts of mercury, the amalgam becomes viscid and its manipulation inconvenient. The effect of thus combining the sodium with the mercury is to impart to the latter a greater affinity for or power of adhesion to the metal under treatment than it possesses in its simple and uncombined condition. Instead of using the solid amalgam as hereinbefore mentioned, the sodium may be combined directly with the mercury employed, the proportions varying according to the requirements of the case.

This invention can be used in conjunction with any machine or apparatus for performing the amalgamating process, and in cases where amalgamating vessels or receptacles constructed of iron are employed, an additional advantage arises from the fact that mercury combined as before mentioned with sodium forms a thin film over the surface of the iron, thus collecting very minute quantities of the metal under treatment, and which may be removed by the ordinary process, and subjected to the subsequent treatment usually employed.

The mode of treatment employed is as follows:—An amalgam of sodium is in the first place formed by combining sodium with mercury. The proportions may be varied within wide limits, that is to say, from less than three to more than thirty parts of sodium to one hundred parts by weight of mercury. The sodium and mercury must be caused to unite, and the amalgam prepared with the customary precautions well known to and understood by chemists. The last-mentioned method of forming the sodium amalgam is that which I usually prefer in actual practice, but, if desired, the amalgam may be prepared electro-chemically, as described by Becquerel and other chemical authors, or by any other suitable means. The amalgam is then added to the mercury employed for the purposes of amalgamation, the proportions varying according to the quantities of precious metal contained, and the state in which it occurs in the ore or matrix; but as in the process the beneficial effects of the sodium are gradually removed, the action should be maintained, if needed, by occasionally introducing fresh supplies of the amalgam into the charge of mercury contained in the machine employed. The quantity must, however, be regulated and determined by the skill and judgment of the operator, as no definite and absolute proportion can be laid down as being necessary. If, however, the proportion of the alkali metal exceeds that of one part to from 120 to 150 parts of mercury, the amalgam becomes viscid, and its manipulation may be inconvenient. The effect of thus combining the sodium with the mercury is to impart to the latter a greater affinity for or power of adhesion to the precious metal under treatment than it possesses in its simple and uncombined condition, so that it will readily amalgamate with the gold or silver, even when the latter metals are soiled by grease or other extraneous matter. Although I prefer that the amalgamation shall be conducted in the presence of water, as in the usual processes, the operation, if desirable, may be performed in a dry manner. I should here state that the amalgam above mentioned should be stored in air-tight vessels, or under naphtha, such as metallic sodium is usually kept in. Instead of using the amalgam as hereinbefore mentioned, the sodium may be combined directly with the mercury employed, care being taken that the proportions shall remain substantially as already indicated.

This invention can be used in conjunction with any machine or apparatus for performing the amalgamating process, and, in cases where amalgamating vessels, or receptacles or plates constructed of iron or other metal employed, an additional advantage arises from the fact that the mercury combined as before mentioned with sodium forms a thin film over the surface of the iron or other metal, thus aiding in the collection of any minute quantities of the precious metal under treatment. The subsequent extraction of the gold or silver from the mercury may be conducted in any desirable manner. I may mention that I do not find in actual practice that a small quantity of sodium, if accidentally allowed to remain in the mixture of gold or silver and mercury, affects the subsequent treatment in any appreciable degree. In cases where, from the nature of the ores or substances under treatment, the mercury used for amalgamation becomes divided into minute globules, technically known as "flouring" or "granulating," there is frequently a difficulty in separating the globules from the heavy particles of the powdered ore or substances containing the precious metal; the addition of the sodium amalgam to such a mixture is found to induce the coalescence of the liquid or viscid metallic particles, so that a mechanical separation of the gold or silver amalgam from the gangue may be readily affected. The employment of sodium in combination with mercury will especially be found beneficial in cases where gold or silver occurs with pyrites, sulphurets, or minerals containing arsenic, antimony, tellurium, or bismuth. The process of amalgamation with ordinary mercury is difficult to perform in the presence of such minerals without great loss both of mercury and of the precious metal under treatment, owing to the surfaces of the latter being in such a tarnished or soiled state that mercury alone will not touch them (as, for instance, when gold exists in pyrites), and also owing to the mercury becoming what is technically termed "sick" or "floured," in which state its power of uniting with the precious metals is much diminished; in these cases the addition of sodium amalgam will be found highly advantageous. I should here also observe that whenever the mercury has become "floured" or powdered by the result of distillation, or from any other cause, it is readily restored to the liquid or bright metallic state by the addition thereto of sodium, either in its simple metallic condition, or as an amalgam with mercury.

Although I have hereinbefore mentioned sodium as being used in the processes above described, other alkali metals, such as potassium and lithium, and other metals strictly analogous thereto in their chemical and physical characters, may be employed in lieu thereof in combination with mercury for the purposes of this invention.

Having thus fully declared and ascertained the nature of my said invention, and the manner in which it is to be performed, I would observe, in conclusion, that what I consider novel and original, and therefore claim as constituting my said invention, is, the employment of an amalgam of sodium, or such other alkali metal as aforesaid, in treating ores or substances containing gold or silver for the extraction and separation therefrom of the precious metals, as hereinbefore substantially set forth and described.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

3248. T. Parker, St. Mary Axe, London, "Producing an oxy-hydro-magnesium light applicable to photographic purposes, to lighthouses, and to other illuminations."—A communication from P. Carlevaris, Genoa, Italy.—Petition recorded December 5, 1865.

189. W. E. Gedge, Southampton Buildings, Chancery Lane, "Improved preparations of the plant known as the coca, to permit its incorporation with confectionery of all kinds, syrups, and liqueurs, and its use for dyeing."—A communication from F. Boutellas-Desmoulins, Passage des Petites Ecuries, Paris.—January 20, 1866.

478. J. Young, Limefield, Mid Lothian, "Improvements in distilling coal, shale, and other substances."—February 15, 1866.

498. E. J. C. Welch, Harrow, Middlesex, "Improved apparatus for carburetting air and gas."—February 16, 1866.

627. W. Weldon, Park Villa, Highgate, "A new process for obtaining soda from common salt."

629. W. Weldon, Park Villa, Highgate, "Improvements in the manufacture of soda from common salt."—March 1, 1866.

663. W. A. Vérel, Haugh, Stirling, N.B., "An improved apparatus for distilling petroleum and the oils obtained from coal, shale, and other substances."

667. J. Gray, Glasgow, N.B., "Improved preparations for acting upon sea-water, or upon hard or impure water, in order to render such water more suitable for use in boilers and otherwise."

669. T. Clayton, Manchester, "Improvements in apparatus employed in producing illuminating gas from inflammable and volatile liquids."—March 5, 1866.

683. J. Norman, Glasgow, N.B., "Improvements in apparatus for reburning and in apparatus for washing animal charcoal or charcoal substitutes."—March 6, 1866.

729. R. Larkin, Old Brompton-road, Middlesex, "Improvements in means or apparatus for obtaining light by the combustion of magnesium."—March 9, 1866.

753. W. F. Deane, Farnworth, Lancashire, "Certain improvements in the treatment and utilisation of the residual liquor arising from the production of chlorine gas."—March 13, 1866.

NOTICES TO PROCEED.

2897. T. Whitwell, Stockton-on-Tees, "Improvements in furnaces for heating the blast for blast furnaces."—Petition recorded November 10, 1865.

2965. 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."—November 17, 1865.

2993. A. C. St. Paul de Sinçay, Boulevart Saint Martin, Paris, "Improvements in the manufacture of sulphur by the reduction of the sulphurous acid accruing from the roasting of sulphuretted ores, and in apparatus for the same."—November 21, 1865.

2998. W. Wells, Manchester, and S. Marland, Clayton, near Manchester, "Improvements in apparatus for obtaining artificial light from volatile liquids or fluids."—November 22, 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.—November 27, 1865.

3078. W. Clark, Chancery-lane, "Improvements in the manufacture of materials for decoloring sugar and other saccharine matters."—A communication from C. J. Gaade, Boulevart St. Martin, Paris.—November 30, 1865.

330. G. Gwynne, Mortimer-street, Cavendish-square, Middlesex, "Improvements in treating fatty and oily bodies."—February 2, 1866.

594. W. E. Gedge, Wellington-street, Strand, "An improved process for extracting the juice from sugar-cane, beetroot, and other plants."—A communication from F. J. V. Minchin, Aska, Madras Presidency, India.—February 27, 1866.

CORRESPONDENCE.

Continental Science.

PARIS, March 24.

THE rumour which you helped to spread abroad that Schönbein has succeeded in isolating ozone and antozone, attracted, it seems, the notice of the Scientific Association of France, and that learned body invited Schönbein to come to Paris and exhibit his experiments to the wondering gaze of Parisian *savans*. Schönbein's reply gives us the exact state of his knowledge or belief on the subject, and is worth communicating to English chemists. He says that he has been engaged almost exclusively, and without interruption, in the study of oxygen for thirty years, and during this time he has discovered a number of facts which allow of his drawing the following conclusions:—1. That oxygen may exist in three different allotropic states; 2. Two of these states are active, and opposed one to the other; he designates one of them ozone, and the other antozone; 3. Equal quantities of ozone and antozone neutralise each other to form ordinary neutral or inactive oxygen; and 4. Ordinary neutral oxygen may be split up or transformed, half into ozone and half into antozone. The experimental demonstration of the truth of these conclusions, however, he admits, is not so simple—as, for example, the composition and decomposition of water; and he adds that the experiments necessary for their logical deduction would occupy more time than could be devoted to a single lecture. "Some scientific journals," says Schönbein, "have been badly informed when they asserted that I had succeeded in isolating ozone and antozone in a state of purity. The assertion is without foundation. It is true that for a long time I have made a great number of attempts to arrive at this desirable end, but always without complete success. Ozone and antozone are always mixed with neutral oxygen from causes closely associated with the generation of the two active modifications." The Professor concludes his letter by offering to come to Paris, should it still be desired, and if his health permit, and give a short course illustrative of the whole subject. It is to be hoped he will be invited, and while here, perhaps he might be induced to go on to London, which I do not think he has visited since the year he announced his discovery of ozone.

Have you heard anything of a discovery said to have been made by Mr. Carey Lea, who has found that a plate prepared with chemically pure iodide of silver will give a picture of any object simply pressed upon it in the dark? The picture is developed by the ordinary agents in the usual way. If it be true, this is a most extraordinary discovery, and will lead to most important conclusions.

The Count De la Tour DuPin has given a valuable hint to tobacco smokers. It is a current opinion that the most expensive tobaccos contain the least nicotine; and the Count gives us a plan by which a man may smoke *caporal* and only get the effects of the best Havanah. It is very simple. Only place somewhere between the pipe-bowl and your mouth, so that it may be traversed by the smoke, a pledget of cotton wool soaked in a solution of tannic or citric acid, and that will arrest the greater part of the nicotine. According to the experiments of the Count, the proportion of nicotine in the original smoke to that in the smoke after it has passed through the cotton is as 7 to 2. Your London youths may thus, you see, puff the strongest Hamburgh cavendish, and only feel the effects of Maryland, to the great improvement of their digestive organs and their personal comfort.

Stories improve vastly by travelling. There is one in *Les Mondes*, for which I fancy your use of an almost obsolete word is responsible. It is quite natural to suppose that "*liver catsup*" means *cat's liver soup*, which is evidently the interpretation here put upon the words; for I read that it has been recently proved that in a large cookshop (*établissement alimentaire*) in London of great renown there is made every day an enormous quantity of a soup which has become very popular, and which is simply made of the half-putrid livers of cats ! ! This is, I take it, the Parisian version of the liver-ketchup or catsup story, and a very amusing version it is.

Adulteration of Saffron.

To the Editor of the Chemical News.

Sir,—My Chemical News does not reach me regularly, or I should have pointed out before that the adulteration of saffron described by Professor Bentley at the February meeting of the Pharmaceutical Society had already been discovered and exposed by Guibourt; an abstract of whose paper will be found in the Chemical News for November 12, 1864. The saffron in question was examined by Decaisne, who states, however, that the dyed stamens belong to *Crocus Vernus*, and not *Sativus*. I am, &c.

A Reader.

March 12.

MISCELLANEOUS.

Royal Institution of Great Britain.—The following are the arrangements for the ensuing week :—Monday, April 2, at 2 o'clock, general monthly meeting.

Chemical Society.—The following is the list of officers elected on March 29 :—*President :* W. A. Miller, M.D., F.R.S. *Vice-Presidents who have filled the office of President :* Sir B. C. Brodie, F.R.S. ; C. G. B. Daubeny, M.D., F.R.S. ; Thomas Graham, F.R.S. ; A. W. Hofmann, 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 :* F. A. Abel, F.R.S. ; Walter Crum, F.R.S. ; Warren De la Rue, Ph.D., F.R.S. ; John Stenhouse, LL.D., F.R.S. *Secretaries :* William Odling, M.B., F.R.S. ; A. Vernon Harcourt, M.A. *Foreign Secretary :* E. Frankland, Ph.D., F.R.S. *Treasurer :* Theophilus Redwood, Ph.D. *Other Members of the Council :* F. Crace Calvert, F.R.S. ; Dugald Campbell ; W. Crookes, F.R.S. ; H. Debus, Ph.D., F.R.S. ; F. Field, F.R.S. ; G. C. Foster ; E. A. Hadow ; H. Letheby, Ph.D. ; Hugo Müller, Ph.D. ; H. M. Noad, Ph.D., F.R.S. ; W. J. Russel, Ph.D. ; Maxwell Simpson, Ph.D., F.R.S.

The Brighton Poisoning Case.—Mr. Noakes surrendered to take his trial a few days ago at Lewes. He was, of course, acquitted. The facts of the case will be fresh in the memory of our readers. Mr. Noakes was called on to supply a customer with tincture of henbane whom he was in the habit also of supplying with tincture of aconite. By inadvertence tincture of aconite was put into a bottle labelled "Tincture of henbane, 30 drops for a dose." A dose was unfortunately taken, and it proved fatal to an old gentleman, who was near his end from advanced heart disease. Mr. Noakes is a highly respectable man, a member of the Society of Friends, and no suspicion of ordinary carelessness could attach to him, and yet there was no room to doubt the fact of his having made the mistake. Such mistakes, we fear, will be made occasionally to the end of time.

Employment of the Micro-Spectroscope for Medico-Legal Purposes.—Dr. Bird Herapath, F.R.S., has examined the hatchet supposed to have been used in the Aberdare murder. The examination was to ascertain whether there were blood-stains upon it ; in doing this he resorted to the microscope, the spectroscope, and chemical analysis. He first examined the metallic portion, upon which he found no reliable stains of blood. He then removed the handle, and experimented upon thin slices of the wood cut from that part underneath the metallic ring. By the microscope stains were detected, the majority of which were due merely to oxide of iron, but some of them, however, showed clotted blood ; moreover, in some cases the woody portions had been infiltrated with the colouring matter of blood changed by the action of water. On some of the sections of the handle, blood globules were detected. A section of the handle was then put into a glass vessel with a fluid medium, and the blood globules floated off ; by the aid of the micrometer they were measured. Some dried globules of human blood were procured, placed in the same apparatus, and tested in the same way. The globules obtained from the hatchet-handle agreed exactly in size. More numerous sections of the handle were made and placed in distilled water—a slightly coloured solution was obtained, which was examined by a micro-spectroscope made by Mr. J. Browning. The solution produced two dark bands within the green and on the border of the yellow rays. Only one other substance—cochineal dissolved in ammonia—would produce two dark bands ; but the position of the bands would be different. Dr. Herapath says that from this test he was satisfied the sections of the handle had been stained with blood, and that chemical analysis confirmed this optical test.

Preparation of Formyl (or Acetylene).—Kletinsky fuses together under naphtha 25 grammes of mercury and 10 grammes of potassium. The dried amalgam rubbed to powder and heated in a flask with 10 grammes of pure chloroform sets free a litre of formyl ȻH. According to Fittig, the so-called formyl is always acetylene. —*Zeitsh. f. Chem.*, 127.

Chemical Quality of London Gas, Past and Present.—In his report on the illuminating power and chemical quality of the gas supplied to the City of London during the year 1865-66, Dr. Letheby makes the following remarks :—"The chemical quality of the gas has, in one particular, been rarely equal to the requirements of the Act of Parliament. I allude to the excessively large amount of sulphur which has been almost always present in the gas supplied to the City ; and you will observe in the following table that the proportions of sulphur in the gas have been larger and larger with every succeeding quarter of the year :—

Amount of Sulphur in the Gas Supplied to the City.

Name of the Company.	Quarters ending in	No. of Experiments.		Grs. of Sulphur per 100 cubic ft.		
		Total.	In excess.	Max.	Min.	Average.
City of London	May . .	59	7	22·5	14·2	17·5
	August .	51	10	25·0	15·5	18·7
	November	55	19	25·1	16·4	19·5
	February .	55	51	28·2	18·0	22·7
	Year .	220	87	28·2	14·2	19·6
Chartered .	May . .	59	12	24·6	13·0	19·0
	August .	51	21	26·3	14·6	19·6
	November	55	34	28·4	15·7	21·5
	February .	59	59	30·7	20·8	24·7
	Year .	224	126	30·7	13·0	21·2
Great Central .	May . .	55	51	28·0	19·5	23·7
	August .	51	51	32·1	21·8	25·8
	November	55	52	30·3	19·2	22·7
	February .	59	58	32·9	14·4	24·3
	Year .	220	212	32·9	14·4	24·1

It is thus seen that the amount of sulphur in the gas of the City Company has ranged from 14·2 grains per 100 cubic feet to 28·2—the average being 19·6 grains ; in the Chartered gas it has ranged from 13 grains to 30·7—the average being 21·2 ; and in the Great Central it has fluctuated from 14·4 grains to 32·9—the average being 24·1. You will also notice that of the 220 experiments made on each of the companies' gas during the year there were 87 occasions with the City Company, 126 with the Chartered, and 212 with the Great Central when the proportions of sulphur were excessive, making a total of 425 out of 664 occasions when the requirements of the Act of Parliament were not fulfilled. I have already reported to you that such amounts of sulphur were not found in the gas of the city companies before the passing of the Metropolis Gas Act of 1860, and that the following were the proportions obtained with the same instruments from 1853 to 1859:—

	Amount of sulphur per 100 cubic feet of gas.
Great Central Company . . .	16·4 gr.
Chartered Company . . .	21·5 „
Commercial Company . . .	17·1 „
Average . . .	18·3 „

And I may further state that I have examined the gas of twenty-four of the towns of England, and have ascertained that the proportions of sulphur rarely reach to 20 grains in the 100 cubic feet; in nineteen instances it was below 15 grains, and in seven instances below 10 grains. It is clearly, therefore, possible for the City companies to comply with the requirements of the Act of Parliament; indeed, I may say, that for a whole year, namely, from September, 1864, to September, 1865, the weekly average of sulphur in the gas of the City Company was only on six occasions above the proportion sanctioned by Parliament; and the average for the several quarters of that year was but 18·3 grains. The two causes which are chiefly concerned in the excess of sulphur in the gas supplied to the City are—1. The presence of pyrites in undue quantity in the coal; and 2. The imperfect purification of the gas. While the gas of the City Company was so free from sulphur, the greatest care was taken to remove the pyrites from the coal; and in proof of the imperfect purification of the gas, I may state that I have had no difficulty in removing much of the sulphur from the so-called purified gas supplied to the public. By first giving the gas a little ammonia, and then passing it through a small bottle of what is called dry lime, the bisulphide of carbon and ammonia are mutually decomposed, and the two together form, with the lime, sulpho-cyanide and sulphide of calcium. This reaction is so simple, and at the same time is so certain, that it indicates the possibility of removing a larger portion of sulphur from the gas; and this is not merely a laboratory result, for it has been tried on a very large scale at the gas works at Nottingham, by Mr. Hawksley, whose experiments at your instance are now so nearly completed that they will ere long be the subject of a valuable report to you. In reviewing, therefore, the whole of these facts, I am led to conclude that the main cause which has operated in lowering the chemical quality and illuminating power of the gas of this metropolis, is the substitution of oxide of iron for hydrate of lime as a purifying agent; for not only does the former substance fail to remove the more complex sulphur compounds from the gas, but it also fails to absorb carbonic acid; and thus the gas is both chemically impure and of lowered illuminating power. In former times, when hydrate of lime was the purifying agent, and so also where it is still used in the towns of England, the purity and illuminating power of the gas, from the same coals, are higher than they are in London, but I will not pursue this matter further than by saying it will soon be the subject of a special report by Mr. Hawksley."

In another part of the report, Dr. Letheby shows that the illuminating power of the gas supplied by the Great Central Company is lower than it was before the passing of the Metropolitan Gas Act of 1860. It is to be hoped that the working of this Act will undergo a thorough investigation before the Select Committee of the House of Commons, which is just about to sit.

Oxychloride of Chromium.—Dry chromate of chloride of potassium fused in a crucible gives together with KCl and KO_2CrO_3 beautiful, glistening, bronze-coloured scales of Cr_2O_3. The same salt dissolved in strong hydrochloric acid and evaporated to dryness yields a beautiful violet-coloured residue of KCl and oxychloride of chromium Cr_2O_3,Cr_2Cl_3.—*Kletinsky, Zeitsch. f. Chem.*, p. 127.

Adulteration of Butter.—Our contemporary, *The Grocer*, publishes the following, which is forwarded by Mr. Frith, in return for a fee of five shillings. It is copied from the original, *verbatim et literatim*:—

" Chemical
" Laborotory,
" London, Mar. 8.

" Sr. I am in reciept of your note of yesterday and have much pleasure in forwarding you my process for Adulterating Butter. I describe the process as conducted in the laborotory; of course the practical man will adapt his arrangements to suit the scale of his operations. To begin with the ingredients are Genuine Butter, potatoes, and fat; the following table estimates the articles at their highest prices; the prcent. of butter might be increased if a superior butter was required, or vice versa, but experience will be the best guide:—

	P. cent.	ozs.	cost.
Butter	50	8	7½
Fat	20	3¼	1
Potatoes	29	4½	½
Salt	1	¼	
	100	16 oz.	9d.

" The Butter that is best is Irish or American inferior quality to that mentioned might be used The fat I recommend is Beef or mutton (and to be melted most careful at a low temperature so as not to burn, and in an earthen or enamelled vessel as Iron would be partially decomposed by the heat and fat and produce a disagreeable taste and smell when melted stir into it about 25 p. cent. of water, which will carry of any impurities held in solution; then set it to cool. The potatoes to be the best to be got the floury sort are best carefully peel and cook them then while still warm rub them thro a fine seiv, so that their cannot possibly be any lumps; the whole articles are now to be carefully conglomerated together the potatoes still warm but the butter and fat cold especial care must be taken here that each substance is lost in the other as apon this part of the operation depends the chance of detection the butter must not be any warmer than mixing it renders it if melted though it may mix or blend better it becomes grainy pack it while Still Soft in the Tubs or vessels used for storing it and when cold it will cut out beautiful wishing you sucess,

"I am, Sir, Your Respt.,
" W. A. Frith."

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.

A. W. W.—Ure's Dictionary has a very good account.

B.—The line is rendered visible by receiving the spectrum on a fluorescent screen.

J. B.—It is difficult to say which is the best. The work of Pelouze and Frémy for some things.

G. T. G.—Only suspended. You need be in no fear that the work will be left incomplete. It is found impossible to get the matter for a regular issue.

W. L. R.—Evaporate the solution until a pellicle forms, and then set it aside. Iron pans will do.

R. D.—The most important point, Mr. Broughton has informed us, is to use quite pure oleate of soda. With this the proportions originally published answer very well.

G. L.—The spectroscope is the best and readiest means of detecting the presence. The quantitative separation is described in the paper referred to.

Books Received.—"Vaccination: a Remonstrance respecting the Vaccination Bill of 1866," by George S. Gibbs.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

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

PART II.

THEORY OF TYPES AND ATOMICITY.

SECTION III.—*Atomicity of the Compound Radicals.*

(Continued from page 109.)

Saturation.—A considerable number of carbides of hydrogen are known. Now, experience teaches us that in none of these bodies does the proportion of this element exceed that indicated by the general formula

$$\text{Є}_nH_{2n+2}.$$

Thus the carbides richest in hydrogen that are known are the following:—

$\text{Є}H_4$	Hydride of	methyl.
Є_2H_6	„	ethyl.
Є_3H_8	„	propyl.
Є_4H_{10}	„	butyl.
Є_5H_{12}	„	amyl.
Є_6H_{14}	„	hexyl.
Є_7H_{16}	„	heptyl.
Є_8H_{18}	„	oxtyl.
Є_9H_{20}	„	nonyl.
$\text{Є}_{10}H_{22}$	„	decyl.

These carbides of hydrogen are called saturated because they cannot enter into direct combination with any other element. Taken as a whole, they are quite indifferent; they can only be modified by substitution.

Let us take the hydride of propyl Є_3H_8. Bromine can only react on this body on condition of taking away some of its hydrogen.

$$\text{Є}_3H_8 + Br_2 = \text{Є}_3H_7Br + BrH.$$

In this first reaction the body Є_3H_8 acts as an hydride Є_3H_7H; the group Є_3H_7 has passed intact from the primitive carbide of hydrogen into the brominated compound Є_3H_7Br. The latter is saturated like the former; the sum of the atoms of hydrogen and bromine is equal to 8. It acts like the bromide of a radical Є_3H_7, and we see that this radical is derived from the saturated carbide Є_3H_8 by subtracting 1 atom of hydrogen. This being removed, the remainder, $\text{Є}_3H_7 = \text{Є}_3H_8 - H$, is no longer saturated. It acts as a mono-atomic radical; it can replace 1 atom of hydrogen, it can also combine with 1 atom of hydrogen, or with the equivalent of 1 atom of hydrogen—for example, 1 atom of chlorine, of bromine, of iodine, of cyanogen, of amidogen, of propyl, &c. Its saturation is then complete. The following compounds in which it enters are all saturated:—

$(\text{Є}_3H_7)'Cl$	Chloride of propyl.
$(\text{Є}_3H_7)'Br$	Bromide of propyl.
$(\text{Є}_3H_7)'I$	Iodide of propyl.
$(\text{Є}_3H_7)'(H\Theta)'$	Propylic alcohol.
$(\text{Є}_3H_7)'Cy$	Cyanide of propyl.
$(\text{Є}_3H_7)'(H_2N)'$	Propylamine.
$(\text{Є}_3H_7)'(\text{Є}_3H_7)'$	Free propyl.

The carbide Є_3H_6, propylene, differs from the saturated carbide Є_3H_8 by containing 2 atoms less hydrogen. To complete its saturation it is then necessary for it to combine with the equivalent of 2 atoms of hydrogen. We know, in fact, that it can combine directly with 2 atoms of chlorine or bromine

$(\text{Є}_3H_6)''$	Propylene.
$(\text{Є}_3H_6)''Cl_2$	Chloride of propylene.
$(\text{Є}_3H_6)''Br_2$	Bromide of propylene.

It has then a combining power equal to 2 atoms of hydrogen, and it can replace 2 atoms of hydrogen. This is expressed by saying that it acts as a diatomic radical. In the following compounds it takes the place of 2 atoms of hydrogen.

$(\text{Є}_3H_6)''(H\Theta)_2$ Propylglycol.*
$(\text{Є}_3H_6)''(NH_2)_2$ Propylene-diamine.

Now, supposing the saturated carbide Є_3H_8 to lose 3 atoms of hydrogen, then to complete its saturation it must combine with the equivalent of 3 atoms of hydrogen; it must be able to replace 3 atoms of hydrogen; in a word, it must be able to function as a triatomic radical. It acts thus in the following compounds:—

$(\text{Є}_3H_5)'''Cl_3$ Trichlorhydrine.
$(\text{Є}_3H_5)'''Br_3$ Tribromhydrine.
$(\text{Є}_3H_5)'''(H\Theta)'Cl_2$ Dichlorhydrine.
$(\text{Є}_3H_5)'''2(H\Theta)'Cl$ Monochlorhydrine.
$(\text{Є}_3H_5)'''3(H\Theta)'$ Glycerine.

In short, the atomicity of a hydrocarbon radical depends upon its state of saturation. For each atom of hydrogen that is removed from the saturated hydrocarbon, the residue or remainder, which acts as a radical, advances a step in atomicity.

Є_3H_8 Saturated hydrocarbon.
$\text{Є}_3H_8 - H = (\text{Є}_3H_7)'$ Monoatomic radical propyl.
$\text{Є}_3H_8 - H_2 = (\text{Є}_3H_6)''$ Diatomic radical propylene.
$\text{Є}_3H_8 - H_3 = (\text{Є}_3H_5)'''$ Triatomic radical glyceryle.

These considerations are of great importance, and it is advisable to define them clearly and to generalise them.

Hydrogen combines, as we know, with 1 atom of chlorine, 1 atom of bromine, &c. It is a monatomic element; it has a combining power represented by 1; it represents a unit of combination or affinity. Every time, then, that we remove from any combination whatever, that is saturated, 1 atom of hydrogen or a monoatomic element like hydrogen, or a group equivalent to 1 atom of hydrogen, we lessen by one unit the sum of the affinities which reside in all the elements of this combination and which are there satisfied. The residue or remainder then acts like a monatomic radical. And again, if we remove from any saturated compound 2 atoms of hydrogen, or chlorine, &c., the remainder will act as a diatomic radical.

Here are some examples:—

$$H_2\Theta - H = (H\Theta)'.$$
$$H_3N - H = (H_2N)'.$$

Amidogen.

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* This formula differs nothing from the typical formula

$$\left.\begin{matrix}(\text{Є}_3H_6)'' \\ H_2\end{matrix}\right\} \Theta_2$$

This latter would express that propylene is substituted for two atoms of hydrogen. The other formula would rather imply the analagous idea that propylene has a combining power = 2. In fact, each of the groups $H\Theta$ equals 1 atom of hydrogen, since they require H to form water. The residue $(H\Theta)' = H_2\Theta - H$ acts as a monoatomic radical. With regard to this, it may be useful to add that this residue in no way represents oxygenated water, as certain chemists declare. The latter is $H_2\Theta_2 = (H\Theta)'(H\Theta')$, and contains the remainder of *two* molecules of water which have lost two atoms of hydrogen $H_4\Theta_2 - H_2$.

† I think I was the first to express the idea that the atomicity of a hydrocarbon radical depends upon the amount of hydrogen that this radical has lost. The following is a remark I made in April, 1855, (*Annales de Chemie et de Physique*, 3rd series, vol. xliii., p. 492), in a note in which, for the first time, the radical Є_3H_5 was considered as triatomic:—"If we express the constitution of propylic alcohol by the formula

$$\left.\begin{matrix}C_6H_7 \\ H\end{matrix}\right\} O_2,$$

in which the radical C_6H_7 replaces 1 equivalent of hydrogen, we see then that the group $C_6H_5 = C_6H_7 - H_2$ can replace 3 equivalents of hydrogen, and thus form the junction between 3 molecules of water."

$$\underset{\text{Nitric acid.}}{NH\Theta_3 - (H\Theta)'} = \underset{\text{Hyponitride.}}{(N\Theta_2)'}.$$

$$\underset{\text{Chloracetic acid.}}{\text{Ȼ}_2H_3Cl\Theta_2 - Cl} = \underset{\text{Oxacetyle.}}{(\text{Ȼ}_2H_3\Theta_2)'}.$$

$$\underset{\text{Acetic acid.}}{\text{Ȼ}_2H_4\Theta_2 - (H\Theta)'} = \underset{\text{Acetyle.}}{(\text{Ȼ}_2H_3\Theta)'}.$$

$$\text{Ȼ}_2H_4Br_2 - Br = \underset{\text{Bromethyle.}}{(\text{Ȼ}_2H_4Br)'}.$$

$$\underset{\text{Glycol.}}{\text{Ȼ}_2H_6\Theta_2 - (H\Theta)'} = \underset{\text{Oxethyle.}}{(\text{Ȼ}_2H_5\Theta)'}.$$

$$\underset{\substack{\text{Chloride of}\\ \text{carbonyle.}}}{(\text{Ȼ}\Theta)Cl_2 - Cl_2} = \underset{\substack{\text{Carbonyle}\\ \text{(carbonic oxide).}}}{(\text{Ȼ}\Theta)''}.$$

$$\underset{\text{Oxalic acid.}}{\text{Ȼ}_2H_2\Theta_4 - 2(H\Theta)'} = \underset{\text{Oxalyle.}}{(\text{Ȼ}_2\Theta_2)''}.$$

$$\underset{\text{Succinic acid.}}{\text{Ȼ}_4H_6\Theta_4 - 2(H\Theta)'} = \underset{\text{Succinyle.}}{(\text{Ȼ}_4H_4\Theta_2)''}.$$

$$\underset{\text{Succinic acid.}}{\text{Ȼ}_4H_6\Theta_4 - H_2} = \underset{\text{Fumaric and malic acids.}}{(\text{Ȼ}_4H_4\Theta_4)''}.$$

$$\underset{\text{Pyro-tartaric acid.}}{\text{Ȼ}_5H_8\Theta_4 - H_2} = \underset{\substack{\text{Citraconic acid and}\\ \text{isometric forms.}}}{(\text{Ȼ}_5H_6\Theta_4)''}.$$

$$\underset{\text{Alcohol.}}{\text{Ȼ}_2H_6\Theta - H_2} = \underset{\text{Aldehyde.}}{(\text{Ȼ}_2H_4\Theta)''}.$$

Reciprocally, the atomicity of a residue or of a radical will diminish a step by each addition of an atom of hydrogen, or, in general, of an element or group representing a unit of combination.

$$(\text{Ȼ}\Theta'' + H = (\text{Ȼ}\Theta H)'$$
$$(\text{Ȼ}_2H_4)'' + H = (\text{Ȼ}_2H_5)'$$
$$(\text{Ȼ}_2H_4)'' + Br = (\text{Ȼ}_2H_4Br)'$$
$$(\text{Ȼ}_2H_4)'' + (H\Theta)' = (\text{Ȼ}_2H_5\Theta)'$$
$$(\text{Ȼ}_2H_5)' + \Theta'' = (\text{Ȼ}_2H_5\Theta)'$$
$$(\text{Ȼ}_3H_5)''' + \Theta'' = (\text{Ȼ}_3H_5\Theta)'$$
$$(\text{Ȼ}_2H_2)^{iv} + Br_2 = (\text{Ȼ}_2H_2Br_2)''.$$

It will be useful to define the functions that these so-formed remainders or residues can fulfil, either as groups possessing a certain substitution value, or as radicals properly so-called, capable of entering into direct combination. These considerations will give us an opportunity, not only of entering further into the notion of the atomicity of the radicals, but also of defining the meaning, at present rather vague, of the word radical.

We must first observe that none of the monatomic remainders or radicals, hydrocarbons or otherwise, that we have hitherto considered, exist in a free state; the same remark applies to the triatomic radicals, and in general to the (carburetted) organic radicals of uneven atomicity. The radicals which are of even atomicity, on the contrary, such as ethylene and its homologous compounds, and carbonyle, can exist in a free state and enter into direct combination with the elements. This is a consequence of the atomicity of the elements, as we shall prove further on. For the time being we will merely state the fact; the monatomic radicals, as such, do not exist in a free state. To become free they must combine, in a manner, with themselves; their molecule is double, like that of the monatomic elements themselves. Thus if we remove H from Ȼ_2H_6, we have a residue $(\text{Ȼ}_2H_5)'$ whose value of combination and substitution = 1, and which therefore can replace one atom of the hydrogen in water; but directly it is set free this group combines with itself to form free ethyl—

$$\text{Ȼ}_2H_5 + \text{Ȼ}_2H_5 = \text{Ȼ}_4H_{10},$$

a saturated combination. Similarly if from water

$$\left.\begin{matrix}H\\ H\end{matrix}\right\}\Theta$$

we remove H, the remainder $(H\Theta)'$ possesses a substitution value = 1. In oxygenated water $H_2\Theta_2$ this residue or remainder is contained twice; it is in a manner combined with itself—

$$H_2\Theta_2 = \left\{\begin{matrix}(H\Theta)'\\ (H\Theta)'\end{matrix}\right.$$

The group $(H\Theta)'$ equals a unit of combination; so it is represented in the preceding table in the same way as hydrogen, chlorine, bromine, &c.

The oxacetyle remainder:

$$(\text{Ȼ}_2H_3\Theta_2)' = \text{Ȼ}_2H_3Cl\Theta_2 - Cl$$

which represents chloracetic acid minus chlorine, acts as a monoatomic radical; it enters as such into the formula—

$$\left.\begin{matrix}(\text{Ȼ}_2H_3\Theta_2)'\\ H\\ H\end{matrix}\right\}N$$

which expresses the composition of glycol. By producing this body under the influence of ammonia, according to the beautiful reaction discovered by M. Cahours, the chloracetic acid acts, in reality, like the chloride of the monoatomic radical oxyacetyle:

$$\underset{\text{Chloracetic acid.}}{[\text{Ȼ}_2H_3\Theta_2]'Cl + \left.\begin{matrix}H\\ H\\ H\end{matrix}\right\}N} = HCl + \underset{\text{Glycocol.}}{\left.\begin{matrix}[\text{Ȼ}_2H_3\Theta_2]'\\ H\\ H\end{matrix}\right\}N}$$

It acts in the same way when it is transformed, under the influence of potash, into glycolic acid, according to MM. R. Hoffmann and Kekulé:

$$\underset{\substack{\text{Chloracetic}\\ \text{acid.}}}{[\text{Ȼ}_2H_3\Theta_2]'Cl} + \left.\begin{matrix}H\\ K\end{matrix}\right\}\Theta = \underset{\substack{\text{Glycolate of}\\ \text{potassium.}}}{\left.\begin{matrix}[\text{Ȼ}_2H_3\Theta_2]'\\ K\end{matrix}\right\}\Theta} + HCl.$$

Fumaric and malic acids‡ differ from succinic acid by containing two atoms less hydrogen, and if the latter acid be saturated, as everything seems to prove, the other two can only arrive at a state of saturation by combining with two elements or with two groups representing two units of combination. Thus, according to the beautiful researches of M. Kekulé, they can absorb directly either two atoms of hydrogen to form succinic acid, or three atoms of bromine to form dibromosuccinic acid. As M. Kekulé has shown, there is between fumaric acid and dibromosuccinic acid exactly the same relation as between ethylene and bromide of ethylene.§

$$\underset{\substack{\text{Fumaric}\\ \text{acid.}}}{(\text{Ȼ}_4H_4\Theta_4)''} + Br_2 = \underset{\substack{\text{Dibromosuccinic}\\ \text{acid.}}}{\text{Ȼ}_4H_4\Theta_4Br_2}$$

$$\underset{\text{Ethylene.}}{(\text{Ȼ}_2H_4)''} + Br_2 = \underset{\substack{\text{Dibromide of}\\ \text{ethylene.}}}{\text{Ȼ}_2H_4Br_2}$$

Ethylene and fumaric acid combine directly with bromine to become saturated; they each act the part of a radical in this reaction.

The same remarks apply to citraconic, itaconic, and mesaconic acids, which differ from pyrotartaric acid by two atoms of hydrogen, and which can combine directly with two atoms of bromine.‖

We might extend these considerations to a great number of other compounds that are not saturated. Let it suffice us to show by some examples that a number of reactions, to all appearance the most diverse, have in reality a great likeness, when considered from the general point of view we have just explained, and which esta-

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‡ See list on page 157.

§ *Annales de Chimie et de Physique*, 3rd series, vol. lxiii., p. 371.

‖ Kekulé, *Annales de Chimie et de Physique*, 3rd series, vol. xlv., p. 117.

blishes a correlation between the atomicity of the radicals and their state of saturation:

$$C_2H_4 + H_2 = C_2H_6 \text{ (Berthelot)}$$
$$\Theta_2H_4 + Br_2 = C_2H_4Br_2$$
$$Zn + Br_2 = ZnBr_2$$
$$C_2H_4 + HBr = C_2H_5Br \text{ (Berthelot)}$$
$$NH_3 + HBr = NH_4Br$$
$$PCl_3 + Cl_2 = PCl_5$$
$$\underset{\text{Aldehyde.}}{C_2H_4\Theta} + H_2 = \underset{\text{Alcohol.}}{C_2H_6\Theta} \text{ (A. Wurtz)}$$
$$\underset{\text{Allyle.}}{C_6H_{10}} + H_2I_2 = \underset{\text{Dihydriodate of allyle.}}{C_6H_{12}I_2} \text{ (A. Wurtz)}$$
$$\underset{\text{Acrolein.}}{C_3H_4\Theta} + H_4 = \underset{\text{Propylic Alcohol.}}{\Theta_3H_8\Theta} \text{ (Linnemann)}$$
$$\underset{\text{Hydrocyanic acid.}}{C_2NH} + H_4 = \underset{\text{Methyl-amine.}}{C_2NH_5} \text{ (Mendius)}$$

We may say that all bodies which have the property of uniting directly with 1 molecule of hydrogen, chlorine, bromine, hydrobromic acid, &c., act as diatomic radicals, in the same manner as olefiant gas or zinc.

All these radicals are of even atomicity, and exist in a free state. Those of uneven atomicity cannot exist as such in a free state. They are residues which can enter into combination, and which then possess a substitution value in accordance with their state of saturation. Such are ethyl and its homologous compounds, allyle and its homologous compounds, glyceryle, &c. As soon as they are set free they double their molecule, and combine, as it were, with themselves.

$$\left.\begin{matrix}(C_3H_5)'\\(C_3H_5)'\end{matrix}\right\}C_6H_{10}$$

Free allyl.

A very important remark occurs with regard to these latter radicals; some of them are at once monatomic and triatomic. This requires some explanation.

Propylene, C_3H_6, is not saturated, but it can exist in a free state. If, then, we take from it 1 atom of hydrogen, it will require 1 unit of combination to return to the state in which it existed as propylene. In this manner, the remainder, $C_3H_6 - H = C_3H_5$, can act as a monatomic radical. But if, instead of comparing it with propylene, which is in a state of incomplete saturation or unstable equilibrium as it were, we compare it with hydride of propyl C_3H_8, which is the saturated compound of the group, we see that it differs from it by 3 atoms of hydrogen; it can then act also as a triatomic radical. The same remarks apply to the homologous compounds of allyle, as will be seen from the following examples:—

CH Formene.	(C_2H_3) Aldehydene.		Θ_3H_5 Allyle.	
$(\Theta H)'''Cl_3$ Chloroform.	$(C_2H_3)'Cl$ Chloride of aldehydene (chlorated ethyleme).	$(C_2H_3)'''Cl_3$ Trichloride of aldehydene (chlorated chloride of ethylene).	$(\Theta_3H_5)'Br$ Bromide of allyle.	$(C_3H_5)'''Br_3$ Tribromide of allyle.
$\left.\begin{matrix}(CH)'''\\(C_2H_5)_3\end{matrix}\right\}\Theta_3$ Ethylate of formene.	$\left.\begin{matrix}(C_2H_3)'\\H\end{matrix}\right\}\Theta$ Hydrate of aldehydene (acetylenic alcohol).	$\left.\begin{matrix}(C_2H_3)'''\\H_3\end{matrix}\right\}\Theta_3$ Ethylic glycerine (unknown).	$\left.\begin{matrix}(C_3H_5)'\\H\end{matrix}\right\}\Theta$ Allylic alcohol.	$\left.\begin{matrix}(C_3H_5)'''\\H_3\end{matrix}\right\}\Theta_3$ Glycerine.

Other radicals are at once diatomic and tetratomic; thus the acetylene of M. Berthelot, and its homologous compounds appear to combine sometimes with 2, and sometimes with 4 atoms of bromine (Reboul). This may be readily understood, for the carbide C_2H_2 is diatomic with regard to ethylene C_2H_4; it is tetratomic with regard to hydride of ethyl C_2H_6. It can then, to arrive at the state of saturation, pass through two stages, as it were. The first brings it to the family of ethylene, the second to that of hydride of ethyl.

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*Researches on Peroxide of Hydrogen and Ozone, by M. C. Weltzien.**

I. Action of Iron and Aluminium on Peroxide of Hydrogen.—By adding very fine iron wires to a solution of peroxide of hydrogen, the two bodies unite, forming ferric hydrate:

$$Fe + 3H_2\Theta_2 = H_6Fe\Theta_6\dagger$$

In the same way aluminium forms an aluminic hydrate, with peroxide of hydrogen.

II. Action of Ferrous Salts on Peroxide of Hydrogen.—*a.* No colouration is produced by adding sulphocyanide of potassium to a solution of ferrous sulphate; but peroxide of hydrogen turns the liquid blood-red; ferric sulphocyanide is formed, and ferric hydrate precipitated:

$$6feS\Theta_4 + 12KCNS = 6feC_2N_2S_2, 6K_2SO_4,$$
$$6feC_2N_2S_2 + 3H_2\Theta_2 = 2FeC_6N_6S_6 + H_6FeO_6.$$

b. The addition of peroxide of hydrogen to a solution of ferrous iodide causes the formation of ferric hydrate, and the separation of iodine:

$$2feI_2 + 3H_2\Theta_2 = H_6Fe\Theta_6 + 2I_2.$$

c. On the addition of peroxide of hydrogen to a solution of ferrous sulphate, a ferric sub-salt is immediately precipitated, and an acid salt remains in solution:

$$6feS\Theta_4 + 3H_2\Theta_2 + 5H_2\Theta = Fe_2S\Theta_9 + 8H_2O + FeS_5\Theta_{18}.$$

d. On the addition of oxygenated water to the ferrous hydrate, precipitated by an excess of potash, from a solution of ferrous sulphate, ferric hydrate is rapidly formed.

III. Action of Magnesium on Peroxide of Hydrogen.—Magnesium acts slowly on peroxide of hydrogen; a strongly alkaline liquid is formed, which, evaporated to dryness, furnishes a white alkaline residue, soluble in water, of hydrate of magnesium:

$$Mg + H_2\Theta_2 = H_2Mg\Theta_2.$$

IV. Action of Thallium on Peroxide of Hydrogen.—It causes the formation of thallous and thallic hydrates, and of water:

$$2Tl_2 + 4H_2\Theta_2 = 2HTlO + H_2Tl\Theta_4 + 2H_2\Theta,$$

thallium being monoatomic and hexatomic. But by pouring peroxide of hydrogen on thallic hydrate, the latter is reduced to the state of thallous hydrate, with disengagement of oxygen. This action is very slow.

V. Action of Argento-Ammonic Nitrate on Peroxide of Hydrogen.—This nitrate is immediately reduced, with rapid disengagement of oxygen and precipitation of metallic silver, which is white and granular when deposited in concentrated solutions. Peroxide of silver is probably first formed, and then reduced by the excess of oxygenated water:—

$$2H_3AgN,N\Theta_3 + H_2\Theta_2 = 2H_4N,N\Theta_3 + Ag_2\Theta_2, Ag_2\Theta_2 + 2H_2\Theta_2$$
$$= Ag_2 + H_2\Theta + 2\Theta_2.$$

VI. Action of Iodide of Potassium on Peroxide of Hydrogen.—By the addition of a neutral solution of peroxide of hydrogen to a solution of iodide of potassium, the liquid directly takes an alkaline reaction. Potash is formed, and iodine separated either immediately or, if the liquids be very diluted, after some

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* *Comptes Rendus*, lxii, 640.

† fe=56 of ferride; Fe = fe2 = 112 of ferride.

time. The reaction seems to be accomplished in three distinct phases. In the first there are formed peroxide of potassium and hydriodic acid; in the second, the peroxide is decomposed, with formation of caustic potash and oxygen; and in the third the latter reduces the hydriodic acid, with formation of water and liberation of iodine:—

$$\begin{aligned} &\text{I.—}2KI + H_2\Theta_2 = K_2\Theta_2 + 2HI, \\ &\text{II.—}K_2\Theta_2 + H_2\Theta = 2KH\Theta + \Theta, \\ &\text{III.—}\quad 2HI + \Theta = H_2\Theta + I_2. \end{aligned}$$

In an acid solution the separation of iodine takes place more rapidly, as the peroxide of hydrogen there encounters hydriodic acid ready formed.

VI. Action of Iodide of Potassium on Peroxide of Hydrogen, in the Presence of Ferrous Salts. — The most sensitive reagent of peroxide of hydrogen is iodide of potassium, in presence of starch and a small quantity of a very diluted solution of ferrous sulphate. The mixture immediately becomes blue. This reaction has been mentioned, but not explained, by M. Schönbein. The explanation is, that a ferrous iodide is formed, which is decomposed by peroxide of hydrogen, according to the equation given above. The quantity of iodine separated being considerable, the consequence is that the reaction is also considerable.

VIII. Action of Permanganate of Potassium on Peroxide of Hydrogen. — It occasions a disengagement of oxygen, and formation of hydrate of potassium, and hydrate of peroxide of manganese:—

$$2Kmn\Theta_4 + 2H_2\Theta_2 = 2HK\Theta + H_2mn\Theta_5 + 5\Theta.$$

Were the hydrate of peroxide of manganese directly reducible by peroxide of hydrogen, five atoms of oxygen would be set at liberty.

$$H_2mn_2\Theta_5 + 3H_2O_2 = 2mn\Theta + 4H_2\Theta + 5\Theta.$$

By condensing the two equations into one, and getting rid of similar terms, the reaction may be represented by the following equation:—

$$2Kmn\Theta_4 + 5H_2\Theta_2 = 2HK\Theta + 2mn\Theta + 4H_2\Theta + 5\Theta_2.$$

In the first phase of the reaction two molecules of peroxide of hydrogen are present; in the second there are three. It cannot then be that the free oxygen disengaged proceeds half from the permanganate and half from the peroxide of hydrogen.

IX. Action of Ferrocyanide of Potassium on Peroxide of Hydrogen.—By adding neutral peroxide of hydrogen to a solution of ferrocyanide of potassium, the liquid becomes alkaline after the formation of hydrate of potassium, and ferricyanide of potassium is at the same time produced.

$$2KfeCy_6 + H_2\Theta_2 = K_6FeCy_{12} + 2HK\Theta.$$

X. Action of Ferricyanide of Potassium on Peroxide of Hydrogen.—M. Schönbein recommends as one of the most delicate tests peroxide of hydrogen, a mixture of ferricyanide of potassium, and a ferric salt. He says that ferric salt is reduced to the state of ferrous salt, and that this, with ferricyanide, gives Prussian blue; but this is incorrect, as it is Turnbull's blue, fe_3FeCy_{12}, which should be formed under these circumstances.

Now I have ascertained that ferric salts are not reduced by peroxide of hydrogen, but ferricyanide is reduced to ferrocyanide; hence the formation of Prussian blue.

$$\begin{aligned} &K_6FeCy_{12} + H_2\Theta_2 = H_2K_2feCy_6 + K_4feCy_6 + \Theta_2, \\ &3H_2K_2feCy_6 + 2FeCl_6 = fe_3Fe_2Cy_{18} + 6HCl + 6KCl. \end{aligned}$$

XI. Peroxides of Potassium, Sodium, and Barium.—By making hydrate of peroxide of barium react on the sulphates or carbonates of potassium and sodium, there are obtained, instead of the hydrated peroxides of the latter metals, alkaline hydrates and peroxide of hydrogen, which quickly decomposes under the influence of the alkalies formed.

The Determination of Sugar in Barley, and in the Products of the Malting Process.[*]

I. Determination by the Fermentation and Alcohol Method.—The grain, unmalted or malted as the case may be, being finely ground, 630 grains were stirred up with 200 septems[†] of cold water, and the mixture allowed to stand for about an hour. It was then well rubbed in a mortar, and transferred to a bottle, 1000 septems of water being used in rinsing the mixture into the bottle, and then 500 septems more were added, making in all 1700 septems of water and 630 grains of substance. The mixtures were generally made about the middle of the day, well shaken at intervals throughout the afternoon, and then allowed to stand to settle till the next morning, when as much as possible of the supernatant liquid was removed by means of a syphon. The solutions were turbid, but did not react with iodine. To 1000 septems 100 septems of lime water were added, and the mixture was very slightly warmed to expedite precipitation, after which there remained a perfectly clear, but coloured supernatant liquid. Of this, 700 septems were taken for fermentation, and the remainder was left for the determination of the sugar by the copper method.

In the preparation of the extract from the malt dust some deviation from the above mode of procedure was made. In its case, 200 septems of milk of lime were added to 800 septems of the original infusion, and, after filtration, only 600 septems of the liquid were taken for fermentation, the remainder, as before, being left for the copper method.

From the above figures it results that the extract submitted to fermentation represented in the case of the malt dust, 177·9 grains, and in that of the barley and of the other products of the malting process, 235·8 grains of original substance.

The yeast employed was pressed in a cloth, or between blotting paper, and then well mixed before being weighed out for use. Of the so prepared yeast 90 grains were employed for each fermentation; and two lots, of 90 grains each, were always mixed witb water, and left to ferment side by side with the fermenting extracts, the whole being maintained as nearly as possibly at a temperature of 78° F.

At the conclusion of the fermentation, each fluid was submitted to distillation, and the distillate was weighed in a 1000-grain bottle, in successive quantities as it was collected, until the specific gravity showed that only pure water came over. The sum of the attenuation of the several separately weighed lots of the distillate, less that of the distillate from the yeast fermented with pure water, gave the total attenuation in 1000 grain measures due to the alcohol formed from the sugar of the substance experimented upon. The amount of proof spirit which 1000 grain measures of spirit of the attenuation thus found being ascertained by reference to Bate's Tables (and interpolation), it only remained to calculate

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[*] From "Report on Experiments to Determine the Relative Values of Unmalted and Malted Barley as Food for Stock." By J. B. Lawes, Esq.

[†] 1 septem measure = 7 grains or one-onethousandth of a pound avoirdupois of water.

the amount of alcohol which that amount of proof spirit represented, and then the amount of sugar (dry malt or grape sugar = $C_{12}H_{12}O_{12}$) to which the amount of alcohol was equivalent, thus:—

$$\frac{x \times 180}{92} = \text{Malt sugar}$$

II. Determination by the Copper Method.—A standard solution was made by dissolving, separately in water,—

245 grains of crystallised sulphate of copper,
700 grains of crystallised tartaric acid,
840 grains of fused caustic soda,

mixing the solutions, and making up with water to 1000 septems at 62° F.

According to calculation, on the assumption that 1 equivalent of grape sugar would reduce 10 equivalents of oxide of copper, 100 septems of this solution should indicate 3·535 grains or 1 septem ·03535 grains of grape sugar.

Another standard solution was made by dissolving—

242·98 grains of crystallised sulphate of copper,
700 grains of crystallised tartaric acid,
840 grains of fused caustic soda,

and making up to 1000 septems. Of this solution 100 septems represented, by calculation, 3·506 grains, or 1 septem ·03506 grain of grape sugar.

The actual value of each of these solutions was determined from time to time by means of a solution made by dissolving 10 grains of pure cane sugar in 2 or 3 ounces of water, adding 20 or 30 drops of strong sulphuric acid (previously diluted), boiling for a short time to convert the cane sugar into grape sugar, and when cold making up to 500 septem measures with water. Each septem of this solution represented, therefore, ·02 grain of cane sugar, or

$$\frac{\cdot 02 \times 180}{171} = \cdot 02105 \text{ grain dry grape sugar.}$$

In testing the value of the solutions, or in actual working, 50 or 100 septem measures of the copper solution were put into a small flask and heated by means of a water bath. The solution of sugar, or prepared grain extract, was then allowed to flow in by degrees from a burette, until the point of saturation was attained. Even with the solutions of pure sugar it was difficult to determine by the eye when the whole of the copper was precipitated, nearer than by one or two septems of the solution; and with the coloured grain extracts the difficulty and range of error in reading were, of course, increased. In practice it was found necessary, as the point of saturation was approached, from time to time to remove a few drops, filter, and test by a solution of yellow prussiate of potass.

Researches on Sugar and Sugar-like Bodies,[*]
by L. CARIUS.

A Sugar-like Body from Benzol.—If grape sugar and isomeric bodies like inosite be considered as hexatomic alcohols, their formula would lead us to suppose the existence of a radical $C_6H_6^{vi}$. We might, therefore, expect to find similar relations existing between this hypothetical radical and benzol C_6H_6, as are known to exist between ethylene and ethylene alcohol.

Some experiments made by the author prove that benzol may be converted into a sugar-like body, which is not, however, grape sugar, nor any other known compound, but a new body, to which he has given the name *Phenose*.

The author has already shown that benzol combines directly with hypochlorous hydrate to form a compound which he calls *trichlorhydrine of phenose*.

$$C_6H_6 + \left[\Theta\left\{\begin{matrix}Cl\\H\end{matrix}\right.\right]3 = \begin{matrix}\Theta_3\\Cl_3\end{matrix}\left\{\begin{matrix}C_6H_6\\H_3\end{matrix}\right.$$

This body is difficult to produce in quantity. The benzol has to be added to a concentrated solution of hypochlorous acid, when a portion of it combines with the benzol, but by far the greater portion becomes decomposed. The best mode of proceeding is to take 216 grammes of oxide of mercury[†] and a litre of water, and 26 grammes of benzol. The solution of hypochlorous acid prepared by the aid of the above amount of oxide of mercury, is placed in iced water, the benzol added, and the mixture strongly and repeatedly shaken for about two days, till all the hypochlorous acid has disappeared. With the above quantities about six grammes of the trichlorhydrine may be prepared, nearly all of which will be in solution.

The solution is first filtered, then precipitated with sulphuretted hydrogen, again filtered, and now saturated with common salt. The trichlorhydrine is now separated by repeated shaking the mixture with ether. After distilling off the ether, trichlorhydrine remains behind as a thick colourless liquid, which must be kept at a low temperature, protected from the air. Crystals gradually form in the solution, and the mother liquor evaporated over sulphuric acid still yields pure chlorhydrin.

The crystals are colourless, and often large thin plates; under the microscope they appear broad needles, similar to benzoic acid. They fuse at about + 10°, readily absorb moisture, and become converted into a brown tarry product. When heated, a part volatilises uncharged; but below 100° some undergoes partial decomposition. They are soluble in alcohol, ether, and benzol, but sparingly soluble in water. They quickly, however, attract moisture from the air, forming a viscid liquid. They have a faint peculiar smell, and a burning taste. On analysis the crystals gave the following results:—

	Found.		Calculated for formula
	I.	II.	$C_6H_9Cl_3\Theta_3$.
Carbon .	30·80	30·72	30·57
Hydrogen .	4·00	3·87	3·82
Chlorine .	45·01	45·05	45·23
Oxygen .	—	—	20·38
			100·00

Alkalies decompose trichlorhydrine, eliminating the whole of the chlorine; but besides the chloride of the metal two other bodies are always formed, the one being benzoic acid and the other *Phenose*. The following equation explains the formation of the latter body:—

$$\begin{matrix}\Theta_3\\Cl_3\end{matrix}\left\{\begin{matrix}C_6H_6\\H_3\end{matrix}\right. + {}_3\left[\Theta\left\{\begin{matrix}K\\H\end{matrix}\right.\right] = \Theta_6\left\{\begin{matrix}C_6H_6\\H_6\end{matrix}\right. + 3KCl$$

The trichlorhydrine, in its behaviour with nitric acid, resembles the organic bodies rich in hydrogen, the so-called fatty bodies. Heated with dilute nitric acid it is easily oxidised, forming oxalic acid. The author could form no nitro-compound.

Phenose— $\Theta_6\left\{\begin{matrix}C_6H_6\\H_6\end{matrix}\right.$

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[*] Abridged from *Annalen der Chemie und Pharmacie*, Dec., 1865.

[†] The author no doubt means, although he does not say so, that this quantity of oxide of mercury is to be treated with chlorine to produce hypochlorous acid; and the solution of hypochlorous acid so produced is to be employed in the subsequent part of the process.

is extremely difficult to produce. Trichlorhydrine and a solution of potash form almost nothing but benzoic acid, and the necessary excess of potash converts any phenose produced into a humus-like body. The best mode of proceeding is as follows:—One molecule of trichlorhydrine is dissolved in a little alcohol, and sufficient water is added to produce a clear solution containing about 1 per cent. This solution is decomposed with three molecules of carbonate of soda; and the solution, which soon turns brown, is digested on a water bath for six or eight hours, after which it is carefully neutralised with hydrochloric acid. To remove any benzoic acid which may have been formed, and also any undecomposed trichlorhydrine, the solution is repeatedly shaken with ether; the ether is removed, and the remaining solution is evaporated nearly to dryness. The moist mass of chloride of sodium, &c., is now treated with alcohol, and the alcoholic solution evaporated; the residue is again treated with strong alcohol, and the solution is filtered. The filtrate contains the phenose, with some chloride of sodium, forming a compound answering to the formula $Ꞓ_6H_{12}\Theta_6NaCl$.

This last alcoholic solution must now be slightly acidulated with acetic acid, and then precipitated with acetate of lead, ammonia is added to the filtrate, which is then precipitated with ammoniacal solution of sugar of lead. The precipitate is well washed, and then decomposed under water by sulphuretted hydrogen; the filtrate is freed from any traces of hydrochloric acid by the addition of carbonate of silver, and if it is not quite colourless it is treated with animal charcoal, and evaporated.

The tenacious residue must now be examined for chlorine, and if any is present the aqueous solution must be treated with caustic baryta $(BaH\Theta)_2$ to one atom of the chlorine, the baryta carefully removed by sulphuric acid, and the hydrochloric acid by carbonate of silver; the filtrate is then again evaporated.

The syrupy residue after standing a long time over sulphuric acid leaves the phenose as a slightly colourless amorphous mass, which quickly deliquesces in the air. It has a sweetish taste, similar to that of grape sugar; it is readily soluble in water and alcohol, but is insoluble in ether. An analysis of the author's product gave the following results:—

	Found.	Calculated for the formula $Ꞓ_6H_{12}\Theta_6$.
Carbon	39·68	39·99
Hydrogen	6·99	6·68
Oxygen	—	53·55
		100·00

When heated phenose becomes brown, and decomposes below 100°, exhaling an odour like caramel. When subjected to dry distillation, it gives a distillate containing acetic acid and tarry matter, and leaves a carbonaceous residue. On being heated with dilute acids or alkalies it is converted into a humus-like substance, and an acid which appears to be glucinic acid.

It is difficult to prepare compounds of phenose with the alkali metals. A lead compound, however, may be prepared having the composition—

$$\Theta_6 \left\{\begin{matrix} Ꞓ_6H_6 \\ Pb_3, \end{matrix}\right.$$

which shows that 6 at ·H are replaceable by a metal. All attempts to prepare an ether have failed, in consequence of the easy decomposability of phenose.

Phenose is as easily oxidised as grape sugar. Even when gently heated with nitric acid it forms oxalic acid; with oxide of copper it behaves exactly as grape sugar; with a silver salt an alkaline solution separates metallic silver. It does not, however, ferment in contact with yeast.

These facts place beyond doubt the existence of a sugar-like body which must be regarded as a hexatomic alcohol, and which stands to benzol in the same relation as ethylen alcohol stands to ethylen; and therefore confirms the opinion that the ordinary known sugars are alcohols.

TECHNICAL CHEMISTRY.

*Theoretical Study of the Manufacture of Soda by Le Blanc's Process, by M. J. Kolb.**

In the presence of cold or tepid water there is no incompatibility between sulphide of calcium and carbonate of soda.

Rough soda containing only one equivalent of chalk for one of sulphate of soda, gives by washing just the same results as a soda differing only in containing exactly the excess of chalk necessary for the formation of the oxysulphide $CaO,2CaS$.

The action of carbon on an equal number of equivalents of sulphate of soda and carbonate of lime gives carbonate of soda and sulphide of calcium, easily separable by washing in cold or tepid water.

At a high temperature no exchange of acids is effected between sulphate of soda and chalk; the first reaction which takes place in the furnace being the reduction of sulphate of soda by carbon.

In this reduction carbonic acid but no carbonic oxide is formed.

The result of a series of experiments is that when the mixture of the three materials is heated to redness, the action of the carbon is divided between the sulphate of soda, which it reduces, and the chalk, which it converts at the same time into lime.

By substituting its equivalent of lime for the chalk, the same soda is obtained, perfectly carbonated.

It is evident, from these two facts, that the carbonic acid of chalk does not contribute to the formation of carbonate of soda, and some experiments have led to the conclusion that it is under the influence of carbonic acid, proceeding partly from the reduction of sulphate of soda, but especially from the gases of the furnace, that the final reaction is produced—that is to say, that sulphide of sodium, lime, and carbonic acid give carbonate of soda and sulphide of calcium.

This explains why it is found so difficult to prepare soda in a closed crucible, while it is very easily made in a tube traversed by a current of carbonic acid.

The formation of carbonate of soda is thus the result of three reactions, which are, so to speak, simultaneous:

$$NaO,SO_3 + 2C = CO_2 + NaS,$$
$$CaO,CO_2 + C = 2CO + CaO,$$
$$NaS + CaO + (CO_2 \text{ in excess}) = NaO,CO_2 + CaS.$$

The second part of this study treats of the action of air, water, heat, and lime on rough soda.

Perfectly dry air has, between 0° and 100°, no sensible action on rough soda, however long they may be in contact; it does not even act by its carbonic acid. Experiments on this subject have shown that perfectly dry carbonic acid has no action on anhydrous lime, nor on anhydrous sulphide of calcium. At a red heat, and even below, air oxidises sulphide of calcium, and the

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* *Comptes Rendus*, lxii., 638.

sulphate of lime formed destroys part of the alkalimetric richness of the lixivium.

Moist air, on the contrary, acts very energetically on rough soda, the lime of which hydrates, and then carbonates; while the sulphide of sodium is transformed into hyposulphite; but at the same time the sulphide of calcium is changed to sulphate, either directly or through the intervention of the oxide of iron found in anhydrous soda, and which is indefinitely regenerated by a series of transformations.

Researches on the action of water on rough soda on the one hand, and sulphide of calcium on the other, either alone or mixed with lime and carbonate of soda, taken altogether or separately, lead in both cases to identical results, which are:—

That the lixivium obtained presents a very variable composition, and depends on three conditions—the concentration of the liquid, the duration of the digestion, and the elevation of the temperature.

The duration of the digestion and the elevation of the temperature favour not only the caustification of a portion of the carbonate of soda by lime, but also a slow exchange between the carbonate of soda and sulphide of calcium. This exchange seems to be the result of the formation of hydrosulphate of sulphide of calcium. The concentration of the lixivium and the presence of caustic soda are entirely opposed to this formation, which is not prevented by an excess of lime.

If, then, it be desirable to have a little free lime in rough sodas, it is merely that a small quantity of caustic soda may be produced, which is an obstacle to the sulphuration of the lixivium.

On a Blue Obtained by the Reduction of Chloroxynaphthalic Acid, by* HORACE KOECHLIN.

AN alkaline solution of chloroxynaphthalate of soda is boiled with zinc in impalpable powder. The reduction begins in about twenty minutes, and a pale yellow solution results. The liquor is now decanted and ammonia added, which in a few hours changes the colour to a beautiful green. After this the solution is neutralised by an acid, which causes the precipitation of brown flocculi. These are collected and washed on a filter, and afterwards dried. When dry the substance appears green, and shows a metallic lustre.

The compound is insoluble in water; it dissolves with a red colour in boiling aniline, and gives a green solution with strong sulphuric acid from which water separates it with a violet tint. It dissolves in alcohol with a violet colour; the solution diluted with water gives a beautiful blue colour, which is turned red by acids. The ammoniacal alcoholic solution is transparent, and appears blue by transmitted light. By reflection it appears red, and looks as holding carmine in suspension. The product fixes itself violet on wool, and may be fixed on cotton by means of albumen.

The dilute alcoholic solution dyes silk blue, and also wool and cotton mordanted with albumen. The bath treated with acid dyes rose colour; the dye, in fact, like litmus, is turned red by acids and blue by alkalies.

Decomposition of Naphthalin. — Naphthalin carried through a red hot tube yields marsh gas, and a very fine soot, which Kletinsky thinks might be used for Indian ink. When fused, naphthalin swells up and dissolves caoutchouc with great facility.—*Zeitsch. f. Chem.*, 127.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Anniversary Meeting, Thursday, March 29.

Professor W. A. MILLER, *M.D., F.R.S., President, in the Chair.*

ON the part of the Council the President furnished a report of the Society's *Transactions* during the past year, from which it appeared that the present state and prospects of the Society were in a very satisfactory condition. The number of Fellows had been considerably augmented; there being now 476 on the list, besides 37 foreign members, against 453 and 41 respectively at the corresponding period in the last year. The Society had to deplore the loss by death of four distinguished members, viz., Professor Brande, Dr. Dauglish, Mr. George Smith, and Professor Piria, of Turin. The number of communications made to the Society during the past session amounted to twenty-six, besides two lectures delivered by the President and by Dr. Gilbert. The Treasurer (Dr. Redwood) then presented his balance sheet, which had been audited by Dr. Attfield and Mr. Heisch. The assets were shown to be the sum of 1300*l.* invested in Government consols, and a balance amounting to 762*l.* 8s. 11d. in the hands of the bankers. The election of officers for the ensuing year was then proceeded with. No amendment having been proposed, the Council's proposition was put to the vote, Professor Wanklyn and Mr. Spiller being appointed scrutineers, who reported that the gentlemen named in the printed list—as announced last week—had been unanimously elected. At the request of the President Mr. Vernon Harcourt read the terms of an amendment, which the Council recommended should be introduced into the fourth bye-law, the effect of which would greatly facilitate the removal of members whose subscriptions had been allowed to fall into arrears. The Council's amendment was put and carried, and its provisions will sanction the removal from the list of members of all such as are indebted to the Society in the amount of two years' arrears due in the month of January immediately preceding the anniversary meeting. At any subsequent period the Council would, no doubt, be prepared to entertain the application of any member thus excluded, who, from absence or other sufficient reason, should have been unable to comply with the prescribed obligations. The draft of the Treasurer's notice circular was read and approved, and a new form of certificate adopted.

Dr. THOMAS STEVENSON proposed, and Dr. HOLZMANN seconded, a vote of thanks to the Council and officers for their services during the past year, which the President duly acknowledged.

Professor WANKLYN suggested that the date of an author's communication should, in every case, be appended to the printed account in the Society's *Transactions*—an opinion in which Dr. STEVENSON acquiesced; and the PRESIDENT stated that no objection could be raised against the date of reception being printed in the Society's journal. The meeting was then adjourned until April 5, when Mr. Spiller would read a paper "*On the Estimation of Phosphorus in Iron and Steel.*"

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, January 19, 1866.

Sir HENRY HOLLAND, *Bart., M.D., D.C.L., F.R.S., President, in the Chair.*

On Radiation and Absorption with reference to the Colour of Bodies and their State of Aggregation.

JOHN TYNDALL, *Esq., LL.D., F.R.S., Professor of Natural Philosophy, R.I.*

THE speaker referred to the relation subsisting between the sensible phenomena of nature, and those processes

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* *Moniteur Scientifique*, p. 263, 1866.

lying beyond the range of the senses, on which the phenomena immediately depend. He spoke of the function of the imagination in picturing operations which, though great in their aggregate results beyond all conception, are too minute individually to be capable of observation. He referred to the luminiferous ether that fills space as the most striking illustration hitherto known of the production of a line of thought from the domain of the senses into that of the imagination, and affirmed the existence of this wonderful medium to be based upon proofs at least as strong as those which sustain the theory of gravitation.

Dwelling briefly on the relation of this ether to the atoms and molecules which are plunged in it, he illustrated, by reference to the phenomena of sound, the difference between good and bad radiators. A naked tuning-fork vibrating in free air imparted so small an amount of motion to the air that it ceased to be heard as sound at an inconsiderable distance; the same tuning-fork brought into union with its resonant case produced a sound which could be heard by thousands at once. The naked fork was a bad radiator, the combined fork and case was a powerful radiator. This combination of the fork and its case, as regards sound, roughly represented the influence of chemical combination as regards radiant heat. By the act of combination the power of the combining atoms as radiators might be augmented ten thousandfold. As an example of this the vapour of water was selected; and it was affirmed that a pound of this vapour taken to the top of a high mountain, there heated and exposed before the cloudless heaven, would radiate nine or ten thousand times—possibly twenty thousand times—as much heat into stellar space as could be radiated by either of the constituents of the vapour when uncombined.

The speaker also referred to the well-known analogy between the pitch of a sound and the colour of light, and throwing a large spectrum upon a white screen mentioned the relation between the various colours to the rapidity of ethereal vibration. The space from the red to the blue embraced an infinite number of rates of vibration, gradually and continuously shortening without any interruption. It might be typified by an infinite number of tuning-forks of gradually augmenting pitch, and all sounding at the same time. This spectrum was derived from the carbon points of the electric light; but it was shown that in the case of various other incandescent substances the spectrum was not of this continuous character. The magnificent stream of green light produced by the volatilisation of silver in the electric lamp was shown upon a screen, and afterwards the light was analysed and found to produce two bands of brilliant green, differing but slightly from each other in refrangibility. Here the case is typified, not by an infinite number of tuning-forks, but by two tuning-forks of slightly different pitch. And just as the rate of vibration in the case of the tuning-fork is a fixed rate, so the rate of vibration of the atoms of silver vapour were fixed. And as the colour of the vapour depended on its rate of atomic vibration, the constancy of this rate secured the constancy of colour in the vapour. We cannot make the vapour of silver white hot, however we may exalt its temperature. We may augment the brilliancy of the particular rays that it emits, but we cannot cause it to emit that variety of rays the blending of which together produces the impression of white.

Like the vapour of silver, the vapour of water has also its definite periods of vibration; and they are not such as to enable the vapour, however high its temperature may be raised, to emit a white light. It can hardly be said to emit any light at all. The flame of hydrogen, for example, is composed of intensely heated aqueous vapour, but it is hardly visible; and it is easy to give the vapour of water a temperature sufficient to raise a solid body placed in the vapour to a bright red heat, while the vapour itself remains absolutely dark. Now the powers of radiation and absorption go hand in hand, and the body which cannot emit luminous rays is incompetent to absorb them. Thus the sun's luminous rays pass freely through the aqueous vapour of our atmosphere; while it is the impediment offered by this same vapour to the radiation from the earth which checks the sudden drain of terrestrial heat, and thus renders our planet inhabitable.

This power of electric absorption was illustrated by the action of two tuning-forks which sounded the same note. Both forks being mounted on their resonant stands, one of them was first sounded. The silent fork was then brought near the sounding one, and held near it for five seconds. The vibrations of the excited fork were then quenched, but the sound did not cease to be heard. In fact, the silent fork had taken up the vibrations of its neighbour, and continued to sound after the latter had ceased to vibrate. Again, one fork being permitted to remain upon its stand, the other was dismounted and thrown into strong vibration. Detached from its stand, its sound was too feeble to be heard by the audience; but on bringing it near the mounted fork a mellow sound rose which filled the room. Thus the vibrations of the one fork were transmitted through the air and imparted to the other. To effect this transference it was necessary that the forks should be in perfect unison: the fixing upon either of them of a bit of wax not larger than a pea was sufficient to destroy the power of the forks to influence each other.

Thus one sounding body absorbs the vibration of another sounding body with which it is in unison; and here we have in acoustics the representative of that great principle which in optics lies at the base of spectrum analysis, namely, that bodies absorb those rays which they can themselves emit. Thus green vapour of silver if interposed in the path of a beam of white light, will absorb the green which it can itself emit. Thus also the incandescent vapour of sodium, itself intensely yellow, cuts clearly out the yellow band of the spectrum. And the same is true of aqueous vapour. Its periods of vibration synchronise with those of the rays, or more accurately waves, emitted by the warmed earth, and hence its power to intercept those waves by taking up their motion. But it is in dissonance with the luminous waves emitted by the sun, and hence those waves pass through large quantities of it with scarcely sensible absorption.

This incompetence of aqueous vapours to absorb luminous rays is shared by all really transparent bodies; in fact, they are transparent in virtue of their incapacity to absorb luminous rays. Now, transparent bodies in a state of powder are always white, and in white bodies luminous rays have no power. The light of the sun, for example, cannot warm white sugar, nor can it warm table salt, nor flour, nor a white dress; it cannot even melt snow. The most powerful luminous beam may be concentrated upon a surface covered with hoar frost without melting a single spicula of the frost crystals. How, then, it may be asked, does sunshine clear away the snow from the mountain heads? Two or three days' sunshine on the mountains suffices to obliterate the traces of a heavy snow-fall: how can this occur if sunshine has no power to melt the snow crystals? It is not the luminous rays of the sun which perform this work, but a body of rays which, though possessing high calorific power, have no light in them. By a process of transmutation these dark rays may be converted into luminous ones, but as they come from the sun, and fall upon the mountain summits, they are utterly incompetent to excite vision. Every stream which channels the glaciers or tumbles down the valleys of the Alps is the direct product of this invisible radiation. To it also the glaciers owe their birth as well as their dissolution. For while the luminous rays of the sun falling on the tropical ocean penetrate the water to great depths without considerable absorption, the dark rays are in great part absorbed close to the surface of the ocean; they therefore heat the water at the surface, and are thus almost the sole excitants of evaporation. Not only, then, do those invisible solar rays, by the fusion of the ice, give birth to the rivers of Switzerland, but it is they that lift the material of these rivers from the sea and store it on the frozen summits of the mountains.

Gathering up the rays emitted by a powerful electric lamp, and concentrating them upon a small focus, water, alcohol, or ether placed at the focus speedily boils, some of them, indeed, almost instantly. But they are not boiled by the luminous rays, though these produce an impression too dazzling to be borne upon the eye. Interposing in the path of the concentrated beam a glass cell containing pure distilled water, the light of the beam is not sensibly diminished, but it is no longer competent to boil or even heat water at the focus. Placing a piece of ice at the luminous focus, it is not melted, though, if blackened wood be placed there, it is set on fire. The moment, however, the cell of water is withdrawn the ice melts—melts because the dark rays previously absorbed by the water of the cell are now absorbed by it. There are liquids of very low boiling points—bisulphide of carbon, for instance—which, when placed at the focus where the whole radiation, dark and bright, of the electric lamp is converged, cannot be caused to boil, can hardly be warmed. Water, for instance, requires a temperature of 212° Fahr. to boil it, bisulphide of carbon requires only 118° 4′; still the former is boiled in a time insufficient to warm the latter. This arises from the fact, that while water powerfully absorbs the dark calorific rays and allows the luminous ones free transmission, the bisulphide of carbon is transparent to both classes of rays, and hence is warmed by neither of them. Thus, also, when it was stated that sugar could not be warmed by the light of the sun, the invisible solar rays were meant to be excluded, for when the total radiation of the sun is converged upon white sugar it is immediately burnt up, the agent of its combustion being, however, the dark radiation.

It is possible to filter the composite radiation from the sun or from the electric light, so as to detach almost completely the visible from the invisible rays. It has been already stated that bisulphide of carbon is transparent to both classes of rays; now iodine, a substance which dissolves freely in the bisulphide, is eminently transparent to the invisible rays alone. Hence, a combination of these two substances furnishes us with a ray-filter, which, while it pitilessly cuts off the bright rays, allows the dark ones free transmission. At the dark focus we can boil water or alcohol, but we cannot warm bisulphide or bichloride of carbon. Bromine also, notwithstanding its volatility, bears exposure at the focus without being heated. Sulphur also bears the temperature of the focus for a considerable time without ignition. Common phosphorus, a combustible so quick that the warmth of the fingers when in contact with it suffices to provoke combustion, bears for twenty or thirty seconds without ignition the action of radiant heat at a focus where, in the fraction of a second, platinised platinum is raised to a white heat. The phosphorus is in a great degree transparent to radiant heat. The red iodide of mercury strewn on paper and exposed at the focus has its colour discharged where the invisible images of the carbon points fall upon it, but owing to the transparency of the iodide to radiant heat, it requires some exposure to produce the thermograph. This red substance is far less absorbent of radiant heat than white paper, and hence it is sometimes easier to obtain a thermograph of the carbon points by exposing to the radiation from the lamp the back of the paper on which the iodide is strewn, than by exposing the face covered with the iodide. It is often, indeed, more easy to burn a thermograph through the paper than to discharge the colour of the iodide. Hence, white paper may be protected from radiant heat by being covered with a substance like the iodide of mercury.

We are here naturally reminded of the experiments of Franklin, which consisted in placing cloths of various colours upon snow, and observing the depth to which they sank in the snow when exposed to direct sunshine. Franklin concluded that the lighter the colour of the body the less is its power of absorption. The generalisations founded on this experiment are for the most part fallacious. Results long ago obtained, establishing the vast influence of chemical constitution on radiant heat, led the speaker to contrast iodine, an element, with alum, a body of highly complex character. Both substances were in powder, the one being dark, the other white. Exposed to the radiation from various sources, the white powder proved itself in all cases the most powerful absorber. The dark powder of amorphous phosphorus was also compared with the hydrated oxide of zinc, but the white powder was the best absorber. Bodies of the same colour compared together showed similar differences. The red oxide of lead, for example, was contrasted with the red iodide of mercury, and the oxide proved the most powerful absorber. So also the white chloride of silver was compared with the white carbonate of lead; the lead salt proved by far the most powerful absorber. In this way it was proved that as regards the absorption of radiant heat, white in some cases exceeds black, black in some cases exceeds white, and the other colours are equally capricious; all evidently depending on the chemical constitution of the substances. Here, as in other cases moreover, radiation and absorption go hand in hand, the substance which absorbs heat most powerfully radiating the same heat most copiously.

In the case of Franklin's white cloth exposed on snow to sunshine, there is no reason why it should sink at all; there is, on the contrary, reason to conclude that it must rise relatively to the snow surrounding it. For, as regards the luminous rays of the sun, they are alike powerless to warm the cloth or to melt the snow. Whatever effect is produced is therefore due to the dark solar rays. Now, snow absorbs these rays with greater greediness than any other substance; hence the white cloth, which absorbs less than the snow, really defends the snow underneath it from the action of the sun, and, owing to this protection, the cloth, if exposed for a sufficient time, will rise in relation to the surface round, just like a glacier table.

But though the cloth is not so good an absorber as the snow, it is nevertheless a very powerful absorber; it comes near the snow in this respect. And when, as in the case of the black cloth, we have added to the absorption of a large portion of the dark rays by the cloth, the absorption of the whole of the luminous rays by the dye, the sum of the absorption of both classes of rays exceeds the absorption by the snow of the dark rays alone. The black cloth will therefore sink in the snow. This is the explanation of Franklin's experiment.

The Lecturer concluded by referring to various experiments on the transmission of radiant heat through rock salt; to the influence of science as a means of intellectual culture; and to the necessary defects of any system of education in which the study of nature is neglected or ignored.

ACADEMY OF SCIENCES.

March 26.

Dr Hofmann presented a memoir "*On the Action of Terchloride of Phosphorus on the Salts of the Aromatic Monamines.*" The same communication has been presented to our Royal Society, from the *Proceedings* of which we shall make an abstract.

M. Liès-Bodart sent a note entitled "*Chemical Researches on Wax.*" A large quantity of wax, the author states, is imported from America more or less adulterated with paraffine, and he gives a process for separating the paraffine. It depends upon effecting the etherification of the wax constituents, the paraffine remaining unacted upon.

The author first dissolves 5 grammes of the substance in 50 cubic centimetres of amylic alcohol, and heats to 100°. He also heats to the same temperature a mixture of 100 cubic centimetres of fuming sulphuric acid and the same volume of water. When heated he pours the diluted acid upon the solution of wax, continues the heat as long as bubbles of gas escape, and then allows the whole to cool. On cooling a mass collects of about twice the size of the original wax. This mass consists of the unaltered paraffine with a mixture of melissic alcohol and cerotate and palmitate of amyl, the last three somewhat altered by the excess of sulphuric acid. The mass or cake is now heated on a water bath to 100° with a mixture of 50 cubic centimetres of monohydrated sulphuric acid and 25 cubic centimetres of Nordhausen acid. The action of this must be continued for about two hours or more, until no bubbles escape even when the mixture is stirred with a glass rod. In this way all except the paraffine is carbonised. The carbonaceous mass which remains is dissolved in amylic alcohol, filtered with the aid of a heated funnel, and the residue on the filter washed with the same alcohol. The alcoholic solution is again heated with monohydrated sulphuric acid to transform the amylic alcohol into sulphamylic acid. This not holding paraffine in solution, that body deposits on cooling, and may, if necessary, be further purified and weighed. The author also gives a process by which the melissic acid and cerotate and palmitate of amyl may be separated, which need not detain us.

M. Ncklès presented a note "*On some New Solvents for Gold.*" The author has discovered that gold dissolves in the ethereal perchlorides and perbromides which he described last year (see Chem. News, vol. xi., p. 254). As the gold dissolves in the manganic compounds, the green colour of these gradually disappears (proto compounds which are insoluble on ether being deposited), and a yellow or red solution of gold is left. The ether being evaporated from this solution and the residue sufficiently heated, a coating of metallic gold is left about the bottom of the tube, which suggests a process for gilding glass. The gold is reduced from the ethereal solution by protosulphate of iron and also by protochloride of tin, but *purple of Cassius* is not produced in the latter case. Many sesquichlorides and sesquibromides, the author states, also dissolve gold, those which are easily reduced answering best. The cause of the solution is obviously the instability of the per- and sesquichlorides and bromides, for which free chlorine and bromine are easily separated. The ethereal periodides also dissolve gold, forming an iodide of the metal, showing that *nascent iodine* is a solvent, although that metalloid in the ordinary state is without action on gold. Lastly, an etherial solution of hydriodic acid will dissolve gold leaf, owing, of course, to the instability of the acid and the liberation of free iodine in the nascent state.

M. Weltzien continued his note "*On the Peroxide of Hydrogen and Ozone.*" The author differs from Schönbein as to the constitution of oxygenated water, and also as to the nature of the oxygen evolved when peroxide of barium is treated with sulphuric acid. We give this paper at length elsewhere.

NOTICES OF BOOKS.

Bulletin Mensuel de la Société Chimique de Paris, &c. March, 1866.

The proceedings of the last two sittings of the Chemical Society of Paris offer two or three things of considerable interest. On February 16 M. Wurtz gave an account of the important syntheses effected by Carius by means of hydrated hypochlorous acid, some account of which will be found in our present number; and at the same time M. Wurtz mentioned that he had succeeded in obtaining chloride of thionyle by the reaction of hypochlorous anhydride on sulphur suspended in protochloride of sulphur.

M. Berthelot at the same meeting gave his reasons for considering the bromated propylene derived from glycerine as isomeric but not identical with bromide of allyl.

M. Friedel continued the account of the researches by himself and M. Crafts on the ethylated compounds of silicium, describing bichlorated silicium ethyl, and giving processes for the production of oxide of silicium tri-ethyl.

The meeting on March 2 was for the most occupied with communications by M. Berthelot on acetylene and its compounds. Notices of most of these communications have already appeared in our pages.

M. Marc Delafontaine gave an account of his most recent researches on the metals of cerite and gadolinite, rectifying an error in his former communication, and describing more fully the characters of the three earths, yttria, erbia, and terbia. The author also expresses an opinion that a fourth member of the group exists. We shall return to this paper.

M. Cloez exhibited a specimen of iridium in small, cubo-octahedric crystals obtained by the decomposition of the chloride under certain conditions of temperature. The same process, he stated, may furnish platinum, and also gold in a crystallised state.

Among the papers published at length we find the memoir of M. Lamy on "*Thallium Glass.*" M. Lamy finds that thallium is preferable to lead to replace potash. It communicates a yellow colour to glass, just as sodium gives a green colouration. Thallium glass, it is said, is denser and more refractive than potash glass, and the author believes such glass will be specially applicable for certain optical purposes, and also for the manufacture of some artificial jewels. The best specimen was obtained with the following proportions:—

Sand	300
Minium	200
Pure carbonate of thallium . . .	335

The mixture fused easily, and formed a perfectly homogeneous mass, which had an agreeable and brilliant yellow tint. The density was 4·235, and the refraction index for the yellow ray was 1·71.

M. P. De Wilde describes the "*Action of Hydrogen on Acetylene under the Influence of Platinum Black,*" whereby it appears that the hydrogen is fixed on the acetylene, and hydride of ethyl produced.

M. Berthelot also describes "*The Action of some Salts of Protoxides on Various Gases.*" Ammoniacal cuprous chloride, the author shows, immediately absorbs oxygen, carbonic oxide, acetylene, ethylene, allylene, and, to a small extent, propylene. It does not, however, act immediately on binoxide of nitrogen.

Ferrous sulphate, dissolved in a mixture of ammonia and chloride of ammonium, rapidly absorbs oxygen and binoxide of nitrogen, but has no special action on acetylene, allylene, ethylene, propylene, or carbonic oxide.

Lastly, chromous sulphate, dissolved in the same mixture, absorbs oxygen, binoxide of nitrogen, acetylene, and allylene, but has no action on carbonic oxide, ethylene, or propylene.

M. Schlumberger gives a long account of "*The Action of Boracic Acid on Curcumine,*" showing the production thereby of a beautiful rose-coloured substance, to which he gives the name *Rosocyanine.* We shall give an abstract of this paper in a future number.

M. Sestini has a communication "*On the Chlorinated Products of Santonine,*" describing mono-, bi-, and trichlorosantonine. The second part of the *Bulletin* contains notices of a few French patents, which we shall give in our miscellaneous paragraphs.

The Alkaline Permanganates and their Medicinal Uses. By John Muter. London: Churchill and Sons. 1866.

This little book gives an account of the uses to which the alkaline permanganates may be put, and the good they may, or may be supposed to do; together with suggestions for their extensive employment. Among other things the author states that permanganate of potash "in the solid state gives the nearest approach to the actual cautery, since its action is of the nature of combustion by fire." We have heard of its application in one instance to an ulcer on the arm, which the surgeon, with a vague idea, we believe, of mitigating the action, had previously smeared with glycerine. The action in this case was so like combustion by fire, that patient and surgeon were in a few moments astonished by seeing an actual flame burst forth. The escharotic effect was decided. The author, we have no doubt, is as good a physician and surgeon as he is a chemist; but he gives us none of his actual experience with the permanganates. We may say, however, that his speculations for the most part look very reasonable.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

169. W. Hibbert, Manchester, "Improvements in the combination of chemical matters, and mechanical apparatus applied therewith, for the prevention or cure of contagious and other diseases to which human beings and animals are subject."—Petition recorded January 18, 1866.

642. V. Lamaudès, Rue de Clichy, Paris, "A new or improved chemical mixture to be used as a disinfecting and preserving fluid for the cure of disease among cattle, and for other purposes."—March 3, 1866.

672. A. V. Newton, Chancery Lane, "An improved process of bleaching." A communication from J. J. Eckel, J. S. Schuyler, and J. W. Gillies, New York, U.S.A.—March 5, 1866.

674. G. Haworth, T. Parrington, and W. Hudson, Preston, Lancashire, "An improved composition or preparation for sizing cotton, linen, or woollen yarns, and other similar substances."

675. R. G. Allerton, New York, U.S.A., "An improvement in the manufacture of waterproof paper."—March 6, 1866.

700. T. Prideaux, Sheffield, "Improvements in puddling and converting furnaces."—March 8, 1866.

732. G. Phillips, Offord Road, Barnsbury, "Improvements in preparing purple and blue colouring matters."—March 10, 1866.

748. J. Macintosh, North Bank, Regent's Park, "Improvements in impervious compounds, applicable where india-rubber, gutta-percha, or such like resins or gums are used."—March 12, 1866.

797. R. H. Ashton, Ashton-upon-Mersey, Cheshire, "Improvements in pictures obtained upon paper, glass, porcelain, or other surfaces with transparent or semi-transparent materials."

801. C. W. Standish, Broadhinton Road, Clapham, Surrey, "Improvements in stoppering bottles."—March 17, 1866.

Notices to Proceed.

2929. J. Dixon, Abchurch Yard, London, "Improvements in purifying or refining iron."—Petition recorded November 14, 1865.

2952. R. Jones, Botolph Lane, London, "Improvements in preserving animal and vegetable substances, and in means or apparatus employed therein."—November 16, 1865.

2953. S. H. Huntly, Upper Baker Street, Regent's Park, Middlesex, "Improvements in apparatus for obtaining fresh water from salt and impure water, also applicable for ventilating purposes."—November 17, 1865.

2972. F. Wilkins, Oxford Street, Middlesex, "Improvements in apparatus for the production of hydrocarbon or other vapours, parts of which apparatus are also applicable to measuring gaseous or fluid matter."—November 18, 1865.

3000. C. P. Coles, Ventnor, Isle of Wight, "Improvements in protecting the bottoms and sides of ships and other structures exposed to the action of sea-water."—November 22, 1865.

3206. A. Budenberg, Manchester, "An improved blasting powder."—A communication from B. A. Schäffer and C. F. Budenberg, Buckan Magdeburg, Prussia.—December 12, 1865.

258. J. M. A. Montclar, Java, "Improvements in the manufacture of materials or compositions for decolorising or purifying saccharine or other liquids, and for making paint, blacking, and foundry blackening, and in apparatus therefor."—January 2, 1866.

345. F. B. Baker, Sherwood Street, Nottingham, "Improvements in the process of dyeing and manufacture of textile fabrics."—February 3, 1866.

CORRESPONDENCE.

Collodion Balloons.

To the Editor of the Chemical News.

Sir,—Can any subscriber who has succeeded in making collodion balloons give me a sufficiently detailed account of the method he employed to enable me to do so? To read the instructions given in books, it appears a very simple thing, but I believe I am not the only one who has found the difference between knowing how to make and actually making them. Begging that you will kindly insert this, I am, &c., H. S.

MISCELLANEOUS.

Royal Institution of Great Britain.—The following are the lecture arrangements for the ensuing week: Tuesday, April 10, 3 o'clock, Professor Frankland, "On the Non-metallic Elements;" Wednesday, April 11, 3 o'clock, Professor Du Bois Reymond, "On Muscular Contraction;" Thursday, April 12, 3 o'clock, Professor Frankland, "On Non-metallic Elements;" Friday, April 13, 8 o'clock, Professor Du Bois Reymond, "On the Time required for the Transmission of Volition and Sensation through the Nerves;" Saturday, April 14, 3 o'clock, G. Scharf, Esq., "On National Portraits."

Death of Mr. Fearnside Hudson, F.C.S.—We regret to hear of the decease of Mr. Fearnside Hudson, F.C.S., F.A.S.L., of Manchester, whose work on inorganic chemistry for the Government Science Classes we lately noticed. Although only twenty-nine years of age, he had acquired a sound and deep knowledge of most branches of natural science. He had received high certificates as qualified master in no less than seven different scientific subjects, and was engaged in writing a work on organic chemistry. He formerly studied at Giessen, and was always remarkable for his intense application and earnest zeal in scientific matters. In poisoning cases he had acquired considerable celebrity, as in the case of the children of the murderer Taylor, his analysis and evidence being entirely endorsed by Professor Taylor. Had he been spared, no doubt his great abilities and persevering zeal would have made him very eminent.

Death of Dr. Allan.—We regret to announce the sudden death of Dr. James Allan, of Sheffield. The deceased was the youngest son of the late Robert Allan, surgeon, of Edinburgh. Born and nursed in the very lap of science, and with a taste for its attainments—especially chemistry—he was sent, after acquiring the usual excellent education of his native country in her local schools, to pursue his studies at the German University of Giessen, then becoming noted for the teaching of Liebig. He afterwards spent some time in the study of physics, under popular teachers, at Berlin. On returning to Scotland he became assistant to Professor Gregory, at Edinburgh. He subsequently became Professor of Chemistry at the Sheffield Medical School, the Collegiate School, and at the Wesley College, and in each situation he was alike beloved by his pupils and respected by his tutorial colleagues. Dr. Allen was known to his fellows as a sound chemist, and as possessing an original and highly cultivated mind, and has left in the memories of his numerous students and friends a pleasant recollection of a good and generous life.

Composition and Quality of the Metropolitan Waters in March, 1866.—The following are the Returns of the Metropolitan Association of Medical Officers of Health:—

Names of Water Companies.	Total solid matter per gallon.	Loss by ignition.*	Oxydisable organic matter.†	Hardness.	
				Before boiling.	After boiling.
Thames Water Companies.	Grains.	Grns.	Grains.	Degs.	Degs.
Grand Junction ‡ . . .	—	—	—	—	—
West Middlesex . . .	20·25	0·86	0·48	13·6	3·5
Southwark & Vauxhall .	20·72	1·01	0·49	14·1	4·0
Chelsea	19·99	0·94	0·41	12·8	4·0
Lambeth	20·29	1·01	0·56	13·7	3·1
Other Companies.					
Kent	24·78	1·11	0·05	18·6	7·0
New River	21·44	1·29	0·24	15·8	4·0
East London . . .	23·25	1·14	0·41	16·5	4·5

* The loss by ignition represents a variety of volatile matters, as well as organic matter, as ammoniacal salts, moisture, and the volatile constituents of nitrates and nitrites.

† The oxydisable organic matter is determined by a standard solution of permanganate of potash—the available oxygen of which is to the organic matter as 1 : 8; and the results are controlled by the examination of the colour of the water when seen through a glass tube two feet in length and two inches in diameter.

‡ Not received.

H. Letheby, M.B., &c.

Society of Arts.—Cantor Lectures.—The following is the syllabus of a course of four lectures "On the Synthesis and Production of Organic Substances by Artificial Means, and the Applications which some of them receive in Manufactures." To be delivered by Dr. F. Crace Calvert, F.R.S., as follows:—

Lecture I.—Friday, April 13th.

"On the Synthesis of Organic Substances."

The direct formation of *acetylene* (the most illuminating compound of coal gas), of *formic acid* (the acid of ants), and of *alcohol* (spirits of wine) from mineral compounds. The transformation of *acetylene* into *olefiant gas*, of *formic acid* into *marsh gas* (fire-damp), of *alcohol* into *acetic* acid, and of these substances again into *benzol, phenol,* and *napthalin* (products obtained from coal tar), and of *marsh gas* into *acetylene* and *benzol*, &c., &c., &c.

Lecture II.—Friday, April 20th.

"On the Transformation of Neutral Substances."

On the transformation of *starch* into *cane* and *grape sugars*, and also *pectic acid* (with remarks on the ripening of fruits and the production of jellies). On the transformation of *sugar* into *alcohol, ether, aldehyde, acetic, formic, prussic, oxalic,* and *butyric acids* (the acid of rancid butter), and also the conversion of *sugar* into *mannite* (obtained also from manna), and into *lactic acid* (acid existing in the blood and flesh of animals, and also in sour milk).

Lecture III.—Friday, April 27th.

"On the Transformation of Organic Acids and Animal Substances."

The artificial production of *benzoic acid* (found in benzoin resin) from the essence of *bitter almonds* and from *coal tar* products, and its conversion into *hippuric acid* (found in the secretion of herbivorous animals); of *tartaric acid* (the acid characterising cream of tartar), from *sugar of milk* and from *succinic acid* (the acid obtainable from amber), and its decomposition into *oxalic* and *acetic* acids—On the transformation of *citric acid* (the acid of lemons and oranges) into *aconitic acid* (found in wolfsbane)—On the transformation of *malic acid* (which characterises the acid flavour of green gooseberries, apples, and rhubarb) into *fumaric acid* (the acid of common fumitory) and also into *equisetic acid* (the acid found in the marsh horsetail), and lastly, into *asparagine* (the body found in asparagus and potatoes)—On the transformation of *uric, cyanuric,* and *cyanic* acids into *allantoin* (the substance found in the allantoid fluid of cows)—On the artificial production of *urea* (a substance which characterises the liquid secretions of man and of many other animals).

Lecture IV.—Friday, May 4th.

"On the Artificial Production of Aromatic Substances."

On the transformation of *salicine* (the bitter principle of the willow and poplar) into the essential oil of *meadow-sweet coumarian*, and of the *tonquin-bean*—On *salycilic acid* and the artificial production of the fragrant essential oil of the *wintergreen*, or *gaultheria*—On the transformation of *indigo*, the *oil of potatoes*, and that of *camomile* into *valerianic acid* (the acid which characterises the odour of valerian-root; the berries of the common guelderrose; the oil of the fish porpoise, and of certain kinds of cheese)—On the conversion of *essence of turpentine* into *camphor;* of the essential oil of *mustard* into that of *garlic*, &c.

[We shall publish this course of lectures after the completion of Dr. Percy's.]

Sulphuretted Hydrogen.—This gas, which for experimental purposes is usually obtained by means of sulphuret of iron, may be procured more conveniently, and in a state of greater purity, by the use of sulphuret of calcium. The latter is formed very easily by mixing uncalcined powdered gypsum with one-fourth of its weight of calcined gypsum, and powdered pit coal equal to one-third of the whole of the gypsum used, and working up the mixture to a stiff dough with water; next forming it into pieces four inches long, two wide, and one and a-half thick, sprinkling them with powdered coal, and drying them, then placing them with coke in a wind furnace, and keeping them at a very high temperature for two hours. When cold they will be found externally to consist of oxysulphuret of calcium; but internally of pure peach-coloured sulphuret of calcium, which may be broken in pieces about the size of nuts, and preserved in well-stoppered glass bottles. If water is added to these, and then sulphuric acid in small quantities at a time, sulphuretted hydrogen is given off with great uniformity.—*Scientific Review.*

ANSWERS TO CORRESPONDENTS.

Dr. Phipson.—Received. An abstract will appear when the paper is published in the *Comptes Rendus.*

E. O.—The proportions given are bad. 4 oz. manganese, 5½ oz. salt, and 9 oz. sulphuric acid will give about one cubic foot of chlorine.

Student.—If you read French, get Naquet's "Elements of Chemistry." The best introduction is Wurtz's Chemical Philosophy, now publishing in our pages.

A Constant Reader asks the following questions:—1. When bichromate potassium solution and sulphuric acid are added to iodide sodium solution, in just sufficient quantity to precipitate the iodine, is iodic acid, or any other oxide of iodine, formed at same time? If so, what is the most convenient method of separating it or of obtaining the iodine from it? 2. When sulphuric acid is first added to strong solution of iodide sodium (with or without bichromate potassium), a dense reddish-purple vapour is produced which does not smell of iodine at all; the smell is most like nitric or nitrous acid. What is this vapour?

Books Received.—"Elements of Quantitative Chemical Analysis," by W. H. Spencer, B.A.; "Dictionary of Chemistry," Part XXXIII.—Phosphorus—Potassium; "The Toxicologist's Guide," by John Horsley, F.C.S.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On Some Properties of Formic Acid, *by* *M.* F. V. JODIN[*].

BEER yeast and many other cellular beings belonging to the simplest types of the fungi family may be classed between the animal and vegetable. As vegetables they extract their nitrogen from ammonia and nitric acid[†]; but they cannot, as animals, assimilate carbon, unless it is offered in the state of a ternary compound.

It is now four years since I proposed fixing the limit of the synthetic power of these beings—that is to say, to find out which was the most simple ternary body which could furnish them with assimilable carbon. Experiments have shown that nearly all ternary compounds of vegetable or animal origin, sugars, tartaric, succinic, acetic, oxalic, &c., &c. acids, can each separately, by its association with ammonia, phosphoric acid, potash, &c., form mycogenic media, in which, under certain conditions, organised productions will develope, at the expense of the ternary compound. Formic acid forms the sole exception, and for that reason merits a special study, which I have but recently been able to undertake.

I first proved afresh that formic acid, free, or neutralised by an alkaline or earthy base, associated with the mineral elements PO_5, NH_3, KO, &c., &c., cannot produce a mycogenic liquid. I have kept similar preparations for more than six months, without the appearance of the least organised production altering the perfect limpidity or the chemical composition of the liquid. In this respect formic acid differs from all other ternary acids, including oxalic acid, which, under these conditions, when the solutions are not too much concentrated, and their acidity sufficiently attenuated by the addition of a base, will give organised productions.

These first experiments seem to show that the molecule of formic acid was incapable of furnishing carbon assimilable to the simplest cellular organisms. I wished to find out whether this assimilation could not take place indirectly, as by attraction, associating, in the mycogenic medium, the formic molecule with one more condensed, for instance sugar.

I have, then, made some mixtures, in which the carburetted element, instead of being, as before, simply formic acid, was an association of nearly equal parts of sugar and formic acid, *combined* with lime or an alkali. Similar mixtures have been found highly mycogenic, and have given abundant results. By sufficiently prolonging the experiment, it will always be found that a more or less considerable portion of the formic acid will have disappeared during the vegetation. Sometimes even, it will have entirely disappeared. Is this disappearance of formic acid due to true assimilation? or to a phenomenon of extra-organic oxidation, analogous to that which takes place during the acetification of alcohol, under the influence of the formation of mother of vinegar? This is a question which my experiments have not yet been able to solve.

I have in the above italicised the word "combined," because, in fact, the mixed preparations remain perfectly sterile if they contain a very small proportion of free formic acid. I have proved that a thousandth of free formic acid is sufficient to keep solutions of sugar from altering, though very mycogenic without this addition. This property is remarkable. I ascertained that it does not depend on a purely chemical action by establishing a comparison between perfectly similar preparations, except that the formic acid was replaced by an energetic mineral acid—hydrochloric acid—the greatest quantity being five to six thousandths. After a certain time these preparations produced mycoderms, much less rapidly, it is true, than in unacidulated solutions.

I sought another comparison in phenic acid or phenol, and found that by putting side by side mycogenic sugared preparations, to which I added in one case from one to two thousandths of formic acid, and in the other an equal proportion of phenol, the former nearly always remained unchanged.

This was not the case with fresh muscular flesh. Having placed three pieces of beef, weighing each about 30 decigrammes, in three bottles containing, the first 200 cubic centimetres of water with a thousandth of phenic acid, the second 200 cubic centimetres of water and a thousandth of formic acid, and the third 200 cubic centimetres of distilled water, the flesh in the first was preserved a relatively much greater time than that of the two others; that in the water acidulated by formic acid putrefied much more slowly than that in the distilled water and presented peculiar phenomena. Thus, the liquid surface was covered with a thick mycodermic layer, which was not the case with the two others. After some time the three liquids presented an alkaline reaction. This explains why the preservative action of the formic acid lasted a much shorter time than that of the phenol, since, according to the preceding observations, formic acid exercises this power only when free, while phenol, on the contrary, can exercise it as well in a slightly alkaline medium.

From the rank occupied by formic acid in the series of organic compounds, these facts seem to me to bear on the most important problems of natural philosophy. By many this acid is regarded as the first of a long series of products engendered by the reduction of CO_2 in the vegetable organism, while it is really the key to the artificial synthesis so brilliantly developed by the works of M. Berthelot. For these reasons the study of its chemical and physiological functions is necessarily of great interest.

TECHNICAL CHEMISTRY.

On the Application of Leucaniline,[*] *by* H. KOECHLIN.

WHEN leucaniline,[†] rosaniline, or one of their salts is treated with bodies rich in oxygen, they are transformed into a brown product, which the author proposes to use as a dye.

Leucaniline is prepared by boiling an aqueous solution of rosaniline with zinc in powder. After boiling for a few moments the rosaniline is reduced, and the colourless leucaniline deposits with oxide of zinc. After filtration the mixture on the filter is treated with alcohol, which dissolves the leucaniline. On evaporating the alcoholic solution, leucaniline is left as a yellowish resinous mass.

In the aniline black process the author replaced the aniline by tartrate of leucaniline, and after printing submitted the specimens to the same treatment as that adopted for oxidised aniline black. The operation produced a puce colour permanent in air, and unaffected by

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[*] *Comptes Rendus*, lxi., 1179.

[†] As regards nitric acid, I am not quite decided on this point.

[*] *Moniteur Scientifique*, 1866.

[†] Leucaniline is hydrogenated rosaniline; it is to rosaniline what white indigo is to blue.

acids and soaps. If the colour is fixed by steaming, the use of sulphide of copper is not indispensable.

For wool this colour will advantageously replace the archil puce. By varying the proportions of the oxidising agents, chlorate of potash, and oxalic acid, a variety of shades of colour from pomegranate red to black may be produced.

By treating a solution of rosaniline with chlorate of potash and hydrochloric acid the author has obtained the puce compound mentioned by Hofmann. This compound is insoluble in water, but soluble in alcohol and strong sulphuric acid; water precipitates it from the alcoholic and sulphuric solutions. It may be fixed by the acid of albumen.

Picrate of ammonia reduced by zinc in the same way as rosaniline gives a reddish-brown colouring matter which dyes wool. It is, no doubt, picramate of ammonia.

M. Durand has patented an application of this property of powdered zinc to quickly reduce the aniline colours. He prints the zinc on a fabric dyed violet blue or green with aniline compounds, steams, and then washes. The colour is destroyed by the zinc, leucaniline being formed, and washing leaves a white spot. Zinc may be also used as a resist for aniline black.

On the Use of Stassfurtite (Chloride of Potassium and Magnesium) as Manure, by M. Fuchs.

Whatever advantages result to manufactures from the discovery of the deposit at Stassfurt, their importance is as nothing compared to the benefits which agriculture will derive from it. Besides azotized matters, plants demand for their development a certain number of mineral substances, in proportions varying according to the species, but constant for a given species; so that every privation of this aliment gives rise to a sickly condition in the plant under observation.

Crops remove from the earth every year a greater or smaller quantity of mineral matters, of which the principal are: potash, phosphoric acid, magnesia, soda, silica, and sulphuric acid. A soil of good quality, in 100,000 parts weight, contained 13·4 of potash, and 8·5 of soda; but after several years of uninterrupted culture of clover only three-fourths of the first, and 5·5 of the second of these two alkalies remained, and the soil would only produce a scanty crop of inferior clover.

The black earth of the Russian Steppes, which have a European reputation for their fertility in cereals, contain in the bed traversed by the roots nearly a thousand times the potash necessary for a crop of beetroot, but it becomes so exhausted by three successive years of this culture, that at the end of that time it ceases to yield a remunerative harvest.

Phosphated composts cannot by themselves communicate to the soil powerful and continuous fertility, and to prevent the rapid exhaustion entailed by their use, other salts necessary to the plant, and particularly potash, soda, and magnesia, must be added. Until lately there existed few alkalies of sufficiently low prices to render them applicable to agriculture. The Stassfurt-Anhalt salts come opportunely to supply this want, and agriculturists eagerly utilise the treasures of this saline repository. Positive experiments show that the simultaneous employment of guano and salts of potash as a manure, has the effect of augmenting the quantity of sugar contained in beetroot, and we are enabled to present the following conclusions:—

1. There is a great advantage in employing salts of potash as a manure conjointly with guano, whenever plants absorbing many alkalies are cultivated continuously, such as tobacco, beets, the vine, potatoes, turnips, and in a less degree all cereals.

2. Potash contributes energetically to the formation of hydrocarbides in vegetables; it increases the sugar in beetroot, and the amylaceous matter in potatoes.

3. Its use is a sure and rapid remedy for the diseases which now attack almost all vegetables which need potash for their development.

4. Magnesia exerts a similar, though less important influence; it is assimilated principally by grains, and its presence is necessary in all cereal-producing soils. Employed conjointly with guano, it transforms the ammoniacal compounds of the farm into fixed salts soluble in carbonated liquids.

5. The two substances known under the name of salt of potash (kalisalz), and compost of potash (kalidunger), which are obtained as accessory products in the fabrication of chloride of potassium and sulphate of potash, by means of the carnallite and kieserite of Stassfurt, realise well enough the conditions exacted for the composition of a rational manure, especially when they are employed, the first in the autumn, the second in the spring; moreover, their price is moderate enough to permit of the agriculturist using it regularly.

6. Except in the case of a soil particularly rich in phosphated matters, the most complete mineral manure is that formed of a mixture of guano and salt of potash, in proportions varying with the culture, and equal in each particular case to those which are realised by vegetable assimilation.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, April 5.

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

The minutes of the previous ordinary meeting were read and confirmed. Mr. Arthur E. Davies and Mr. T. B. Redwood were formally admitted Fellows of the Society, and the following gentlemen were duly elected by ballot, viz.:—Mr. Robert McCalmont, Belfast; Mr. William Carr Stevens, Mark Lane, London; and Mr. Thomas Vosper, 27, Nightingale Street, Manchester. The names of several candidates were proposed.

Mr. J. Spiller read a paper "*On the Estimation of Phosphorus in Iron and Steel.*" The author stated that he had succeeded in introducing a modification into the process ordinarily employed in the estimation of phosphorus, whereby a saving of time was effected without impairing the accuracy of the results. The details of Fresenius's method—that usually followed in such cases—were first briefly described, the steps in the process being thus enumerated:—1. Solution of the iron (or steel) in *red* nitro-hydrochloric acid; 2. Evaporation of the ferric solution to expel much of the excess of the acid; 3. Further neutralisation with ammonia or carbonate of ammonia; 4. Partial reduction of the ferric chloride by the action of sulphurous acid; 5. Precipitation of the phosphoric acid, together with the remaining ferric oxide, by boiling the solution with acetate of ammonia; 6. Treatment of the precipitate (by decomposition with sulphide of ammonium, &c.) for the purpose of separating the phosphoric acid; and 7. Precipitation of the latter as ammonio-magnesian phosphate. The author referred then to his proposed modification, which consisted in dispensing altogether with the acetic treatment. For the purpose of concentrating the whole of the phosphoric acid contained in the solution of the specimen under examination in a comparatively small proportion of ferric oxide, it was only necessary to add to the partially reduced and *cold* solution aqueous sesquicarbonate of ammonia until the precipitate, at first red, assumed a greenish hue—a sign that some of the ferrous carbonate was also thrown down. This being collected on a filter was (without washing) dissolved in hydrochloric acid, and to the warm solution were added successively citric acid, ammonia in excess, and sulphide of ammonium, whereby the iron was precipitated, and might be filtered off, washed perfectly with dilute sulphide of ammonium, and the solution only reserved. For the extraction of the phosphoric acid, the somewhat bulky filtrate should be slowly evaporated with full exposure to air, the separated sulphur removed, and the solution precipitated as usual by the mixed chlorides of magnesium and ammonium, in the presence of free ammonia. The product incinerated and weighed in the form of pyrophosphate of magnesia. Mr. Spiller mentioned a few precautions, referring to the occurrence of silicium, and particularly specified a degree of temperature (70° to 75° Fah.) which should not be exceeded when the precipitation with carbonate of ammonia was being conducted. The filtrates from this precipitate had in many instances been examined by the acetate method without discovering the presence of any phosphoric acid in solution, and several analytical results were quoted in support of the accuracy of the process.

Professor **Wanklyn** then read a paper "*On Magnesium*," detailing some experiments made conjointly by himself and Mr. E. T. Chapman. The authors found the magnesium ribbon of commerce to be remarkably pure, which was proved by the quantities of hydrogen evolved during the solution of known weights of the metal in certain diluted acids. The behaviour of the metal in resisting the attack of chlorine, bromine, and iodine, was pointed out, and also the very singular properties of the magnesium amalgam, which decomposed water with even greater facility than sodium amalgam.

Professor **Abel** mentioned an observation of his own to the effect that magnesium filings might be fused with nitrate or chlorate of potash without immediately undergoing oxidation, and only at a very high temperature, and long after the oxygen had been freely evolved, did it seem possible to start the ignition and brilliant combustion of the metal. This tardiness was discovered in attempting to employ metallic magnesium for certain pyrotechnic purposes.

Dr. **Odling** drew a parallel between the active properties of magnesium amalgam and the alloys of zinc and antimony.

Mr. E. T. **Chapman** offered a few observations "*On Mercury-Ethyl*," which the author succeeded in preparing by the action of sodium amalgam upon the bromide of ethyl in the presence of acetic ether—a mode of production which was not found to answer in a corresponding experiment with zinc, when it was hoped that zinc-ethyl would have been formed. The alcoholic solutions both of mercury-ethyl and mercury-methyl were decomposed by sodium, with evolution of gas and precipitation of the mercury.

In reply to the President, Mr. **Chapman** stated that he always employed a considerable excess of alcohol, but otherwise followed the usual method in the preparation of bromide of ethyl.

Dr. A. W. **Hofmann** said he preferred, in the first instance, to prepare the bromide of phosphorus, and afterwards decompose this product with absolute alcohol, by which all danger of explosion seemed to be avoided, even when large quantities were operated upon.

Mr. W. A. **Tilden** read a paper entitled "*Further Contributions to the History of the Periodides of the Organic Bases.*" The author described a series of compounds which were formed by the action of aqueous chloride of iodine upon the hydrochlorates and other salts of organic bases. These products were constituted upon the periodide type, but contained two atoms of chlorine instead of the outstanding iodine in the original formula. The iodo-chloride of tetrethyl-ammonium and the corresponding compound of caffeine, each in beautiful crystals, were exhibited, and similar products containing quinine and triethylamine were said to have been prepared. These bodies were compared with the periodides formerly described, thus,—

Periodide of tetrethylammonium $(C_2H_5)_4NI, II$.
Chloriodide of tetrethylammonium $(C_2H_5)_4NCl, ClI$.

In answer to Dr. Frankland, Mr. **Tilden** stated that his salts had all been crystallised from hydrochloric acid solutions, and that he had never yet succeeded in preparing compounds containing an *even* number of atoms of chlorine or iodine.

Mr. **McLeod** then exhibited a mode of forming acetylide of copper in considerable quantity by a modification of the process first indicated by M. Berthelot. The apparatus was simply one in which the inverted combustion of oxygen in coal gas was usually shown as a lecture illustration, with an appropriate receptacle charged with ammonio-subchloride of copper, through which the products of combustion were passed. A gasometer of marsh gas (prepared by heating acetate of sodium with soda-lime), was in this instance made use of, and, to make the proof absolute, the gas was first passed through a preliminary washing-bottle containing the same copper solution. A red precipitate of the substance in question was quickly formed, and Mr. McLeod stated that in the apparatus exhibited he had prepared in an hour a gramme, or more, of the acetylide of copper. The formation of acetylene was manifestly the result of burning out three-fourths of the hydrogen in marsh gas, but as yet he had come to no satisfactory conclusion respecting the exact composition of the red powder, which was believed to contain a certain quantity of cuprous oxide in union with the acetylide. The product was very explosive, and in one instance underwent violent decomposition in the water oven, although it is usually said to explode at or near 120° C. When fired by the stroke of a hammer the substance flashed without noise, but when gently heated on filter-paper it suddenly exploded with a loud report, and at the same time diffused a black, soot-like material on the surrounding paper, which burnt like tinder; whether carbon or oxide of copper, remains to be ascertained. [These experiments were shown at the meeting.] Coal gas or benzol vapour also furnished acetylene. The glass jet, at which combustion occurred, was wrapped with thin platinum foil, so that, if the requisite supply of gases was kept up, the flame would be instantly rekindled if extinguished by accident; the use of an ordinary platinum blowpipe jet could not be recommended. Specimens of the acetylide of copper, prepared from a variety of hydrocarbons, were exhibited, some of which had been boiled in water to show the slight alteration of colour.

Dr. **Frankland** said he had frequently seen Mr. McLeod's apparatus in action, and he considered it not only an instructive lecture experiment, but a very good process of making acetylene.

Dr. A. W. **Hofmann** spoke of the interest attaching to these compounds, and mentioned a reaction by which acetylene could be formed, viz., by acting with ammonia (in alcoholic solution) upon the bromide of ethylene.

Mr. **Wanklyn** detailed other methods of preparation, and especially dwelt upon that in which bromide of ethylene was boiled with ethylate of sodium.

Dr. A. W. **Hofmann** then vacated the chair, which was thereupon taken by Dr. Frankland, and offered some interesting observations "*On the Synthesis of Guanidine.*" The speaker commenced by reverting to his discovery, nearly twenty years ago, of melaniline, the constitution of which he now proposed to view upon a treble ammonia type, when it appears as the carbo-diphenyltriamine. In a similar manner the methyluramine of Dessaign be regarded as carbo-methyltriamine, while two other compounds formed by the action of chloride of carbon upon aniline, and by treatment of ethylate of sodium with cyanic or cyanuric ether, may be arranged in the same group under the names respectively of carbo-triphenyltriamine and carbo-triethyltriamine. At the head of this natural series stood guanidine, the interesting body prepared by Prof. A. Strecker by the action of oxidising agents upon guanine. Its formula, CH_5N_3, admitted of this body being viewed as carbo-triamine—a compound in which the three ammonia molecules are riveted together by the carbon atom without any hydrogen being replaced by complex groups that could disguise its constitution. Although this substance had hitherto been formed by somewhat complicated processes, the author conceived it possible to build up this compound by simple methods, and tried first the action of chloride of carbon upon ammonia, hoping that a reaction, true in the case of aniline, might do good service in the present instance, but experiment did not support the following hypothesis:—

$$CCl_4 + 3H_3N = CH_5N_3,HCl + 3HCl.$$

By substituting for the chloride of carbon a compound nearly related to it, viz., the chloropicrin of Dr. Stenhouse, the author found that the synthesis of guanidine was easily effected. Since it was necessary to raise the temperature, when aqueous solutions were employed, to 150° or 160° C., Dr. Hofmann found it convenient to operate with alcoholic solutions, and obtained the same results at the lower temperature of a water bath; but in every case the liberation of nitrogen necessitated the frequent opening of the tubes to relieve the pressure. The change which occurred was expressed by the following equation:—

$$\underbrace{CCl_3NO_2}_{\text{Chloropicrin.}} + 3H_3N = \underbrace{CH_5N_3.HCl}_{\text{Hydrochlorate of Guanidine.}} + 2HCl + HNO_2.$$

The evolution of nitrogen was manifestly due to the secondary action between nitrous acid and ammonia, and sal ammoniac was at the same time formed. After seven or eight days' digestion the action was completed, and the liquid could then be mixed with water without separating into two layers. The solution was slowly evaporated to dryness to expel the excess of ammonia, and the residue was treated with absolute alcohol, which dissolved out only the deliquescent hydrochlorate of guanidine. From this the platinum salt was prepared and analysed. With the object of avoiding the evolution of nitrogen, Dr. Hofmann was led to attempt the formation of the base itself by the action of ammonia upon Mr. Bassett's ether, appropriately called "orthocarbonate of ethyl" by Dr. Odling, and this mode of synthesis was found to be possible at the temperature of 150° C.

$$\underset{\substack{\text{Orthocarbonate}\\\text{of Ethyl.}}}{C(C_2H_5)_4O_4} + 3H_3N + H_2O = \underset{\text{Guanidine.}}{CH_5N_3,H_2O} + \underset{\text{Alcohol.}}{4(C_2H_5,HO)}$$

In conclusion, the author pointed out that the orthosilicate of ethyl might furnish similar results, or be converted by the action of ammonia into a guanidine containing silicium.*

Dr. **Frankland** moved a vote of thanks to Dr. Hofmann for his interesting communication—a proposal which was warmly responded to—and

Dr. **Odling** offered a few remarks upon the constitution of urea viewed in comparison with that of guanidine. The first-named substance was the carbo-diamine hydrate, thus—

Guanidine.	Urea.
CN	CN
H_2N	H_2N
H_3N	H_2O

The meeting was then adjourned until the 19th inst., when Professor G. C. Foster will deliver a lecture "*On the Thermal Phenomena Accompanying Chemical Action.*"

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology,

by Dr. Percy, F.R.S.

Lecture No. III.

Ladies and Gentlemen,—On the last occasion I brought before you the subject of the formation of sapphire, ruby, and those minerals consisting essentially of crystallised alumina of various colours. I told you that there is no doubt whatever as to the fact of the true sapphire or the true ruby having been produced artificially by Deville—on a very small scale, it is true, and unhappily that fact does not justify any very sanguine hope with respect to our ability in future to produce the same mineral on a large scale, so as to be attractive to the jeweller. It may be that, in order to generate large crystals, time, that important element—a long time in a geological sense—may be absolutely essential—a condition which, of course, we transitory mortals can never hope to command.

I am directing your attention especially to the formation of these minerals because they indicate to us the precise condition under which the rocks containing them have been generated, and they may be therefore regarded, so far, as exponents of the geological mode of formation, so to speak. It is true that they are very small—almost microscopic objects; yet they no doubt admit of very important applications, and may lead to deductions of the highest possible consequence in geological reasoning. Now, although we are still able to produce by artificial means, in one particular way, a mineral compound which occurs in Nature, it does not follow that Nature should have adopted that way, and no other. For example, I shall be able to show you, by-and-by, a very well known mineral called felspar, which occurs occasionally beautifully crystallised in certain furnaces, purely as a product of direct, unmistakable igneous action; but I can also show you that we can generate the same mineral matter, precisely identical with the natural mineral, by means of aqueous solutions. Here, then, we have two distinct methods of generating this important mineral. It may be, and no doubt often is the case, that Nature has adopted not only one, but several modes of generating a mineral species.

Now, the next substance to which I have to direct your attention is one that bears intimately on the formation of sapphire and certain aluminous materials. It is a mineral, not very interesting in a jeweller's point of view, though interesting in many respects. It is the mineral called staurolite. It is essentially a silicate of alumina; that is, a combination of silica and alumina. We are indebted to Deville for a very instructive and remarkable experiment showing how this mineral may be formed by the agency of a very small quantity of the element fluorine. If you take fluoride of silicon, the gas which was generated here on a former occasion—that gas which, on bubbling through water, becomes decomposed, depositing gelatinous silica—and expose alumina to its action at a bright red heat, you produce the mineral in question, and fluoride of aluminium. There is a curious interchange between the

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[*] As a consequence of the typical character of guanidine, Dr. Hofmann applied a new nomenclature to the series of bodies named at the commencement of his discourse, and showed their intimate connexion, thus—

Carbotriamine (Guanidine)	$\left.\begin{matrix}C''''\\H_3\\H_2\end{matrix}\right\}N_3$
Dessaignes' Methyluramine (Methyl-guanidine)	$\left.\begin{matrix}C''''\\(CH_3)\\H_4\end{matrix}\right\}N_3$
Melaniline (Diphenyl-guanidine)	$\left.\begin{matrix}C''''\\(C_6H_5)_2\\H_3\end{matrix}\right\}N_3$
Triphenyl-guanidine	$\left.\begin{matrix}C''''\\(C_6H_5)_3\\H_2\end{matrix}\right\}N_3$
Triethyl-guanidine	$\left.\begin{matrix}C''''\\(C_2H_5)_3\\H_2\end{matrix}\right\}N_3$

compounds, and the result of the reaction is the formation of this mineral, staurolite, in a crystallised state. Suppose we have a long porcelain tube which we can insert into a furnace so as to expose it to a sufficiently high temperature for our purpose. Within the tube we place a quantity of alumina, and at this end we will introduce a current of fluoride of silicon. We get the fluoride acting upon this alumina, a compound of aluminium and oxygen, and the result is an interchange. We get silicate of alumina and fluoride of aluminium. Suppose we now pass this fluoride of aluminium over the remaining alumina; on acting upon the silica at a high temperature, this fluoride of aluminium will undergo a decomposition exactly analagous in character to that which takes place in the first instance, and we get again silicate of alumina and fluoride of silicon eliminated. We pass that fluoride of silicon again over the alumina, and we again get silicate of alumina and fluoride of aluminium. Thus, by the action of a small and definite quantity of fluoride of silicon, we can succeed in converting a large and indefinite quantity of alumina into this mineral, silicate of alumina.

Now this is a very important point, and it illustrates what may have taken place in nature—not that nature ever acted precisely in this way; but by these consecutive reactions a large amount of a given mineral may have been produced by a very small quantity of a particular agent, and there is reason to believe that, in some cases, at all events, this kind of reaction has prevailed pretty extensively. This is a remarkably illustrative experiment, and it is on that account especially that I am anxious to bring it prominently before your notice.

Another mineral of the same class is the common yellow topaz, with which we are all well acquainted—not that magnificent Oriental topaz, or yellow sapphire, to which I called your attention on the last occasion. It is a similar mineral to staurolite, and it might be thought it would be formed by the same process, but Deville says it is not so. On the one hand, Daubrée states that he formed topaz by heating alumina to redness in a current of fluoride of silicon. Now these two observers, both distinguished men, disagree, and of course we must wait for some future observations to enable us to decide which is right. If, on the other hand, in this experiment we substitute the earth zirconia for alumina, we generate a silicate of zirconia, or the mineral zircon, a product exactly similar in all essential respects to the natural mineral of that name, which occurs abundantly in a rock in Norway, so well known to mineralogists and geologists as zircon sienite. Again, this action may tend to illustrate the particular conditions under which this rock may have been generated in former periods.

Another aluminous mineral I called your attention to is cryolite, which I said might be used as a source of aluminium simply by heating it with the metal sodium. This cryolite is a white crystalline body. It fuses at a comparatively low temperature, and occurs abundantly in Greenland. There is a bed there not less than 18 feet in thickness. I have been told by Mr. Taylor, who has lived there for a long time, that the mineral could be exported for about 9*l*. a ton. This rock, if I may call it a rock, is composed of three equivalents of fluoride of sodium, and one of fluoride of aluminium ($3NaF + Al_2F_3$). It contains no water, or, in other words, it is anhydrous, and it yields exactly 13 per cent. of aluminium; that is, the pure mineral would yield that. It has not yet been applied to any very important purpose. Attempts have been made, I believe, to employ it as a source of sodium for the manufacture of soap, but I do not know how far success may have attended those attempts. There is no doubt that, if we had no cheaper source, it might be used as a source of aluminium.

But I call your attention especially to another rock of interest just now, a rock occurring in the south of France, which contains a large amount of alumina. It is termed banksite. The proportion of alumina is 60 per cent. Here is a curious iron ore from Belfast, which contains a large amount of alumina apparently uncombined. I think about 20 or 30 per cent. We have made several analyses of it, and if it were necessary it might be made a source of alumina, but alumina abounds on all hands, and we have no difficulty in preparing any amount we may require.

We pass on now to another metal of considerable importance in a geological respect, the metal calcium, which forms the basis of lime, and which we are so familiar with in that form—a compound of the metal with oxygen.

Calcium is undoubtedly one of the most abundant metals on the face of the globe. I am sorry to say that I have not a specimen of it to show you, but it possesses a strong affinity for oxygen, and when separate, easily oxidises on exposure to the air. It is an exceedingly light metal, has a yellow colour, and is easily fused. It has, as I say, an intense affinity for oxygen, and the oxide of calcium has a powerful affinity for water. If we take a piece of common chalk or limestone, which consists of the oxide of calcium and carbonic acid, and expose either to a pretty good red heat, the carbonic acid is evolved, and there remains behind oxide of calcium in a greater or less state of purity. If now we add a little water to that, as you know perfectly well, the operation of slaking takes place—that is to say, the water enters into chemical combination with the oxide of calcium, forming a true chemical compound, and that is how we account for the evolution of heat in this operation of slaking.

The compound of most interest to us in connexion with lime undoubtedly is the carbonate of lime, which occurs in three very distinct forms, each one of which we must study separately. First of all we have the amorphous, formless, non-crystalline kind, and that is well illustrated by common chalk, which is essentially composed of carbonic acid and oxide of calcium in combination. It is never absolutely pure—it always contains more or less of foreign matter. Then, again, we have carbonate of lime in two distinct crystallised states, that is, crystallising in two distinct systems of crystallisation—the prismatic and the rhombohedral. The prismatic is the well-known mineral called arragonite; the rhombohedral is the perhaps better known mineral calcite or calcspar. It is also known to you under the name of "doubly refracting spar." Of this there is a very fine specimen in the museum above. If a piece of it is placed over a single line drawn on paper, that line will appear double, and hence the name "doubly refracting spar."

Carbonate of lime is composed of one equivalent of carbonic acid, and one of oxide of calcium or lime.

Now, ladies and gentlemen, there are, in relation to arragonite and calcspar, several points, apparently very small points, but nevertheless very important ones, which have a definite and decidedly geological bearing with regard to the formation of several mineral matters or rocks in which these substances occur, or of which they constitute an integral part, and on that account I must be allowed to dwell somewhat minutely upon those points.

First of all, in regard to the specific gravity of these substances. The difference between arragonite and calcite in respect to specific gravity is a fact worth noting. That of arragonite varies from 2·93 to 3·01. These are the extremes I find recorded. Calcite has a lower specific gravity, ranging from 2·69 to 2·75. Arragonite, you will remember, crystallises in the prismatic system, and calcite or calcspar in the rhombohedral system. Next as to solubility. According to Bischoff, one part of carbonate of lime dissolves in 110,000 parts of pure water, to put it in round numbers. It dissolves to a much greater extent in water containing carbonic acid, forming the well-known compound termed bicarbonate of lime. You have all seen that calcareous deposit thrown down from certain springs. The water is allowed to run over objects immersed in these springs—bird-nests, and so on. Well, a portion of the carbonic acid, by which the carbonate of lime is held in solution, escapes through exposure to the air, and carbonate of lime is deposited on the object. This is falsely called "petrifaction." There is no real conversion into carbonate of lime. It is simply incrustation. But if, by the operation of some siliceous salt, I can remove the whole of the organic matter of the article immersed, and convert its structure into silica by replacing the organic matter by that substance, then we get a case of real petrifaction. The so-called "fossil wood" is a capital example of this. It is wood in which every part has been replaced by silica in such a way that the structure is perfectly retained.

One part of carbonate of lime dissolved in about a thousand parts of water containing carbonic acid. The exact numbers are 998 parts. In this case the gas was passed through the water for about an hour.

Bischoff tells us that there is a great difference in the solubility of carbonate of lime, according to the nature of the carbonate of lime operated upon. Thus, 11 parts, in round numbers, of chalk were dissolved in 10,000 parts of water by passing carbonic acid through for an hour. He repeated this experiment several times, and the result was nearly the same in each case. Then he tried another kind of carbonate of lime—that thrown down from a salt of lime—precipitated, in fact, by an ordinary reagent passing the carbonic acid through for about the same time as he did in the case of the chalk. Then he says that 28 parts dissolved in 10,000 parts of water.

There is a curious fact with regard to arragonite which is very well known—that when heated up to a certain temperature it falls to powder, and formerly it was generally believed and stoutly maintained that this powder really consisted of minute microscopic rhombs of calcite. That point has been disputed, and, I believe, correctly so, by Gustave Rose, who is undoubtedly one of the best living authorities on such questions.

Let us consider the conditions under which these various forms of carbonate of lime—arragonite, calcite, and chalk, or the amorphous variety—may have been formed. Unfortunately, this is a consideration which may involve tedious minutiæ, but it is impossible to avoid them if we are desirous to obtain correct information upon the subject.

The best observer on these points, as far as I know, is Gustave Rose. It is impossible to repeat his experiments before an audience like this. There is nothing in them attractive to the eye, and they are very slow affairs, taking a long time in order to enable us to get a result. It is only in the laboratory that experiments of this kind can be satisfactorily performed.

Well, arragonite may be formed by dropping common chloride of calcium into carbonate of potash or soda. In this operation decomposition takes place. There is an interchange amongst the elements. The chlorine goes over to the potassium or sodium, and we get chloride of potassium or chloride of sodium (common salt), and we get also carbonate of lime. That is very plain. Now, as to the formation of arragonite. The mass is clear when molten, but it becomes opaque on solidification. When the mass was washed with cold water an amorphous carbonate of lime, or chalk, was produced, according to Rose. He tells us that it was always obtained first in minute microscopic globules, perfectly non-crystalline, but that after twenty-four hours the whole became changed into small crystals of calcspar—clear and distinct rhombic crystals. On the other hand, when the product obtained was boiled in water instead of being washed in cold water, as in the case just mentioned, the globules, he says, were almost instantly changed, not into rhombs of calcspar, but into prisms of arragonite. Now, note, this is the effect of temperature. Understand this particularly. By taking this mass, consisting of chloride of sodium or potassium and carbonate of lime, and washing it with cold water we get crystals of rhombic spar. On the other hand, by boiling it with water, we get prisms of arragonite. This difference of temperature has caused all this difference of form. But the small, microscopic crystals of arragonite, when left to cool in the water, became, he tells us, further transformed into rhombs of calcite. That is a remarkable point, and he found the same results were obtained by substituting chalk, arragonite powder, or calcspar for the chloride of calcium in the experiment.

Becquerel long ago performed an experiment concerning the artificial production of arragonite. He produced it by leaving plates of selenite or gypsum in a solution of bicarbonate of soda for several years, the solution having a specific gravity of 1·070, that of water being taken as 1000. He obtained the same result in a few days by heating it to the boiling point. The experiment had to be performed under pressure, otherwise carbonic acid would have been evolved. For this purpose you require a very strong glass tube. Here, then, by the slow operation, during a long time, of a solution of bicarbonate of soda upon gypsam or crystallised selenite you get arragonite, and you get the same result produced rapidly by boiling the same compound in the solution.

I have some further experiments of Rose bearing upon this subject to bring forward. He found that by leaving a *very dilute* aqueous solution of carbonate of lime—not only dilute, but *very* dilute—in excess of carbonic acid freely exposed to the air, arragonite was formed. All depends upon the solution being very dilute, and at the ordinary temperature. If a common solution, he says, is thus left exposed, you do not get arragonite, but crystals of calcite. Here, then, these great differences in crystalline form are due to these very small and apparently unimportant changes of condition. By heating a common solution of carbonate of lime; that is, one containing an ordinary amount of carbonate of lime dissolved by the aid of carbonic acid, you get arragonite and not calcite. An ordinary solution of carbonate of lime, or, what is equivalent, a much stronger one, gives you calcite by exposure at the ordinary temperature. The same solution, when heated, deposits arragonite. We shall see that arragonite is frequently produced in certain hot springs. Then, further, Rose says that if such a solution be evaporated in a platinum vessel we obtain carbonate of lime in all its forms—namely, chalk, arragonite, and calcspar.

I will just show you that very common experiment of dissolving lime in water containing carbonic acid. It takes some time, but it will go on while I am talking about other matters. We have here a solution of lime in water. We will pass carbonic acid through the water, by which means carbonate of lime will be formed. That is much less soluble than the lime, and we shall render the water opaque. But by continuing to pass the carbonic acid the carbonate of lime will be redissolved, and the solution will become perfectly transparent.

Rose then went on to investigate exactly the effect of different temperatures. At the boiling point of water, that is, at 100° centigrade, the greatest part of the residue, he says, was arragonite in characteristic small prisms. At 90° most arragonite was formed, and the crystals were larger than at other temperatures. At 70° the prismatic crystals of calcspar predominated, and were accompanied by hexagonal plates and small stars of calcspar, and the arragonite crystals were small. At 50° there was more calcspar, and the proportion of plates and stars, as compared with the rhombs of calcspar, increased. At 30° no arragonite whatever was found. The rhombic crystals of calcspar were comparatively large. There were still some plates and stars. All the arragonite occurred at a higher temperature than 30° centigrade, and the hexagonal plates of calcspar were formed at a lower temperature than 70°. Calcspar is always formed in solutions containing carbonate of lime, when carbonic acid is set free. By exposing in a warm place a well stoppered vessel containing a concentrated solution of carbonate of lime in excess of carbonic acid, crystals of calcspar were thrown down. Then he went on further to determine the influence of dilution. When he took an excessively dilute solution he got arragonite; and if the solution was ever so little stronger he got calcspar. He mixed chloride of calcium with carbonate of soda under very special conditions, whereby decomposition might take place with extreme slowness, and under conditions of extreme dilution. I think you will admit that these apparently unimportant and trivial matters may really become very valuable to geologists in considering the conditions under which the various deposits with which they have to deal may have been produced.

In native arragonite a little carbonate of strontia is frequently found, but not always. It was at one time supposed to be a constant constituent, but that supposition is erroneous. In looking over a good many analyses I find that the maximum amount is stated at about 2½ per cent., not more.

We find arragonite in the deposit of the hot springs of Carlsbad. It occurs also at Molina, in Arragon, hence the name. This is a specimen of it from the forest of Dean. It sometimes occurs in great beauty, but the interesting point is the associated matters. It occurs, for example, in basaltic rock—no doubt there the result of secondary action, a sort of action we shall hereafter consider. It occurs also in the serpentines at Piedmont, in the lavas of Vesuvius, and Iceland, and in beds of brown iron ore, and in Styria.

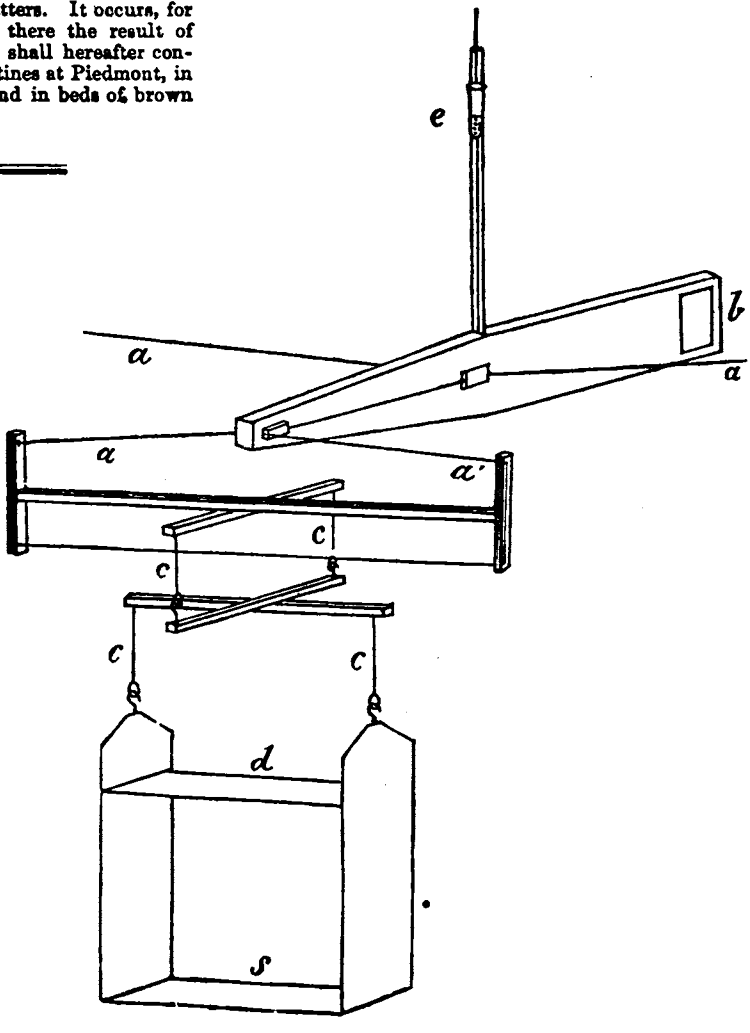
(To be continued.)

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, March 20.

E. Schunck, *Ph.D., F.R.S., Vice-President, in the chair.*

Dr. J. P. Joule, F.R.S., exhibited a balance which he had constructed on the principle which had been introduced by Professor Thomson, and employed by him in weighings for a long time. The adjoining figure will fully explain the instrument. The beam has a leaden weight let into its extremity *b*. It is supported by a wire *a a* stretched between the sides of the box containing the balance. This wire is led round so as to form the suspender *a′ a′* of the scale. Silk threads, *c c*, *c c*, hanging from the cross pieces, form a gimbal system by which the scale is supported in such a manner that any variation in the position of the weights does not alter the torsion of the suspender. A counterpoise of known weight is placed on the stage *d*. When an article is to be weighed it is placed in the lower part of the scale *s*, and then, the counterpoise being removed, weights are placed on the stage to effect the counterpoise in the new condition. The difference between the first and second counterpoises of course gives the weight required. The upper edge of the beam is furnished with an index for showing minute effects; and attached to this is a small bottle *e* for holding shot or sand, by the addition of which the stability of the beam may be decreased to any required extent. The instrument exhibited was able to weigh articles of upwards of 3000 grains to one-hundredth of a grain. Dr. Joule stated that he had also employed Professor Thomson's principle in the construction of a galvanometer for the absolute measure of electrical currents. In this instrument a flat coil is suspended between two fixed flat coils, one of which attracts while the other repels the suspended coil, to which last the current is conducted by means of the suspending copper wires. This electrical balance is sensitive to one part in two millions.



Mr. Binney, F.R.S., exhibited a "*Singular Mineral*," which Mr. Ward, of Longton, had found in a nodule of clay ironstone from the North Staffordshire coalfield. At first sight it looked like a fossil coral of the genus *Cyathophyllum*, but on more careful examination it appears to be a mineral mass in a semicrystalline state. The form of the mineral appears to have been spheroidal with crystals radiating from the centre. By the kindness of Dr. Crace Calvert he had ascertained the specimen to consist chiefly of carbonate of lime, carbonate of iron, and phosphate of lime, with traces of magnesia, alumina, and organic matter, and 10 per cent. of silica. He also exhibited a "*Beautiful White Specimen of Carbonate of Strontia*" obtained from a vein of carbonate of lime. It occurred among the lime in radiated masses similar to those of carbonate of barytes as sometimes found in veins of sulphate of barytes. This mineral has been found in considerable abundance, but up to this time it is believed that no use has been found for it on a large scale.

Messrs. **Hull** and **Brockbank** exhibited specimens of the iron ores referred to in their paper "On the Liassic and Oolitic Iron Ores of Yorkshire and the East Midland Counties," read at the last meeting of the Society.

Professor **Roscoe** stated that he had just received a letter from Professor Bunsen, announcing the discovery of a most interesting and important fact, namely, that the well known black absorption lines of the didymium spectrum, when examined with polarised light, vary according to the direction in which the light is allowed to pass through the crystal. This shows that the position of the black absorption lines is in some degree dependent upon the physical structure of the body through which the light passes, and is not merely determined by its chemical constitution.

The following papers were read at the Photographical Section Meeting, February 8, 1866:—

"*On the Supposed Photographs by Boulton and Watt.*"

By **Joseph Sidebotham**, Esq.

About three years ago the scientific world was startled by the announcement of the discovery of sun pictures, on paper and on silver plates, said to have been produced at the close of the last century, by Matthew Boulton and James Watt; shortly afterwards Mr. Smith, of the Patent Museum, read a paper on the subject, and exhibited the pictures in question at a meeting of the London Photographic Society, and also produced copies of many documents connected with the subject. The whole was published in the *Journal of the Photographic Society*, together with the discussions, and a large amount of correspondence appeared in the journals. No conclusion, however, appeared to be arrived at, nor any suggestions made of the process by which the pictures on paper could have been produced.

During the last winter, in company with Mr. James Nasmyth, I paid a visit to the Patent Museum. Through the kindness of Mr. Smith, we had an opportunity of examining these pictures carefully, hearing what he had to say on the subject, and seeing some of the original letters and papers. Mr. Smith also gave me a small portion from one of the torn pictures, and has since sent me another, for the purpose of careful examination. Through his kindness, also, I am enabled to exhibit to you this evening a number of the perfect pictures, in the hope that, by your seeing and examining them, some light may be thrown on the secret of their production.

It will be, perhaps, well to give you a short historical sketch of the pictures. Those who wish to refer at length to the published accounts will find them in vol. viii. of the *Journal of the Photographic Society*.

The pictures in question consist of a number on paper—some large (so large, indeed, that it requires two sheets to form one subject), others small. They vary in shade of colour from black to dull red—many being of a sepia tone Some are plain, others coloured. These pictures came from Boulton's old house at Soho, and many of them are evidently experiments, being marked with large figures in pencil. The plates are two silvered copperplates, also found in the old library at Soho. These we will, however, leave for the present, and proceed with the pictures on paper.

According to the evidence of letters and other documents produced by Mr. Smith, Matthew Boulton was in possession of a secret plan for producing what he called "mechanical pictures"—the inventor, or partial inventor of the process being a person of the name of Eginton, who appeared to superintend this department of the Soho establishment. These pictures (all apparently copies of paintings) were produced rapidly, and at very low prices—from seven shillings and sixpence upwards, according to the size. They appear to have all the touches of a painting. Sometimes they were transferred to canvas and painted in oil colours, sometimes tinted on the paper itself, sometimes transferred to copper plates. Orders appear to have been given to artists for the sole purpose of having the paintings to copy or reproduce. They were sold in considerable numbers, and could, it appears, be produced of various sizes according to order. The pictures on paper were all reversed, the figures left-handed. When more than one sheet of paper was required for a subject, the picture was not joined in a straight line, but curved, so that the juncture fell in the shadow, as in the leading of painted windows. Eginton was a glass painter, and perhaps took his idea from that source.

There is much interesting matter published concerning a proposed government pension to Eginton, and a letter to the Earl of Dartmouth on the subject from Matthew Boulton; also letters from Mr. M. P. W. Boulton and others; but, as they have no direct bearing on the mode of producing the pictures, I merely allude to them here.

Although it is well known that Watt, Boulton, Davy, Wedgwood, and other members of the Lunar Society experimented in photography, and tried to fix the images formed in the camera, we have the direct statement that, up to the year 1802, Wedgwood had been unsuccessful—that no amount of exposure appeared to produce an image. It is not likely, therefore, that, for years before (the mechanical production of pictures was in full operation in 1790), his intimate friend Matthew Boulton should not only have been in possession of a secret mode of fixing images of pictures, but actually producing and selling large numbers of them. For this and other reasons we must, I think, decide that these pictures could not in any way have been produced in the camera; besides the great size and the perfect definition would be beyond the power of any instruments that could then be made. There is another argument, too—that if the camera could have been used, paintings would have not been the only subjects reproduced—views from nature, or, at any rate, works of art, would have been experimented upon.

On some of the pictures are seen curious small spots, each casting a shadow in the same direction—a very familiar appearance to those who have copied oil paintings in a raking light, when each raised spot of colour does actually cast its shadow. This has been considered an evidence of the pictures having been produced by the camera; but I shall further on be able to account for this appearance in another way.

Although we cannot call these pictures photographs, seeing that they have been produced by some different process from any we are acquainted with, we have the distinct evidence of Dr. Lee and Mr. Hodgson, clear and unmistakeable, that pictures produced by this mechanical process were pointed out by Matthew Boulton as having been produced in some way by sunlight.

Perhaps we shall do well to narrow the field of inquiry, by considering some of the suggestions that have been made, and showing how they could not have been produced.

We may decide that they could not be copies by hand:—1st. Because they are distinctly called "mechanical pictures," produced by a secret process. 2nd. Because in two copies of the same subject such minute lines and marks are found to exist in both—lines not visible without the microscope, quite impossible to be copied by hand. Besides, we have the testimony of those whose lives have been spent in engraving and making *facsimile* productions that the thing is impossible. They could not, I think, be impressions from metal or blocks. The peculiar surface of the paper, and the colouring matters used, would be quite unsuited to printing purposes. The great cost of engraving these large surfaces for but a limited number of copies; the different sizes in which the pictures could be made; the non-necessity, in such case, for the reversing of the pictures - are all good arguments against any system of engraving being used.

It has been said that the plate mark on some of the pictures suggests the employment of plate printing; but, on examination, as you will see, the supposed plate mark is merely an embossed line on the paper, either intended as a finish or, more probably, to mislead as to the mode of production.

The specimens for your examination consist:—

1st. Of two similar pictures—one plain, the other coloured. A careful examination of these will show that spots and lines only visible with a lens exist exactly the same in each, such as no artist could possibly copy; yet, strange to say, there are considerable differences—some of them striking: but these are of precisely the same nature as you would have in an under-exposed and an over-exposed print, both from the same negative.

2nd. We have a coloured mechanical picture—subject, "The Graces Awakening Cupid." This may be compared with an engraving of the same subject, evidently both taken from the original painting. In this you will notice the mechanical picture is reversed.

3rd. We have a red mechanical picture—"Flora Bedecking Pan." This may also be compared with an engraving of the same subject, or rather one somewhat similar. In the engraving another figure is added; and there are other differences. In this case the original picture had probably been reproduced with additions, and the engraving taken from the later one.

4. A large picture in two parts, from a painting by Benjamin West. You will notice, as peculiar, the mode in which the two portions of the picture are intended to be joined together; also that the two halves are not of the same tint, either in shade of colour or depth.

I will now give you the result of my examination of the pictures and the fragments given to me by Mr. Smith for the purpose of analysis. The surface of the paper appears, first, to have been prepared with gum and sugar. On that is the image impressed, consisting of finely-divided particles, apparently laid on either in the form of vapour or very fine powder. Over the picture is a coating of albumen. This has been applied, most likely, by floating the picture on the surface of a vessel containing albumen. The picture has then, probably, been taken up carefully and allowed to drain for a short time, and then laid flat to dry. Small air-bubbles, or particles of dust, on the surface would just produce the curious appearance of projections and shadows before-mentioned—the powdery surface being slightly carried away and deposited, just as we see it. Those who have made experiments in photography—such as in the old carbon process, &c.—will at once fully understand my remarks. The albumen, in drying, has run into the hollows of the paper, as we see in the specimens. It is easy now to see how the images could be transferred to canvass, or painted upon on the paper.

How the images were formed I cannot even venture a suggestion. The process, if re-discovered, would be still valuable, even with our other and various modes of reproduction. For effect and beauty the specimens now shown are not to be despised; and for permanency have had the test of nearly eighty years.

Many of these pictures must be in existence in old houses and country inns; and, if more specimens were obtained, some clue to the secret might be found. I feel confident I have more than once seen specimens. Once, in particular, when on a photographic trip, in 1853, with our old member, Mr. Barton, either at Ludlow or Hereford, we saw several of them, and puzzled ourselves to make out what they were, with their striking photographic appearance. At length we decided that they must be sepia drawings.

The pictures on silver plates are two, and, on certain evidence, thought to be views of Soho House before the alteration. As this took place at the end of last century' these pictures, according to that idea, must have been taken at least sixty-six years ago. All we have to judge upon is this evidence, which is rather weak. The pictures are evidently taken in the camera, and are genuine photographs. From the evidence published in a pamphlet by Mr. M. P. W. Boulton, it appears highly probable that these pictures were taken about twenty-eight to thirty years ago by his aunt, Miss Wilkinson.

Independently, however, of this, I fear we must give them up as modern productions. Their appearance is that of daguerreotypes of the early period, made sensitive with iodine alone; and the image, as may be seen through the microscope, is composed of mercury vapour. But another piece of evidence appears to me more conclusive still, and that is the size of the plates. I have here a daguerreotype view of Rome, taken in the early days of the art — one of a number taken at that time in Rome and Paris. If we now compare the size of the plate with the Soho pictures, we shall find them identical. Such could scarcely be an accidental coincidence. These plates were not made or used for any other purpose; and it is not within the bounds of probability that the standard size of pictures, taken by Daguerre in 1835, should have been precisely the same as those used by James Watt in 1799. However, from the stamp on the corner of my plate, the peculiar form of the figure four (4) points it it out as a French production; whilst the Soho plates are apparently English, rendering the possibility of their exact coincidence in size still more improbable.

"*Speculations on the Process employed by Messrs. Boulton and Watt in the Production of the Pictures called by them 'Mechanical Pictures.'*" By J. B. DANCER, F.R.A.S.

My remarks at present are confined to the two pictures on the table, of human figures, numbered 7 and 8. They measure $17 \times 13\frac{3}{8}$ inches, and are identical in size and subject. By the kindness of Mr. Sidebottom, I have had an opportunity of making a minute examination of them. The only apparent difference between them is, that No. 7 is in plain ink, and in No. 8 the garments of the figures are coloured—one red and the other blue.

I am informed that these pictures are similar to those which are supplied by the firm of Boulton and Watt, and copies from originals sent to them. They were issued, it is said, with tolerable rapidity, and at a very moderate price; but the process by which they were multiplied was kept a profound secret.

At the first glance the pictures look as if they were produced by hand; but, on comparing them carefully, the close resemblance in the drawing in each is found to be so remarkable that no artist, however clever, could produce such exact duplicates without great expenditure of time. A more minute examination by means of a lens shows scratches and lines (evidently accidental) which correspond accurately in each picture, affording a convincing proof that these copies could only be produced by some mechanical or chemical agency.

It has been stated on good authority, I believe, that a darkened room or tent was used; also, that the presence of sunlight was required in the process. Now, this at once suggests the use of the camera obscura—an instrument which was perfectly well known at that period. A common method of exhibiting this instrument was to darken a room and fix a lens in a hole made in the window-shutter, and view the images produced on a screen of paper placed opposite to the lens. By this method a reversed and inverted picture would be seen by the spectator.

Another form of camera in use at that time consisted of an upright box with a sliding tube through the top, in which was fixed a lens, and above this a mirror placed at the angle of 45°. This form is still in use for the purpose of tracing images thrown on to paper placed at the bottom of the box. These primitive forms of the camera must be well known to all present. I name them only as affording some explanation for the use of the darkened room or tent.

The next question which suggests itself is this—Did they employ the camera in producing images on chemically-prepared surfaces? In fact, did they practise what we now name photography?

It is stated that in 1802 Wedgwood and Davy experimented with salts of silver on leather, and produced impressions of various subjects. Now, if we may be allowed to imagine that Mr. Boulton and his colleagues were acquainted with this effect of light on such substances, they might have reasoned on the phenomena, and prepared paper with these constituents—tannic acid, gelatine, and some salt of silver. Had they done so, they might have produced a picture by sufficient exposure in the camera. One thing is certain, the pictures 7 and 8 have a plentiful coating of gelatine, albumen, or some other substance on their surface.*

At this stage of the inquiry I should like to ask a question of those who have inspected a large number of these pictures. Do any of them show unmistakable marks of the originals, such as we are all familiar with in photographic copies? If this could be favourably answered, then photography of the present day would be benefited by the discovery of the means adopted in fixing these pictures. I much doubt if one of our best photographs on paper would contrast favourably with these pictures in the whites after a lapse of seventy years. But in my humble opinion photography has not been the agent employed in producing these pictures.

Mr. Sidebotham had a portion of one picture presented to him, and he kindly shared this with me. In my experiments I found that the colouring matter forming the picture could be washed off like ordinary ink, without leaving a trace of any chemical action on the paper. Now if this portion of the picture be a genuine sample, it does not exhibit the ordinary characteristics of a photograph.

On further consideration, there are many reasons which would lead me to conclude that these pictures have been produced by some modification of mezzotint engraving, in which the camera had enabled the engraver to trace his outline from the original to any scale required, giving him the correct outline drawing, the shading being an after process; but the rapidity of production, and the low price charged, unfortunately excludes this process from the list of probabilities. Although mezzotint is said to be the most rapid method of engraving, I am compelled to abandon it or its modifications, and pass on to some other process.

Now, if we do not believe in the photographic portion of the secret, and are not permitted to employ engraving on metal on account of the expense and labour, we find the field of speculation becomes somewhat limited.

Now comes a very important question,—Did Mr. Boulton anticipate Senefelder in some process similar to lithography, employing metallic plates or metallic alloys? I can almost imagine that such was the case. Even prepared paper surfaces, such as are named in Senefelder's specification, dated 1801, might have been used at Soho. When we look at the rough hand-made paper on which these impressions are placed, and see the thick coating of gum or gelatine on the surface, the question then arises,—Is this prepared surface necessary for taking up the ink or whatever was used, or is it merely to smooth over the coarse wire lines in the paper? We do not know that the want of smooth paper interfered with the practice of lithography for a long period. Machine-made paper was a great improvement, but now paper is made especially for the purpose.

After glancing over these processes, I am led to imagine that the following mode may in some degree serve to produce pictures similar to those before us. Admitting that the impressions were touched up by hand, I think the camera was employed only for tracing the outline and reducing or enlarging the image to any required scale. The pictures Nos. 7 and 8 give good evidence of tracing. The shading would be an after process, having the original for a copy, the crayon employed being made of some resinous or fatty matter mixed with the colour—this production then to be used as a transfer on the prepared surface.

In such pictures intended for painting, the ink would be light in colour—in others red or black, as the taste of the artist dictated. In this manner, as Senefelder states in his specification, the various styles of etching, stroke engraving, drawings in black and red chalk and aquatinta, &c., could be imitated, and at small cost compared with any other known process.

I shall now leave this very interesting inquiry in your hands. As an excuse for the brief and imperfect handling of the subject, I may state that it is only two days since I first saw the pictures, and I have not had sufficient time to work up the subject in a proper manner; but if my speculations serve to provoke a discussion amongst the members of the Section its purpose will have been answered.

ACADEMY OF SCIENCES.

April 2.

MM. Faivre and V. Dupré read a memoir "*On the Gases of the Mulberry and Vine, the parts of the Plant containing them, and the Changes they Determine in Vegetation.*" The authors expelled the gases by injecting mercury into the vessels, and thus procured gas from the roots and branches. The mixture consisted of oxygen, carbonic acid, and some nitrogen, the proportions varying with the stage of vegetation. Thus in winter the amount of carbonic acid was exceedingly small, and the oxygen large. With spring, however, the carbonic acid began to increase, and when vegetation was most active the amount of oxygen was small. In the roots the proportion of oxygen was always smaller than in the branches.

M. Poirel contributed a notice "*On the Mortars which Enter into the Formation of Artifical Blocks for Submarine Foundations,*" in which he stated his opinion that all the works executed in our harbours in which Portland cement is used, are destined to a more or less speedy destruction. None of the Roman cements known, he says, will resist the action of the salts in sea water. The author believes in one particular hydraulic lime, that of Theil.

Dr. Dronke presented a "*Note on New Chemical Analyses made with reference to the Disease of Silkworms.*" The author analysed the ashes of various mulberry leaves, and also of healthy and sick silkworms, and has come to the conclusion that the lime contained in the leaves has the most important influence on the well-being of the worms.

MM. A. and P. Dupré contributed a memoir "*On the Law which Governs the Work of the Union of Simple Bodies, and on attractions at minute distances.*" The memoir will soon be printed in a more complete form, and we shall then give an account of the authors' important discoveries, which they now state require the confirmation of further experiments.

Dr. Phipson sent a note "*On Silicium in Cast Iron.*" The author now states that silicium does not exist in two allotropic modifications, but as combined silicium—that is, *as silicide of iron*, and as oxidised silicium as silicate of iron. It was this latter which he called free silicium in his former paper.

Chemical Society.—The next meeting will be held on Thursday, April 19, when the following paper will be read:—"Heat of Chemical Action," by Professor Cary Foster.

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* My son William Dancer tested this substance, and pronounced it to be gum.

NOTICES OF BOOKS.

Lectures on Clinical Medicine, Delivered at the Hôtel-Dieu, Paris. By A. Trousseau. Translated and Edited, with Notes and Appendices, by Victor Bazire, M.D., &c. London: Hardwicke. 1866.

The wide and well-deserved reputation of Trousseau, as a practical physician, renders it unnecessary to say a word in praise of these lectures. Something, however, must be said for the editor and translator, who, in his notes and appendices, has well supplemented the valuable matter of the lectures. It will be sufficient to quote the titles of the different discourses to show their extreme importance, and to recommend them to the careful study of the medical profession. The subjects are as follows:—I. Venesection in Cerebral Hæmorrhage and Apoplexy; II. Apoplectiform Cerebral Congestion, and its Relation to Epilepsy and Eclampsia. This lecture we may say deserves the serious attention of jurists as well as physicians. III. Epilepsy; IV. Epileptiform Neuralgia; V. Glosso-Laryngeal Paralysis; VI. Progressive Locomotor Ataxy; VII. Aphasia.

Cholera Prospects: Compiled from Personal Observation in the East for the Information and Guidance of Individuals and Governments. By Tilbury Fox, M.D. London: Hardwicke. 1865.

The author of this little work made a journey to Egypt and Syria on the outbreak of the cholera last year, and has given us the results of his observations in these pages. There is nothing particularly new in them. The author accepts the doctrine that India is the nursery and breeding place of cholera, and contends that all outbreaks of this disease can be clearly traced to their source in that country. He is afraid that it may become naturalised in Egypt and Syria in consequence of the annual pilgrimages to Mecca, which bring together Mohammedans from India and Turkey; and, like many others, he fully anticipates an outbreak in our own country early this year. As regards preventive measures and treatment, he has nothing new to recommend. It is to be hoped that the International Commission now sitting at Constantinople will impress on the Turkish Government the necessity for vigorous hygienic measures at Jeddah and Mecca this year. As we write we hear of cholera raging in parts of Germany, and it behoves our own Government to be on the alert.

Annales de Physique et de Chimie. March, 1866.

The journal is again mainly occupied with communications which have been made to the Academy of Sciences. There are, however, two novelties—one a paper "*On the Formation of Organic Acids*" by M. Persoz. The author rejects the idea that organic acids are formed by the oxidation of a radical, and considers them to have a complex constitution in which carbonic acid seems to play the fundamental part, if such an expression may be allowed. He advances an opinion that all oxacids of organic origin may be formed by reactions fundamentally resembling that by which Dr. Wanklyn formed acetic acid—viz., the reaction of sodium methyl on carbonic acid. M. Persoz expresses the molecular constitution of acetic acid by the formula

$$\left.\begin{matrix}C_2H_3\\CO\end{matrix}\right\}CO+OHO,$$

and he considers that the same formula will apply to all organic acids of the same group. The author promises to complete his work by indicating the methods by which carbonic acid may be made to react on the different bodies to form organic acids.

M. Brassier contributes an article "*On the Estimation of Phosphoric Acid.*" The process of the author is a slight modification of Mr. Warington's. As the paper is short, we shall give it at length.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

883. W. Moseley, King Street, Covent Garden, "An improved electrical indicator."

885. W. Moseley, King Street, Covent Garden, "Improvements in galvanic batteries."—Petitions recorded March 24, 1866.

897. J. Higgin, Manchester, "Improvements in dyeing and printing textile fabrics and yarns."—March 27, 1866.

Notices to Proceed.

3107. L. J. Bouchart, Rue de l'Echiquier, Paris, "Improvements in the mode of applying mineral soda to the scouring and lubrication of textile matters and machinery and in the manufacture of soap."—Petition recorded December 4, 1865.

3368. R. A. Brooman, Fleet Street, "Improvements in the manufacture of acetate of lead."—A communication from J. F. Laigny, Courville, France.—December 29, 1865.

80. E. B. Wilson, Glasgow, "Improvements in furnaces."—January 10, 1866.

674. G. Haworth, T. Parrington, and W. Hudson, Preston, "An improved composition or preparation for sizing cotton, linen, or woollen yarns, and other similar substances."—March 7, 1866.

748. J. Macintosh, North Bank, Regent's Park, Middlesex, "Improvements in impervious compounds, applicable where india-rubber, gutta-percha, or such like resins or gums are used."—March 12, 1866.

CORRESPONDENCE.

Continental Science.

Paris, April 5.

I do not see the English photographic journals, and therefore cannot be sure that the following process, which I find in *Cosmos* without any acknowledgment, will be quite new to your readers. I give it, however, very shortly, and refer you to the source, that you may, if worthy, give the complete details. It is by A. M. Mialerlt-Becknell, who writes from St. John the Baptist, in Louisiana, and it is certainly the most simple method of obtaining photographs on copper plates which I have ever seen described. The author takes a smooth and perfectly clean copper plate and dips it for 30 seconds into a bath composed of sulphate of copper 125 grains, common salt 75 grains, water 2 ounces, acidulated with a few drops of acid, any acid whatever. As soon as withdrawn the plate is well washed, and then dried with a soft clean cloth. The plate is then ready for exposure in a frame under a glass negative. In good sunlight five or ten minutes' exposure are sufficient, but in cloudy weather a longer time is required. To fix the picture it is only necessary to dip the plate into a solution of hypo containing a little chloride of silver. A bath which has been used for paper proofs will do, but it must be filtered clear. After a few seconds' immersion the parts of the picture that were reddish whiten, and at the same time the shadows take a violet tint, passing away to black. As soon as this occurs the plate must be taken out, well washed, and dried over a spirit lamp. As the blacks are formed of a very fine powder the plate must be varnished to preserve the picture. The author supposes that a layer of protochloride of copper formed in the bath constitutes the sensitive surface, and he thinks that in the hypo and chloride of silver bath the unacted on protochloride is dissolved, and silver is deposited on the bare copper. He suggests a method of engraving the picture chemically, but as he admits that it is not satisfactory, I will not detain you with it.

To-day the Scientific Association of France and the Réunion of the Learned Societies of France begin their sittings at the Sorbonne. I hope I shall have something to communicate respecting the meetings next week. You are aware that these meetings correspond to those of your British Association, of which, indeed, they are an imitation. The sciences are divided into three sections—1. Mathematical Sciences, which includes astronomy, geometry, mechanics, &c.; 2. Physical Sciences, including physics, meteorology, and chemistry; and 3. Natural Sciences, including geology, mineralogy, botany, zoology, &c. Each section has its president, vice-president, and secretary, and everything is regulated by his Excellency the Minister of Public Instruction.

Preparation of Formyl (or Acetylene).

To the Editor of the Chemical News.

Sir,—I deem it a duty to call the attention of your readers to the danger attending the preparation of formyl according to Kletinsky's process, as published in No. 330, page 155, of your valuable journal. A terrific explosion occurred in my laboratory last week, after a gentle heat had been applied for about ten minutes to the mixture of chloroform and amalgam of potassium. Although much property was destroyed, I am happy to say that neither myself nor any of the gentlemen in my laboratory received any injury.

I am, &c. F. Crace Calvert.

Royal Institution, Manchester, April 11.

MISCELLANEOUS.

Registered Jelly Strainer.—Mr. John Marston has recently brought out an apparatus for straining jellies, &c., similar in construction to the contrivance known in the United States as "Physick's Jelly Strainer." It is made of block-tin, and its dimensions are 11 in. by 9 in. It has a permanent inner funnel, and between this funnel and the circular sides of the strainer there is a space like that of a hot-water dish, in this case also for hot water. In proceeding to use the strainer, boiling water is poured into the space through a lip at the top of the strainer, a flannel is stretched on the outside of the skeleton funnel, and pressed into the strainer. The jelly is then poured in, and the ends of the flannel brought over the top. The jelly drips through the proper opening near to the bottom of the strainer, whilst the water on cooling is made to pass out at the opening on the opposite side. We have had one in use for some months in our laboratory, and find it very effective.

Woods v. Highley.—This case offers a very instructive lesson to opticians and photographers, and therefore deserves some notice in our pages. Mr. Highley, in search of subjects for magic lantern slides, met with a book containing some comic illustrations which he thought would answer his purpose. He accordingly made photographic copies, and then, good naturedly, invited the designer to see them exhibited on a screen. In a few days he sold the copies, the only set made, at cost price, and a very few days after he was served with a bill in Chancery, by the holder of the copyright of the book, The bill generally recited that the defendant had sold and exhibited the copies largely to his great personal profit, and had thereby greatly diminished and injured the sale of the plaintiff's book, and ended by praying an injunction, and a return of all sales and profit. Mr. Highley submitted to the injunction, and paid the costs, some 30*l.* It was open to argument whether the Copyright Act would apply to magic lantern slides. A distinguished Scotch advocate has published an opinion that it would not; but Chancery suits are expensive, and the law uncertain, and we think Mr. Highley did wisely in submitting to the injunction. It is nevertheless a case of great hardship, and the plaintiff's proceedings have the appearance of vindictiveness, since probably a call on Mr. Highley, or, at most, a lawyer's letter, would have been sufficient to stop any sales. It is now open to the trade to try the question, if magic lantern slides are sufficiently profitable; but it would be better, as Mr. Highley has suggested, for a photographer who wishes to make such copies to apply to the publisher for permission, and we believe it will very seldom be refused.

New Explosive Mixtures.—M. Ehrhardt has patented the following compositions. Our readers will remember that Mr. Horsley has described similar mixtures:—

Blasting powder.		
Chlorate of potash	¼	part
Nitrate of potash	¼	"
Tannin or cachou . . .	1	"
Charcoal	2	"
Powder for artillery.		
Chlorate of potash	1	part
Nitrate of potash	1	"
Tannin	1	"
Powder for shells.		
Chlorate of potash	1	part
Tannin	1	"

Meetings of the Week.

Saturday, April 14.

Royal Botanic, Regent's Park, 3¾ p.m.

Monday, April 16.

Medical, 32a, George Street, Hanover Square, 8 p.m.
Royal Institution, 3 p.m., Professor Du Bois Reymond "On Muscular Contraction."

Tuesday, April 17.

Anthropological, 4, St. Martin's Place, 8 p.m.
Pathological, 53, Berners Street, Oxford Street, 8 p.m.
Royal Institution, 3 p.m., Professor Frankland "On the Non-Metallic Elements."

Wednesday, April 18.

Meteorological, 25, Great George Street, Westminster, 7 p.m.
Royal Institution, 3 p.m., Professor Du Bois Reymond "On Muscular Contraction."
Society of Arts, John Street, Adelphi, 8 p.m.

Thursday, April 19.

Chemical, Burlington House, 8 p.m.
Linnæan, Burlington House, 8 p.m.
Royal, Burlington House, 8 p.m.
Royal Institution, 3 p.m., Professor Frankland "On the Non-Metallic Elements."

Friday, April 20.

Royal Institution, 8 p.m., G. Macfarren, Esq., "On the Music of the Church of 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.

Volta.—M. Gassiot's is described, we believe, in the *Proceedings* of the Royal Society; but we have not the exact reference at hand. We do not remember where M. Siemen's is described.

E. O.—Sulphuric acid by weight. The calculations are, of course, made for pure; and a little excess of ordinary peroxide may be used.

A. B.—We cannot assist you in your difficulty. Prolonged contact with a strong alkali may induce a change

Books Received.—Chemical Testing of Wines and Spirits, by J. J. Griffin, F.C.S.

Received.—F. C. Calvert, F.R.S.; John Matthews; J. B.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

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

PART II.

THEORY OF TYPES AND ATOMICITY.

SECTION IV.—*Atomicity of the Elements.*

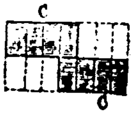
(Continued from page 159.)

The notion of saturation has given a theoretical basis to the considerations relating to the atomicity of the radicals. It has become the starting point of a still more important theory: that of the atomicity of the elements.

M. Kekulé, in an important article published in 1858,* first proved that carbon ought to be looked upon as a tetratomic element, for, said he, when we consider the simplest saturated compounds of carbon we see that the smallest quantity of carbon that can enter into a compound—that is to say, 1 atom of carbon—requires invariably 4 atoms of a monoatomic element or 2 atoms of a diatomic element; in a word, that the elements combined with 1 atom of carbon represent 4 units of chemical force. It is thus in the following combinations:

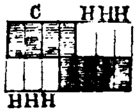
$\overset{iv.}{\text{Ꞓ}}H_4$	Marsh gas.
$\text{Ꞓ}Cl_4$	Perchloride of carbon.
$\text{Ꞓ}H_3Cl$	Chloride of methyl.
$\text{Ꞓ}H_2Cl_2$	Chlorated chloride of methyl.
$\text{Ꞓ}HCl_3$	Chloroform.
$\overset{''}{\text{Ꞓ}}\Theta_2$	Carbonic acid.
$\overset{''}{\text{Ꞓ}}\Theta Cl_2$	Chloride of carbonyl.
$\overset{''}{\text{Ꞓ}}\text{Ꞩ}_2$	Carbonic sulphide.

But if we take series containing several atoms of carbon, we must admit, according to M. Kekulé, that the latter are themselves united by a portion of the force existing in them. Thus, in all the saturated combinations which contain 2 atoms of carbon, 1 atom of carbon is combined directly with another atom of carbon and exchanges with it a unit of chemical force, in such a way that of the 8 units of chemical force which reside in 2 atoms of carbon, 2 units are satisfied by the combination of carbon with carbon, and there remain only 6 which are, so to say, disposable. On this account 2 atoms of carbon can never take more than 6 atoms of a monoatomic element, therefore the body Ꞓ_2H_6 constitutes the hydrocarbide limit of the series of combinations of carbon and hydrogen which contain 2 atoms of carbon. M. Kekulé represents this partial saturation of carbon by carbon by a diagram† similar to the following:—



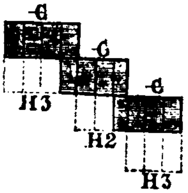
It will be seen that the two atoms of carbon are so placed that one overlaps the other. The two atoms are there made to touch for a quarter of their lengths, in order to indicate that they exchange a quarter of their affinities.

The six atoms of hydrogen arrange themselves round this framework of carbon so as to occupy the six vacant places, and are bounded by the dotted lines of the preceding figure—



As we advance in the series each atom of carbon unites itself in some way to another atom of carbon, and with these atoms is also increased the number of spaces where the atoms of hydrogen can joint on in their turn, since the affinities of the carbon have there remained free.

Thus, as all the atoms of carbon touch, and each loses an affinity by its contact (its combination) with each of its neighbours (except the two last, which only lose one, since they only have one neighbour), it is evident that the greatest number of atoms of hydrogen which can join on to this chain of atoms of carbon will be twice the sum of the latter, plus two. This explains the formation of the saturated series Ꞓ_nH_{2n+2}. If necessary, we can convince ourselves that it must be so by continuing the construction of the figure given above, which, it must be understood, represents neither the form of the atoms nor that of the molecule.



The idea of the combination of carbon with carbon is as natural and legitimate as that of the combination of hydrogen with hydrogen or of oxygen with oxygen (page 169, vol. xi.). A most important chemical fact testifies in favour of this idea. How is it that marsh gas has not a single polymere? It cannot have any. For how could several atoms of carbon hold together when all the affinities of each of them were satisfied by hydrogen? By adding H_2 to Ꞓ_2H_6 you do not make Ꞓ_2H_8; you must necessarily make two molecules of $\text{Ꞓ}H_4$, which cannot unite because in each of them all the affinities are satisfied. Thus it is that the series in which tetratomic carbon is entirely saturated by hydrogen is only represented by one term—marsh gas—and that in the carbides of hydrogen, which contain several atoms of carbon, the ratio of one to four between the number of these atoms and those of hydrogen is never reached. We know, in fact, that the carbides richest in hydrogen are,

$$n\text{Ꞓ}H_4 - H_{(2n-2)}$$

which means that in a carbide containing *n* atoms of carbon, $2n-2$ affinities or units of combination are employed to connect the atoms of carbon with each other.

But the carbides of hydrogen are not always saturated, and when this is the case, we might imagine that one or more atoms of carbon would manifest the combining power that this element exerts in oxide of carbon.‡

This deserves some consideration.

Oxide of carbon contains a single atom of carbon, and a single atom of oxygen; carbon there acts as a diatomic

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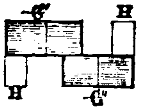
* Ueber die Constitution und die Metamorphosen der Chemischen Verbindungen und über die chemische Natur des Kohlenstoffs. *Annalen der Chemie und Pharmacie,* vol. cvi., p. 136.

† It is as well to point out that this figure and those following do not represent in any manner either the form or the position of the atoms. They simply indicate their mutual relationships, and to a certain extent the points of junction of the affinities. Each compartment represents a unit of chemical force or affinity.

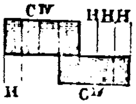
‡ The idea that carbon can act sometimes as a tetratomic and sometimes as a diatomic elemement was first suggested by M. Couper.—*Annales de Chimie et de Physique,* 3rd series, vol. liii., p. 459.

element, for it is combined with one atom of a diatomic element.

Suppose now that 2 atoms of diatomic carbon exchange 2 affinities, 2 others remain free and can unite with 2 atoms of hydrogen. We may thus represent the constitution of acetylene C_2H_2.

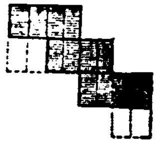


But we know that oxide of carbon can combine directly with oxygen and with chlorine; diatomic carbon passes then to the state of tetratomic carbon. Its affinities were, so to say, lying dormant; they awake, and we see them completely satisfied in carbonic acid and in chloride of carbonyle (chloroxycarbonic gas). This being allowed, it seems natural to suppose that carbon, which is diatomic in oxide of carbon and tetratomic in carbonic acid, may enter into organic combinations, as, for example, in many carbides of hydrogen, sometimes as a diatomic and sometimes as a tetratomic element. This latter case is shown in the saturated carbides of the series C_nH_{2n+2}. But in certain carbonated hydrogens less rich in hydrogen one or more atoms of carbon exist in the state of a diatomic element whilst the other atoms are tetratomic. This is why these non-saturated carbides can enter into direct combination with chlorine, bromine, or even hydrogen; the diatomic carbon which they contain tends to become tetratomic carbon, as in the case of oxide of carbon becoming oxychloride. Let us take one example to define this idea. In olefiant gas we must have one atom of diatomic carbon and 1 atom of tetratomic carbon. These 2 atoms being united, the first combines with 1 atom of hydrogen and the second with 3.



But when chlorine intervenes, the affinities of the diatomic carbon are excited, and the two atoms of chlorine unite with the non-saturated element.

Another case may occur. There are carbides of hydrogen, such as naphthaline $C_{10}H_8$ which are very far from a state of saturation, and which yet show no great tendency to arrive at it. It is doubtless on account of several atoms of tetratomic carbon being joined together so as to exchange *two* affinities. Thus, in the following system the intermediate atom of carbon is entirely saturated by the affinities of the other 2 atoms of carbon—



The latter each preserve two affinities free.

I do not wish to pursue further these developments, and I think the preceding instances will suffice to show the importance of the theory we are expounding—namely, the atomicity of the elements. This theory alone permits of attempting and of answering in a satisfactory manner this great question. How do the organic molecules hold together, and why is it that the elective affinity, which the atoms of carbon, hydrogen, and oxygen exercise upon each other, does not exhaust itself in the most simple compounds? Why can so great a number of atoms accumulate in the complex molecules of organic nature, and in general in all complex compounds, whatever be the elements contained?

The answer is this—All these molecules are cemented, so to say, by polyatomic elements which possess the property of uniting them together so as to partially neutralise their power of combination, without completely destroying it, for this power is multiple. Such is the action of carbon in organic compounds; but this action is not confined exclusively to carbon; it belongs also to oxygen and nitrogen, which, like it, are polyatomic elements. They also can serve to unite the various parts of the molecule, and it must not be thought that in an organic compound all the elements, with the exception of carbon, are united directly to the latter, as in the case of the hydrocarbons. Let us take some examples—

Alcohol, or hydrate of ethyl, contains $C_2H_6\Theta$. Now, we know that the carbide C_2H_6 is already saturated; we at once infer that the 6 atoms of hydrogen are not all in direct connexion, and in intimate union with the 2 atoms of carbon. Experience teaches us, on the other hand, that one of the 6 atoms of hydrogen is easily replaced either by a simple body, such as potassium, or by a group of atoms acting like a simple body, whilst this is not the case with the other 5 atoms of hydrogen.

This would seem to show that these latter are united directly to the carbon, and that the sixth unit of combination necessary to complete the saturation of C_2 is supplied by the oxygen. But the latter being diatomic, has one affinity remaining which is saturated by the sixth atom of hydrogen. Thus the indivisible atom of oxygen here serves as a connexion between the incompletely saturated group C_2H_5 and the sixth atom of hydrogen. Such is the true meaning of the typical formula

$$\left.\begin{matrix} C_2H_5 \\ H \end{matrix}\right\} \Theta \text{ or } (C_2H_5)\Theta H.$$

And we see that this formula, which is based upon the interpretation of the reactions of alcohol, shows better than any other the mutual relations of the elements. The same remarks apply to ethylamine: the non-saturated group (C_2H_5) exchanges one affinity with triatomic nitrogen, the latter preserving two which are saturated by 2 atoms of hydrogen, and serving thus to unite the latter with the ethyl group.

$$\left.\begin{matrix} C_2H_5 \\ H \\ H \end{matrix}\right\} N''' = (C_2H_5)N \left\{\begin{matrix} H \\ H \\ H \end{matrix}\right.$$

It is well known that in ethyl itself the atoms are joined together by tetratomic carbon.

(To be continued.)

On Oxyammonia, or Hydroxylamine, by W. Lossen.

Dr. Hofmann in the course of a discussion at the last meeting of the British Association gave a short account of this base. (See Chemical News, vol. xii., p. 136.) A longer account has since been published by the author*, from which we make the following abstract:—

Oxyammonia, or hydroxylamine, $NH_3\Theta$, is formed by

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* *Zeitsch. für Chemie*, November, 1865.

the action of hydrochloric acid on tin and nitrate of ethyl. The most convenient proportions are five parts of nitric ether, twelve parts of tin, and fifty parts of hydrochloric acid (sp. gr. 1·24). The mixture after a time becomes hot, but only a little hydrogen is evolved. When the action has terminated, the alcohol re-formed is driven off by heat, and the tin is precipitated by sulphuretted hydrogen. On evaporating the filtered solution chloride of ammonium first crystallises out, and then hydrochlorate of hydroxylamine, which is very soluble in water. On boiling the dry residue in absolute alcohol the latter salt dissolves with but a very small quantity of sal ammoniac, which may be precipitated with chloride of platinum. The hydrochlorate of hydroxylamine may then be completely purified by repeated crystallisations from strong alcohol.

The action of nascent hydrogen upon nitric ether may be represented by the following equation—

$$\underbrace{C_2H_5N\Theta_3}_{\text{Nitric ether.}} + 6H = \underbrace{NH_3\Theta}_{\text{Hydroxyl-amine.}} + H_2\Theta + \underbrace{C_2H_5,H\Theta}_{\text{Alcohol.}}$$

The analysis of the hydrochlorate led to the formula $NH_3\Theta,HCl$. This salt crystallises from an alcoholic solution in long prismatic needles, like those of urea. By the spontaneous evaporation of an aqueous solution, large irregular hexagonal plates are obtained. It remains unaltered at 100° to 110° C.; but at higher temperatures fuses and decomposes, giving off large quantities of nitrogen and hydrochloric acid with some aqueous vapour and sal ammoniac.

Sulphate of hydroxylamine is very soluble in water. Alcohol precipitates from aqueous solutions in a crystalline form. The oxalate crystallises from an aqueous solution in brilliant prisms. A crystalline phosphate has been obtained. The nitrate forms a viscous liquid soluble in water and alcohol. When heated this salt gives off large quanties of binoxide of nitrogen.

The base has not yet been isolated from the aqueous solutions, partly because it easily decomposes; when potash is added to a solution of salt of hydroxylamine nitrogen is evolved and ammonia formed—

$$3NH_2\Theta = NH_3 + 2N + 3H_2\Theta.$$

A tolerably stable solution of the oxide may be obtained by precipitating the sulphate with exactly sufficient baryta water. This solution may be boiled without decomposition. On distillation a part of the base passes over with the vapour of water.

The hydrocyanate appears to be isomeric with urea. When, however, a solution of hydroxylamine saturated with hydrocyanic acid is evaporated, the residue is not the hydrocyanate.

When the hydrochlorate is rubbed with cupric oxide at the ordinary temperature an evolution of gas takes place in which binoxide of nitrogen may be detected.

On the Estimation of Phosphoric Acid, by M. Brassier*.

In ordinary commercial analyses of substances tolerably free from iron and alumina it is usual merely to precipitate the phosphate from a hydrochloric solution with excess of ammonia. But in this case, besides the error from the presence of alumina, the phosphate so precipitated is not of constant composition, and the calculations of real phosphoric acid must therefore be inexact. In the process also in which the iron and alumina are kept in solution by means of tartrate of ammonia, and the phosphoric acid determined as ammonico-magnesian phosphate, an error sometimes arises from the precipitation of tartrate of magnesia. Mr. Warington has recommended the use of citric acid in place of tartaric, citrate of magnesia being more soluble than tartrate. M. Brassier now states that phosphate of lime, oxide of iron, and alumina are not precipitated by excess of ammonia in the presence of citrate of ammonia, but on the addition of chloride of magnesium the whole of the phosphoric acid goes down in the form of ammonio-magnesian phosphate. His process is as follows:—The hydrochloric solution is first precipitated by excess of ammonia, and the precipitate so obtained is re-dissolved by citric acid, the solution being maintained strongly ammoniacal. Pure chloride of magnesium is now added in sufficient quantity to precipitate the whole of the phosphoric acid, which goes down as ammonio-magnesian phosphate without a trace of lime. The precipitate forms slowly as usual. The solution, as pointed out by Mr. Warington, must be pale green or yellowish. The objection to M. Brassier's process is, that it will not apply to substances containing sulphates, the same objection, however, applying to the estimation as tribasic phosphate of lime.

Ammonio-magnesian phosphate is, however, slightly soluble in citrate of ammonia, consequently as little as possible of this salt must be employed. The precipitated phosphate of lime should therefore be dissolved by citric acid, added drop by drop, keeping the liquid alkaline at the same time. The chloride of magnesium also must be free from sulphate of magnesia.

TECHNICAL CHEMISTRY.

On Sodium Amalgamation;† *in a letter from* Henry Wurtz *to Professor* B. Silliman.

In the opinion of yourself and others upon whose judgment I rely, the time has arrived for the promulgation of the discoveries made by me, now many years since, of certain new properties of the alkali metals, rendering them of value in the amalgamation of ores of the precious metals.

You are aware that, pending the repeated investigations which I have conducted upon this important subject I have made communications of my results, both oral and written, from time to time to many persons, yourself among the number; but that until the latter part of the year 1864, no final step was taken to place these discoveries before the public in a tangible form. On December 27, 1864, a patent of the United States Government was granted to me for specified modes of applying the said discoveries; the specification having been at my request retained on file in the Patent Office for six months (as the new patent law permits), so that the expiration of the term of this patent did not commence until June 27, 1865.

It appears, however, that my frequent communications had led to wide discussion of the remarkable phenomena involved, phenomena which I seldom hesitated to exhibit, even to the most casual acquaintances, taking only the precaution of silence as to the agent employed (the sodium); and the inevitable consequence has been the occupation of other minds with the subject both here and abroad. In fact, since the issue of my patent I am informed that several applications (necessarily fruitless) have been made at Washington by others for

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* Abridged from *Annales de Chimie et de Physique*, March, 1866, p. 355.

† *American Journal of Science and Arts*, vol. xli., p. 216 March, 1866.

patents covering some or all of my uses of the alkali metals; and an English patent has been procured in the name of the eminent chemist William Crookes, dated August 12, 1865 (about eight months‡ subsequent to the filing of my specification at Washington); of the specification of which I have procured a copy, and find it to present a remarkable similarity to my own. Moreover, I frequently find allusions and statements relating to this subject, generally more or less imperfect and obscure, in the public prints throughout the world.

It has clearly, therefore, become incumbent upon me —if only as a matter of justice to the mining community and others interested—to furnish authentic information as to what has actually been done, and what it is proposed to do. I have, therefore, prepared an abstract of my specification, embodying in a condensed form such portions of its substance as appear of present importance to miners and metallurgists.

Other portions of the subject matter of the specification will form a sufficiently voluminous, and I hope interesting, topic of a future communication; as, for instance, my new modes of preparing amalgams of the alkali metals in large masses with any desired rapidity, safety, and economy; and which you, with other chemical scientists who have witnessed its operation, deem important in a purely scientific view; as involving novel phenomena, and illustrating molecular laws obscurely seen at present.

With a few explanatory observations, which seem needed, I shall conclude. I have found it necessary, for practical purposes, to prepare three different grades of the sodium amalgams, differing from each other in their proportions of sodium about as the numbers 1, 2, and 3; and which I designate accordingly.

A few lines, also, regarding the term "magnetic amalgams," which not a few will deem fantastic, and as suggesting unauthorised analogies. I hope to show, however, at some other time, that in applying the term I have followed the dictates of reason, and even the direct path of the modern leaders in cosmical dynamics, the apostles of the doctrine of correlation of physical forces; and that the analogical element which I find is that between attractive and repulsive antagonistic force which exerts a chemical, or rather an elementary discrimination between bodies at insensible distances, and the antagonistic force of magnetic attraction and repulsion, which is so eminent an example of a similar elementary discrimination, though at sensible distances also. No one (to offer an illustration nearly, though not quite perfect) doubts the intimate relation between radiated and convected heat, although the one propagates itself throughout the universe of space, whilst the other is susceptible only of diffusion throughout insensible distances from molecule to molecule.

More of this, however, hereafter. The term, from its convenience alone, will doubtless come into extensive use, as a technical term, among those who are most concerned in the utilisation of the magnetic amalgams.

19, Nassau Street, January 15, 1866.

SPECIFICATION.

My invention consists,—In imparting to quicksilver . . . . a greatly enhanced adhesion, attraction, or affinity for other metals and for its own substance; by adding to it a minute quantity of one of the highly electro-positive metals . . sodium, potassium, . . &c.

My invention . . . is applicable,—

1st. In all arts and operations in which amalgamation by quicksilver can be made available to separate or extract gold, silver, or other precious metals from their ores.

. . . .

3rd. In all operations in which amalgamation by quicksilver, in conjunction with reducing metals, such as iron or zinc, can be made available in recovering metals from their soluble or insoluble saline compounds; such as silver from its sulphate, chloride, or hyposulphite; lead from its sulphate or chloride; gold from its chloride or other solution.

. . . .

8th. In the mercurisation of metallic surfaces in general; for instance, in the amalgamation of the surfaces of zinc in voltaic batteries; of the surfaces of copper plates, pans, &c., used in the saving of gold from its ores; . . .

9th. In the more convenient transportation of quicksilver, by the reduction thereof into solid forms.

. . . .

I shall now proceed to the description of those special and peculiar qualities of these amalgams of the alkali metals which I have discovered, and which have led to my new uses of them in the chemical and metallurgic arts.

A quantity of one of the magnetic amalgams, dissolved in 100 times its weight or more of quicksilver, communicates to the whole a greatly enhanced power of adhering to metals; and particularly to those which, like gold and silver, lie toward the negative end of the electro-chemical scale. This power of adhesion, in the case of these two metals, is so great that the resistance which I have found their surfaces, when in the native state, usually oppose to amalgamation (a resistance which is much greater and more general than has been hitherto recognised, and which is due to causes as yet undiscovered, or at least uninvestigated) is instantly overcome; whether their particles be coarse, fine, or even impalpable. Even an artificial coating of oil or grease (which is such an enemy to amalgamation that the smoke of the miners' lamps is pronounced highly detrimental in gold and silver mines) forms no obstacle to immediate amalgamation by this magnetic quicksilver. The atoms of the quicksilver are, as it would seem, put into a polaric condition by a minute addition of one of those metals which range themselves toward the electro-positive end of the scale; so that its affinity for the more electro-negative metals is so greatly exalted that it seizes upon and is absorbed by, their surfaces instantaneously; just as water is absorbed by a lump of sugar or other porous substance soluble in it.

Such quicksilver (unlike ordinary quicksilver) even adheres strongly to surfaces of iron, steel, platinum, aluminium, and antimony; an adhesion which, however, as I have discovered, in the case of these five metals is not of the nature of a true amalgamation, there being no penetration whatever into the substance of the metal; so that the superficially adherent magnetic quicksilver may be readily wiped off clean, just as water may be from glass. The only metal I have as yet found, which cannot be enfilmed by the use of the magnetic amalgam, is magnesium.

I shall now specify the details of my various new and useful applications of the alkali metals.

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‡ Professor Wurtz has inadvertently misquoted the date of Mr. Crookes's English patent. It should be February 11, 1865, instead of August 12, 1865. The plain statement given above has been garbled by the *Mining Journal* into an accusation of plagiarism. For an answer to this we beg to draw attention to Mr. Vaughan's letter, which appears in another part of this number.—Ed. C. N.

I. Applications of the Magnetic Amalgams to Working the Ores of the Precious Metals.—My improvement in methods of amalgamating gold and silver ores consists in adding from time to time to the quicksilver used in amalgamation, about one-hundredth part or less, of its weight of one of the magnetic amalgams. The frequency with which the amalgam is to be added cannot be exactly specified, as it will be found to depend more or less on a multitude of circumstances; such, for instance, as the temperature, the purity of the water and the quantity of the water used, the ratio borne by the surface of the quicksilver to its mass, the amount and mode of agitation of the quicksilver, the nature of the process and of the apparatus used, the character of the ore, the strength of the amalgam, &c., so that this important point can only be determined by experience in each case. Some general directions may, however, be derived from the experiments which have been made. It has been found that very much less sodium is requisite in those cases in which much water is employed, and that water frequently renewed; for instance, in the rifles of a sluice, and in all forms of amalgamators through which a continual current of fresh water is kept running; mercurial solutions of sodium, as I have discovered, being little affected by water which is free from acid, alkaline, or saline impurities. In those cases, however, in which little water is employed, and especially where the ore and quicksilver are ground up together into a "slum" or slime, this water soon becomes alkaline, and an oxidation of the sodium sets in, necessitating its frequent renewal. In such cases, therefore, the following manipulation is recommended:— The whole amount of quicksilver to be used for working up a batch of slime—say 50 lbs.—is magnetised by dissolving in it 1 per cent. of amalgam No. 2; or better, 2 per cent. of the soft amalgam No. 1, which dissolves more readily; half of the whole, or 25 lbs., is then thrown into the mill with the ore at first, and, as the incorporation proceeds, certain fractions of the other half are gradually added, at intervals of time varying according to circumstances, until the whole has been added. If, as is usual, the quicksilver is a portion which has been separated from the slime of a previous operation, it will usually retain some sodium, and therefore will require fresh amalgam in proportionately smaller quantity.

In sluicing operations the soft amalgam No. 1 is most suitable, on account of its ready solubility in mercury; and in these cases it is practicable to test the quicksilver in the rifles and ascertain when the magnetic quality requires restoration, by throwing in a few grains of gold dust. Similar tests are easily applied to slimes, and in amalgamating methods generally, a slip of tarnished sheet copper being a very suitable agent for such testings.

It may be remarked in passing that the amalgam No. 1 is at any time easily prepared from No. 2, by melting it in an iron ladle with about its own weight of quicksilver, or from No. 3, by melting with twice its weight; considerable time, however, being requisite in the case of No. 3, to produce the additional combination. In copper plate amalgamation—that is, in those cases in which auriferous materials are brought into contact with amalgamated metallic surfaces, it is better to substitute altogether for quicksilver itself (both in the first coating of the metallic surfaces, and in any subsequent additions of quicksilver made) the pasty amalgam No. 1. In these modes of amalgamation great economy in wear and tear of apparatus, as well as in first cost, is effected by using, in connexion with the magnetic amalgam, plates or surfaces of iron instead of copper. The power of coating or enfilming iron renders the amalgams, in fact, peculiarly valuable in every form of arrastra, dragmill, or other apparatus for amalgamation which has internal surfaces of iron, these surfaces becoming coated over with quicksilver and thus immensely extending its chances of contact with those particles of gold which are so fine as to remain suspended in the water.

Other important devices arise out of this power of enfilming iron surfaces, such as the keeping of iron surfaces of stamps, and of other apparatus used in crushing ores continually coated with quicksilver. Quicksilver possessed of the magnetic quality may be kept dropping or trickling upon the surfaces of crushing rollers; or in those crushers in which iron balls are used, the surfaces of these balls may be kept enfilmed. In like manner as the adhesion of quicksilver to other metals is exalted by the alkali metals, so, also, as I have discovered, is its cohesion with itself greatly increased. It is rendered more viscid, more difficult to divide mechanically, and when thus divided runs together again instantly upon contact. Hence arise new results of incalculable value. For instance, the so-called "flouring," or granulation of the quicksilver, which in the amalgamation of ores always occasions so great losses, both of the quicksilver itself and of its amalgams with the precious metals, is reduced to a minimum or altogether prevented.

The recovery of floured quicksilver and amalgams from slimes and similar mixtures is also greatly facilitated and accelerated thereby. For this purpose some strongly magnetised quicksilver is thrown into the separator. Such slimes may even be operated upon with advantage by the ordinary process of panning by hand; a little magnetic quicksilver being thrown into each pan and stirred about at first for a few moments with the hand, which will collect together and incorporate all the scattered globules of auriferous amalgam. In fact, in all panning operations, even upon the pay dirt of placer diggings, much labour, gold, and time may in this way be saved.

It is necessary to specify an important precaution applicable in some cases in which magnetic amalgams are used, and particularly in those cases in which the ore is ground or agitated with quicksilver in contact with metallic iron. This arises from the liability of the adhesion of some abraded particles of iron to the amalgam. The following plan is therefore recommended in these cases:—The amalgam, after separation from the excess of quicksilver, and before retorting, is fused in an earthen dish or iron ladle (with addition of a little quicksilver, if necessary, to make it more fluid), and the iron, which will rise and form a scum on the surface, is skimmed off. The excess of quicksilver may then, after cooling, be again separated from the amalgam in the usual way. Any amalgam which may adhere to the iron scum is readily detached therefrom by boiling in water to remove the sodium. This process depends on the simple fact that the adhesion to the iron totally disappears with the extraction of the last traces of sodium from the quicksilver. In fact, it is possible to remove all the iron from the amalgam by boiling directly in water, without any previous fusion; more particularly if the water be made somewhat acid or alkaline. The presence of iron in a sample of amalgam is readily detected by the magnet, which instrument may be sometimes used to advantage also in separating intermixed iron from amalgam, after all sodium has been extracted from the latter. There are still other metals which will usually be found adherent to the amalgam when sodium has been used; such as platinum and osmiridium. These, like iron, immediately detach themselves on the removal of the sodium by boiling the diluted amalgam in water. A mixture of platinum or osmiridium, or both, with iron, may of course be freed from the latter by the magnet. It will generally be found desirable, as in other cases where quicksilver is used and ores containing arsenic or sulphur operated upon, to remove as much as practicable of the arsenic or sulphur by previous roasting or other chemical treatment.

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III. Applications to the Recovery of Metals from their Saline Compounds.—In the common operation of reducing silver to an amalgam from its native or artificial chloride, or from its sulphate, by the action of metallic iron or zinc in conjunction with quicksilver, immense advantage arises from the use of the magnetic amalgams, especially in the reduction of the time occupied to a fraction of that heretofore required. This applies as well to ores in which the silver occurs naturally as chloride, bromide, or iodide, as to those in which the silver has been previously converted into chloride or sulphate, or both, by roasting with common salt or otherwise; and to chloride which has been precipitated from solution. . . .

When gold has been obtained in solution, either from ores or from other materials, by the action of chlorine, aqua-regia, cyanide of potassium, or any other solvent, also when silver has been obtained in solution, in hyposulphites or otherwise, the most rapid and thorough mode of saving these metals will be found to be their conversion into amalgams, by precipitation with metallic iron in contact with magnetic quicksilver, more especially when the solutions are dilute. . . .

The greater rapidity and perfection of the precipitation in these cases are obviously due to the absolute contact at once established with the iron surfaces by the magnetic quicksilver, and the perfect and powerful voltaic circuits thus kept up constantly throughout the two metals and the solution.

. . . .

VIII. Applications to the Mercurialising of Metallic Surfaces in General.—In all cases in which it is an object to save time and labour in the coating of surfaces of other metals with quicksilver, . . . the magnetic amalgams come into play. . . .

By virtue of the adhesion to iron and other non-amalgamable metals imparted by the magnetic amalgams, I am enabled to apply quicksilver, or fluid or pasty amalgams, to any metallic surface, with great rapidity and facility, with a brush, after the fashion of a paint; the material of such brush being fine wire of iron, steel, aluminium, or platinum. Of these the material most generally suitable is the finest steel wire, tempered to about a spring temper, or somewhat softer; and the most generally useful form for such brushes is that of a flat varnish or white-wash brush.

Among the important uses of such brushes may be instanced,—the amalgamation of copper (or iron) plates used in saving gold from ores. . . . Another valuable use is the recovery of quicksilver which has been spilled or scattered in the form of globules; such a flat brush, saturated with magnetic quicksilver, instantly collecting, incorporating, and sucking up the scattered globules, even from the most irregular surface.

The same principle of adhesion of magnetic amalgams to a brush of steel wire, is applicable in many obvious ways to the separation of metals from ores, and of granulated or floured quicksilver from ores and slimes, &c.

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(To be continued.)

PROCEEDINGS OF SOCIETIES.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology,
by Dr. Percy, F.R.S.

Lecture No. III.

(Continued from page 175.)

We next come to calcite or calcspar, the rhombic form of carbonate of lime, of which you have specimens before you. You understand that this calcite—there is no mistake about this point—has chemically the same composition as arragonite, the other crystallised form of carbonate of lime. Chemically, they are identical; crystallographically, they are widely different.

Here are magnificent specimens of calcspar, which are much sought after for optical purposes. In some of these specimens I think the compound may be said to be in a state of absolute chemical purity. Occasionally we find included in the crystals various matters which are interesting to us as indicating the conditions under which the crystals have been formed. For instance, they not unfrequently enclose such substances as copper pyrites and sand.

We have seen how calcspar may be thrown down from its aqueous solution under different conditions of temperature and dilution. There is another mode, or an alleged mode, of the formation of calcite which has attracted a great deal of attention in former times. It was asserted from experiments made by Sir James Hall that common limestone or common chalk could, by exposure to a very high temperature simply, be converted into crystallised calcite—this conglomeration of crystals of the rhombic form of carbonate of lime. I shall not trouble you with the details of these experiments. I have gone over them carefully, and I must say that they do not appear to be so conclusive as to justify that strong belief in them which has prevailed so long. Still it must be stated that Gustave Rose took up the subject about a year ago, and although he was first opposed to the experiments of Sir James Hall, he has come to the conclusion that saccharoidal limestone may be formed by the action of heat alone. I must, however, avow that I am somewhat sceptical, and should like to see further experiments on this point.

Carbonic acid may be easily displaced from carbonate of lime, but it is not easy simply by heat in a closed tube. Some capital experiments were made on this point some time ago, and it was found that by passing over various gases in a closed tube you may liberate carbonic acid. Carbonate of magnesia, when heated in a close vessel, evolves all its carbonic acid very easily. For instance, take dolomite, which is a compound of carbonate of lime and carbonate of magnesia, and heat it at a low temperature. The magnesia loses all its carbonic acid, and the lime scarcely any, and therefore you get magnesia and carbonate of lime.

Of the source of lime in nature we shall have a great deal to say hereafter, when we come to study some of the volcanic rocks. There is no difficulty whatever in accounting for lime in the rocks around us. It is a common constituent in the so-called plutonic rocks, otherwise primitive rocks—that is, rocks which existed in the molten state of our earth. By the action of carbonic acid, moisture, and so on, on these rocks after refrigeration decomposition takes place, and there is no difficulty in accounting for the presence of carbonate of lime in them.

I want just to repeat some observations about the purity of carbonate of lime in nature. Perhaps chalk is the least pure. We have it in a state of almost absolute purity in calcite. All our statuary marble, or most of it, is more or less impure. It is veined very often, to the great annoyance of the sculptor; but almost all the specimens contain a notable quantity of foreign matter, especially alumina.

We have some plutonic or igneous rocks, which contain a very large quantity of lime. There is the mineral called labradorite, which contains 15 or 16 per cent. Then there is another mineral, well known, called Wallastonite, or tabular spar, which we can produce artificially, and which contains lime.

The next subject I have to bring before your notice is a compound of lime to which I have alluded, and one which is very beautiful frequently, namely, fluor spar, of which we see so many fine specimens in mineralogical cabinets. You have some very fine specimens before you. Here is a lump from Grassington, in Yorkshire. Then there is a specimen of green fluor. It always occurs in the cubical system, either as a cube or some modification of the cube—the octahedron, and so forth. It consists essentially of the elements fluorine and calcium. It is a fluoride of calcium. The common name for it is fluor.

Fluor is very widely diffused in nature. Indeed, it is difficult to say where it is not. The late Professor George Wilson, of Edinburgh, examined this matter with great perseverance, and succeeded in finding fluor in almost everything he touched, even in animal fluids and in our bones. It is true the presence of it occurs in very small quantities, but still it is there.

Fluor spar, when pure, contains in round numbers 48½ per cent. of fluor, the rest of it being calcium. Its specific gravity may be taken at 3. The extremes, I find, are 3·017 and 3·188—say 3.

There are some points of interest respecting its solubility, and this is a subject which was specially investigated by the same Dr. Wilson to whom I have just referred. It is soluble in water, but its solubility is very decidedly increased by the presence of carbonic acid in the water. He found on carbonic acid passing through water containing finely suspended fluor that he could, without difficulty, detect its presence by the very ordinary reagent for the the detection of lime, oxalate of ammonia. He found that one part of fluor spar dissolved in 26·923 parts of pure water, and that the solubility of it was somewhat increased by heating. Fluor spar is partially decomposed by a hot aqueous solution of an alkaline carbonate. This is a point which may be of consequence in geological reasonings. In this case we have the formation of alkaline fluoride and carbonate of lime. This decomposition may possibly take place in hot alkaline mineral waters where fluor spars occurs.

Some varieties of fluor are remarkably interesting on account of their phosphorescence. I will show you this property by experiment. Here we have some of the mineral chlorophane, which is nothing more than fluor spar. When exposed to a gentle heat it becomes magnificently phosphorescent, emitting a green light. Hence the name "chlorophane," which is derived from two Greek words. There will be some decrepitation when the heat is applied. Already you see how it glows, and even in this amount of light you are able to see the luminosity. The chlorophane is glowing magnificently, with a beautiful green light, but the experiment is one which should be performed in the dark, for it cannot be made on a large scale, as the mineral is not a very common one.

Fluor spar has been obtained distinctly crystallised, artificially, by the late M. Senarmont, another French inquirer. The French have done a great deal in these matters—more, I think, than any other nation; and no one has made more conscientious experiments than Senarmont, whose recent loss we have to deplore. He effected the crystallisation by heating recently precipitated gelatinous fluoride of calcium during 60 hours. This is a salt easily obtained by double decomposition in the laboratory. By exposing this all this time to a temperature of 250° centigrade, in contact with a solution of alkaline bicarbonate, he effected the crystallisation. There was a peculiar arrangement by which a little hydrochloric acid could be introduced and brought into contact with the alkaline solution. By this means carbonic acid would be evolved, and this carbonic acid acted as a solvent under great pressure. This is the arrangement, then, by which this was crystallised—namely, heating it in contact with water at a high temperature for a long time, the water containing carbonic acid. It virtually came to that. The fluor spar is soluble, not only in water containing carbonic acid, but also in pure water; and with these facts before us there is no difficulty in understanding how these fine crystals of fluor spar have been formed during long ages. It may require a hundred years, or a thousand years, or a hundred thousand years; but that is nothing in a geological point of view. I do not think we have much reason to suppose that fluor spar has been produced by the action of heat alone, but it may be crystallised in that way. Here is a beautifully crystallised specimen obtained from some "blue john" which was exposed to a high white heat in a platinum crucible. I think we may here detect the form of the regular octahedron.

It might be supposed by some persons that fluor spar, which is a frequent constituent of mineral lodes, might have been injected into those lodes in a molten state; but I think when we come to examine the question we shall find that there is no evidence that such was the case. I think there is no question that its presence there was a result of aqueous action—I do not mean to say at the ordinary temperatures, but at comparatively low temperatures.

We find fluor spar in various rocks. According to Dr. Wilson, the Peterhead granite contains it; and it is also present in various trap-rocks. I have a list here of the minerals in which fluor occurs. Among them are micaceous minerals, pyrochlore, zircon-syenite, varieties of hornblende, pyenite, chondrodite, topaz, and cryolite.

It is a curious thing that topaz should contain it. This suggests the formation of the topaz by fluoride of silicon. In cryolite the fluor spar occurs most abundantly.

There are some interesting points in connexion with this subject, a knowledge of which we derive from the consideration of certain pseudomorphs, or false forms. For example, we may take a cube of quartz, or a cube of anything else if you please, and we may find that in certain cases that cube may be replaced by a totally different mineral, and thus we shall get a cube of a certain mineral which, of itself, does not crystallise in that crystalline system. That is what we call a pseudomorph. The quartz in the instance we have supposed may have been removed and left a mould, and in this mould we may get fluor spar. There is a point of some interest in respect to the removal of the quartz, or the replacement of it by fluor spar. Here is a beautiful specimen presenting numerous cubical cavities entirely of quartz; and there is no doubt whatever that those cavities were formerly filled with fluor spar. The fluor spar crystals had been removed, *pari passu*, apparently—at all events, on the outside. There is now a deposit of silica in the soluble state, thus showing that some solvent was at work which had the power of removing the fluor spar and not touching the quartz. That conclusion, I think, is inevitable.

I have already called attention to the deposition or occurrence of fluor spar in certain mineral springs. One of the best known of these is at Carlsbad, where this mineral was first discovered by Berzelius. Bischoff has made a curious calculation about the quantity of fluor spar which might be thrown down, and he tells us that at this place 24,700 lbs. might be thus deposited annually. Now just imagine a cause like this operating during a great number of years, and we have no difficulty in understanding how a large deposition may occur, given the element of time.

The next mineral to which I must direct your attention is one which largely occurs on the surface of the earth, and especially in sea water. It is the metal magnesium, of which we have heard so much of late. It is only quite recently that this metal has been made on anything like a large scale. Formerly it was merely a chemical curiosity, and its properties were very imperfectly known. Magnesium is lighter than aluminium. Aluminium, I told you, has a specific gravity of 2·5, and magnesium has a specific gravity of under 2. It is 1·7, if I remember rightly. It is a white metal which resists atmospheric action in a very satisfactory way—very much more so than one would have thought, *à priori*, from the appearance of the metal. When once combined with oxygen it sustains the combination very powerfully, and can only be separated by the action of a stronger affinity.

The metal is produced on exactly the same principle as aluminium—that is to say, a fluoride of magnesium is formed, and that is exposed to the action of heat, and the fluorine is displaced, and the magnesium is obtained in a free state.

The metal burns on being heated in contact with air, and gives forth a brilliant light. This light has been employed for some useful purposes, such as signals, and, I believe, with very great success. The metal is worked into a suitable form and wound on a reel, and there is clock-work machinery for paying it out gradually. A signal given by the aid of this light has been, I believe, seen at a distance of 28 miles. One difficulty attending the use of magnesium for this purpose is the large amount of vapour—shall I call it?—which is produced. The magnesia which results from the burning gets suspended in the air, and forms a disagreeable smoke. Some time ago we lighted up the crypt of the Houses of Parliament with the magnesium light. That crypt has been painted with most beautiful colours, and every tint could be seen with the greatest clearness. The burning of magnesium in the form of wire is now a common experiment in every drawing-room.

Here is a specimen of the metal on a large scale. Here is another specimen, drawn out into wire, showing its ductility. Here is another specimen, showing its fusibility, and its capability of being cast. Here is a medal of it, which has been cast in a mould.

With these remarks I will terminate what I have to say to-day. On the next occasion I shall take up the subject of carbonate of magnesia, and enter at some length into that interesting question of dolomite.

PHARMACEUTICAL SOCIETY.

April 4.

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

The first paper was by Mr. Daniel Hanbury, jun., "*On Pharmaceutical Herbaria.*" The author began by some remarks on the advantages of possessing, and the interest of collecting, an herbarium. About 170 plants are enumerated in the British Pharmacopœia, and of these 50 are either indigenous to, or are cultivated in, Great Britain. The assistance to be derived from even a collection of the latter would be of great use to a student reading up Materia Medica. But Mr. Hanbury would not confine a collection to the plants enumerated in the Pharmacopœia. A number of others are still commonly used, and some were until lately officinal. We need only mention a few of these, such as marsh mallow, black hellebore, horehound, pennyroyal, wormwood, &c. There are others which are liable to be confounded with officinal plants, such as pyrethrum and matricaria, sometimes substituted for camomile and fools' parsley, which is said at times to do duty for conium maculatum. As to exotic medicinal plants, Mr. Hanbury thinks that foreign members of the Pharmaceutical Society might assist in procuring and forwarding specimens which the secretary might distribute. One complete herbarium should be preserved in Bloomsbury Square, and others in the rooms of the branch societies. But the greatest good would be derived from individual collections, having for their nucleus the commonest indigenous plants used in medicine. The author next described shortly the best method of mounting specimens for reference. They should all be brushed over with an alcoholic solution of corrosive sublimate, then re-dried with slight pressure, and afterwards fastened upon the paper by narrow strips of gummed or glued paper. Specimens which are likely to be frequently handled may be fixed more securely by brushing glue while hot over a portion of the specimen, woody stems, roots, bulbs, &c., being for additional security fixed with strips of paper. For a pharmaceutical herbarium, containing a limited number of specimens, a large book may be found more convenient than loose sheets. The plants may then be preserved in proper sequence convenient for reference, and such a volume would be found of far more practical value than a collection of figures. The authors of the British Pharmacopœia mention 26 works in which figures of the plants enumerated in the volume are to be found. Some of these are very rare, and inaccessible to most; while to purchase the whole Mr. Hanbury estimates would cost about 230*l*. The value of a collection of plants to the pharmaceutical student must therefore be very great, and the subject merits some attention from the Pharmaceutical Society. Mr. Hanbury also mentioned that some of the Continental Governments require apothecaries to provide and maintain in good order a collection of medicinal plants for the use of their apprentices.

The next paper was by Mr. H. B. Brady, "*On Medicated Pessaries and Suppositories.*" The author insisted on the necessity for uniformity of form as well as composition of these articles, now, with two exceptions, made up according to the notions of individual prescribers and pharmaceutists. He recommends, therefore, the insertion of a considerable number in the next Pharmacopœia. The best excipient Mr. Brady believes to be cacao butter, with from 5 to 10 per cent. of lard. As to size and quantity, he thinks that 15 grains would be sufficient for a suppository, and two drachms for a pessary. As regards form, he contends that the Minié bullet shape is the most convenient. The best way of forming them is to cast them in metal moulds, gun metal plated being the best material. In making the pessaries and suppositories the active ingredients, such as morphia, tannic acid, &c., should first be rubbed with the lard, then added to the cacao butter in a copper vessel set in warm water, well incorporated, and after cooling to the consistence of cream, poured into the metal mould. For a pharmaceutist having but few demands for such articles a paper cone will answer for a mould. Mr. Brady, we ought to say, has tried a variety of excipients, including cocoa-nut stearine and mixtures of oil, lard, and wax; but after all the trials has decided in favour of that just mentioned, which he accordingly recommends for general adoption.

Mr. J. Hills agreed with Mr. Brady that it was advisable pessaries and suppositories should be included in the Pharmacopœia, since it was difficult to prepare them extemporaneously. He thought, however, that it was better to use cacao butter without any admixture of lard.

Mr. Gale pointed out one objection to cacao butter; it slightly decomposed iodide of potassium. He preferred to use moulds made of pewter, with a hole at the bottom.

Dr. Waring then read a paper "*On the Purgative Nature of Some Euphorbiaceous Seeds,*" a report of which we defer.

New Use for Borax.—Borax is proposed as a substitute for cow-dung in the dunging process. The solution recommended is one part of the salt in 250 parts of water

ACADEMY OF SCIENCES.

April 9.

M. P. DUCHARTRE read a memoir "*On the Growth of Plants during the day and during the night.*" The author has made observations with several plants, the vine, a hop plant, and a strawberry plant among others, and has found the branch of the vine and the bine of the hop and strawberry plant to grow two or three times faster during the night than during the day.

M. Baudrimont presented a memoir entitled "*Experiments and Observations on Oxygen and Binoxide of Manganese,*" and embodying some interesting facts. He began by noticing the fact that when hydrochloric acid reacts on binoxide of barium binoxide of hydrogen is produced; while the action of the same acid on binoxide of manganese results in the evolution of chlorine. We must therefore admit that chlorine has more affinity for hydrogen than the oxygen which peroxidises the barium, while the contrary is the case with the oxygen which peroxidises the manganese. This may be proved in the following way:—If we fill a flask with chlorine and then add a little water and some finely powdered peroxide of barium, an active effervescence takes place, and the chlorine is found to be replaced by oxygen, which does not act on ozone paper. Other experiments show the differences which exist between the binoxides of barium and manganese. Sulphovinic acid heated with peroxide of manganese gives aldehyde; the same acid heated with binoxide of barium gives oxygen, bicarburetted hydrogen, ether, and sulphurous acid.

M. Baudrimont goes on to say that he has succeeded in preparing oxygenated water with peroxide of manganese, but he does not tell us how. This oxygenated water is destroyed by peroxide of barium, just as that prepared by the last-named substance is destroyed by peroxide of manganese, and, more remarkable still, the two oxygenated waters destroy each other. The author states that he is able to confirm the ideas of Schönbein with regard to the two allotropic conditions of oxygen, ozone, and antozone. He is now engaged in the study of the physical constitution of these bodies.

Lastly, he throws out the suggestion that, as oxygen presents two allotropic states, it may be the same with the bodies with which it unites. Hydrogen giving rise to two distinct binoxides, it is probable that it also presents two distinct states complimentary to each other in the two oxides which it forms. It is probably the same with barium and manganese, and, indeed, with all other elements.

M. Jeannel presented a note "*On Acetate of Soda.*" The author mentions some curious facts. Fused acetate allowed to cool in the open air crystallises in prismatic needles at +58°; allowed to cool, however, in a limited amount of moist air, it does not crystallise even at zero, but becomes a soft translucent mass. If after having been so cooled it is exposed freely to dry air, and touched with a dry solid body, it suddenly assumed the ordinary crystalline form of prismatic needles, disengaging a large quantity of heat—rising, indeed, to the crystallising point +58°—or near it. M. Jeannel remarks that this experiment shows how solar heat may be stored up and made to reappear again at will. It is possible, he says, in our climates to raise acetate of soda under bell-glasses or glass frames to +59°. The acetate so exposed and cooled sheltered from the air does not crystallise, and is always ready to give out the heat again on being touched with a dry solid body. The author makes other statements regarding the crystallisation of this and other salts, which he says are quite sufficient to upset M. Gernez's theory of *pancrystallisation.*

M. Langlois presented a note "*On the Formation of Trithionic Acid.*" It gives an easy process for obtaining trithionate of potash. The author passes an excess of sulphurous acid into a perfectly saturated solution of carbonate of potash until crystals of bisulphite deposit. The whole is then transferred to a flask and digested with flowers of sulphur in a warm stove for three or four days. The liquor gradually acquires a yellowish tint, which disappears when the whole of the bisulphite is transformed into trithionate. Very little sulphate of potash is formed in this way. The crystals of trithionate of potash are very stable, but a solution quickly decomposes, giving sulphate of potash, sulphurous acid, and free sulphur.

$$KO.S_3O_5 = KOSO_3 + SO_2 + S.$$

The author considers that in the formation of trithionate by the above process, the free sulphur at first combines to form hyposulphite, which, in the presence of an excess of bisulphite, passes immediately to trithionate.

M. Torreggiani describes *a new battery* and a practical application as follows:—After repeated experiments, I have proved that a pile in which the positive pole is represented by metallic lead and the negative by carbon, and containing a saline solution (an alkaline acetate) gives a large quantity of pure carbonate of lead besides electricity, which may be profitably employed. The author considers that is an easy and innoxious way of making white lead.

M. Zaliwski-Mikorski also contributed a note "*On the Voltaic Pile,*" of no special interest.

NOTICES OF BOOKS.

An Introduction to Practical Chemistry, including Analysis. By JOHN E. BOWMAN, F.C.S. Edited by CHARLES L. BLOXAM, F.C.S., &c. Fifth edition. London: Churchill and Sons. 1866.

A BOOK so well known as this, of which a fifth edition is now in demand, requires nothing to be said in its praise. And yet something must be said for the alterations and additions which the very able editor of this edition has made. Considering the object of the work, and the present state of opinion, we think he has done wisely in omitting all formulæ and equations. Many students who will work in the laboratory with this book will have been taught their chemistry on the old system of notation, and to such, as Mr. Bloxam points out, the formulæ which represent carbonate of soda as $Na_2\text{ȻΘ}_3$, and sesquicarbonate of ammonia as $2[(H_4N)_2\text{ȻΘ}_3]\text{ȻΘ}_2$ will be comparatively unintelligible. Theoretical explanations being quite unnecessary, it is better, we think, to leave the student unembarrassed, and allow him to frame his equations on the system he has been taught.

We may commend, too, the alterations which have been made in the analytical portion of the work. The change made in the arrangement of the reactions of the metals fixes the analytical classification of those bodies in the mind, and facilitates reference for the confirmatory tests. The tables also introduced into the Appendix increase the usefulness of the book; while the alterations made in the systematic course for the blowpipe examination of unknown substances are great improvements on the instructions in former editions.

Altogether we may say that Mr. Bloxam has greatly improved a very useful book, and it is only fair to add that we know of none better for students beginning analysis.

There is one section of the Appendix which the editor might have added to with advantage or omitted altogether, and that is the glossary of chemical terms, which in these days, to be anything like complete, requires to be greatly extended. A complete glossary would now prove a very useful compilation.

Lectures on Animal Chemistry delivered at the Royal College of Physicians. By WILLIAM ODLING, *M.B., F.R.S, &c.* London: Longmans, Green, and Co., 1866.

IT is only necessary to announce the separate issue of this admirable course of lectures, neatly printed, and in a convenient form. In preparing them for separate publication the author "has discussed with greater fulness those sections of the course which relate to synthetic processes, to the nature of leucine and tyrocine, and to the decomposition products of uric acid," thus considerably increasing the value and interest of the lectures for medical readers.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

3105. D. Hall, Wharton, Cheshire, "Improvements in the manufacture of salt, and in machinery or apparatus for that purpose."—Petition recorded December 4, 1865.

671. C. W. Siemens, Great George Street, Westminster, "Improvements in the manufacture of zinc, and in the construction of furnaces connected therewith, which latter improvements are also applicable to other metallurgical processes."—March 8, 1866.

862. W. P. Newton, Chancery Lane, "Improvements applicable to the treatment of the substances used in the purification of gas."—A communication from Dr. Deicke, Mülheim, Baden.

863. C. E. Amos, Southwark, Surrey, and W. Anderson, Erith, Kent, "An improved mode of treating waste liquors for the dissipating or utilising of the same."—March 23, 1866.

Notices to Proceed.

3112. J. Steart, St. James's Road, Bermondsey, Surrey, "An improved method in the production of fibre from various fibrous plants and animal products."—Petition recorded December 4, 1865.

3248. T. Parker, Saint Mary Axe, London, "Producing an oxy-hydrogen-magnesian light, applicable to photographic purposes, to lighthouses, and to other illuminations." A communication from P. Carlevaris, Genoa, Italy.—December 15, 1865.

3323. W. E. Newton, Chancery Lane, "Improvements in the preparation of glue or gelatine, so as to render it insoluble in water and applicable by the admixture of other substances to various purposes for which common glue or gelatine cannot now be used." A communication from W. Wurtz, New York, U.S.A.—December 23, 1865.

3351. N. W. Wheeler, Brooklyn, New York, U.S.A., "Improvements in distilling and in relieving distilled and other liquids from gases mechanically mixed therewith."—December 27, 1865.

70. J. M. Macrum, Knightsbridge, Middlesex, "Improvements in the apparatus and process for distilling oils and other liquids." A communication from J. Johnston and J. Davis, Alleghany City, Penn., U.S.A.—January 9, 1866.

300. W. R. Lake, Southampton Buildings, Chancery Lane, "Improvements in working and treating india-rubber, gutta-percha, and other similar gums."—A communication from F. Marquard, Railway, New Jersey, U.S.A.—January 31, 1866.

CORRESPONDENCE.

Continental Science.

Paris, April 14.

In my last short note I ought to have mentioned a series of popular scientific lectures which are now in course of delivery for the benefit of what you may call the Benevolent Society for Men of Science. This Society, as you may remember, was founded by Thenard, who endowed it liberally according to his means. But since Thenard's day the proportion of scientific men has greatly increased, while the men themselves have not all learned the art of becoming rich. The fund, therefore, although now supplemented by yearly subscriptions and donations, has proved inadequate to relieve the increased number of applicants, or perhaps I ought to say recipients, for, like the Royal Society fund, no one but the members of committee know the individuals who are assisted. A course of popular lectures, therefore, was suggested as a means of adding to the fund, and some of our first men at once offered themselves as the lecturers. More than this, the Empress offered her patronage, not the empty support given by allowing her name to be placed on the tickets and *affiches*, but her actual presence at the lectures. It is needless to say this insured a full and fashionable audience, and the finances of the Society will be proportionately improved. I may as well add the subjects of the lectures. The first was by M. Delaunay "On the Retardation of the Earth's Movement of Rotation." The second was by M. Frémy "On Ozone." In the third M. Bertrand will give the history of the old Academy of Sciences; and the last will be by M. Jamin, "*Sur le vide et le plein*," which title I shall not attempt to translate into English.

It is worth mentioning that Baron Dupin, at the last meeting of the Academy of Sciences, presented Dr. Fairbairn's work on the construction of iron ships, paying the author some high compliments, which were well received by the Academicians and public present.

I read a story in *Cosmos* which is wonderful if true. It is to the effect that Sir George Matthews, a distinguished physicist, of Darlington, and MM. Barckley and W. Thompson, Professors at Oxford, started in a balloon from the first-named place on March 27 intending to go straight to St. Petersburg, guided by machinery of Sir George's own construction. Foggy weather, however, changed their intention when over Hanover, and they turned round to get back to England. But while crossing France they got short of fuel, so on March 31 made a stop over Houlme (Seine-Inférieure) to coal. Not wishing the machinery to be studied, they remained ten metres above the ground, and hauled up the coal in baskets, after which having thanked the astonished natives, they continued their voyage to England, and were out of sight in a few minutes. Have you heard of their arrival in England?

Sulphate of Iron as a Disinfectant.

To the Editor of the Chemical News.

Sir,—Great attention is paid, and with reason, in this country, in Holland, and in Belgium, to the disinfection of stalls and of the excrements of animals of the bovine race, infected with typhus, in order to arrest the ravages of this terribly contagious malady.

The use of phosphoric acid, which is proposed for this purpose, is rational, in that it enriches the manure, but not if you consider the expense, the difficulty of transport, and the many precautions necessary in handling it.

Sulphate of iron, on the contrary, is of insignificant value (say, a farthing per pound), economical, and easy of employment, and having great effect upon all animal matters, would completely purify the infected places and the manures of animals suffering from typhus. It does not injure the manure, but conserves its most energetic parts by converting the carbonate of ammonia into sulphate of ammonia, a fixed salt, which is easily appropriated by the plants.

It was in 1845 that Mr. Schattermann, director of the mines of Bouxwiller, Departement du Bas-Rhin, proposed the disinfection of fecal matters and of manures by means of sulphate of iron, and since then this salt has been generally employed in France for these purposes, as well as to purify the slaughter-houses, ditches, and all places where noxious emanations arise. Its use is very simple. Dissolved, it gives a very acid liquid, that can be handled without danger, and which penetrates everywhere when used to wash the infected places or to mix with the manures.

When the cholera was at Marseilles, great quantities of sulphate of iron were used, not only in France, but also in Switzerland and in Germany, to disinfect closets, slaughter-houses, and all places giving off noxious emanations, and with perfectly satisfactory results.

I would add that if cattle that have died from Rinderpest were saturated with a solution of sulphate of iron, they might be removed with perfect safety, even in the day-time, and the cost of disinfection would be some few pence only.

I am, &c.,
W. G. S. MOCKFORD.

London, April 12.

Sugar in Malt.

To the Editor of the CHEMICAL NEWS.

SIR,—On reading the paper by Mr. Lawes in your last week's number, "On Determining the Amount of Sugar in Malt," it reminded me of many mis-spent hours. In 1863 I made a great many experiments to determine the quantity of sugar in malt, and just when I had finished I saw an article in the *Polytechnische Centralblatt*, stating that malt contains no sugar at all, but that the water used to eliminate the sugar is the very means of producing it, by the aid of the gluten or "diastase" upon the dextrin in starch. This can be easily verified by using alcohol instead of water.

I am, &c. JOHN MATTHEWS.

Burton-on-Trent, April 11.

MISCELLANEOUS.

THE SODIUM PROCESS—WHO WAS ITS INVENTOR?

(*From the "Mining Journal," April 13, 1866.*)

"THE question 'Who was the inventor of the sodium process?' is one which all connected with chemical science will be glad to see conclusively settled, more especially as in England we are accustomed to attribute its origin to one who has already had the annoyance of having his right to another chemical discovery seriously disputed. The March number of the *American Journal of Science and Arts* contains an elaborate communication on Sodium Amalgamation, from Dr. Wurtz to Professor B. Silliman. Assuming the processes of Wurtz and Crookes to be identical, it appears that Wurtz is entitled to priority of invention by more than eight months, and as the dates are verified by the records of the Patent Offices of England and the United States, this point may be regarded as conclusively disposed of. To facilitate the formation of an opinion as to the identity or otherwise of the inventions, we subjoin abstracts of the two specifications, so far as relates to gold and silver amalgamation, side by side."

* * * * * * *

"These parallels might be continued throughout the entire specifications, but the above will suffice to show the identity, practically, of the inventions, and will afford sufficient evidence upon which to base a conclusion as to whether the one specification has been used as an aid in drawing the other."

* * * * * *

"The similarity between the two specifications is so striking that we think—considering he has a fair priority in point of time of eight months, even allowing the time necessary for the news of his discoveries to reach this country—Dr. Wurtz has fair grounds for demanding at least some explanation from Mr. Crookes to account for the apparent plagiarism. Dr. Wurtz, in his over anxiety to include the whole of his numerous discoveries in connexion with the chemical and metallurgic arts, may have extended his specification to an unnecessary length, but he has not the less claim to all the honour attaching to each particular discovery therein recorded. With regard to the authorities upon which the comparison of the two inventions are made, it may be well to remark that the extracts from the official documents relating to Dr. Wurtz's American patent, inserted in *Silliman's Journal* (which enjoys a universal reputation, and may therefore be thoroughly relied upon), have been adopted with respect to Dr. Wurtz's claims, whilst Mr. Crookes's have been taken from the official reprint of his specification."

In reply to the above, the following letter has been sent to the Editor of the *Mining Journal*:—

"*The Sodium Process.—Who was its Inventor?*

SIR,—My attention has been drawn to an article in the last number of the *Mining Journal* under the above heading, and in which an attempt is made to controvert Mr. Crookes's right to be considered as the inventor of the sodium process in gold and silver amalgamation.

The covert allusion to the discovery of thallium may well be allowed to pass without notice, as that point has been long since settled; but the case is otherwise with regard to the sodium process. The writer of the article in question professes to cite dates, and points to them as showing that Dr. Wurtz, and not Mr. Crookes, was the inventor, and calls upon the latter to give an explanation of the circumstances upon which his claim rests. As the patent agent who has acted for him since his first patent was applied for, and as having been engaged in the preparation of his specifications, I may be permitted to state some of the facts of the case.

In so doing, I will also refer to dates, and may observe that I believe Mr. Crookes was, previously to July, 1865, altogether ignorant of the existence of such a person as Dr. Wurtz, of New York. For upwards of six years prior to 1865 Mr. Crookes had been engaged in experiments having for their object the employment of metallic sodium in amalgamation; and having sufficiently matured his process, he applied for a patent on February 11 in that year. In the course of the month of July, 1865, I was informed that the application which I had made for the American patent had been rejected on the ground that Dr. Wurtz had already patented an invention which was substantially identical with that of Mr. Crookes, and it then appeared that Dr. Wurtz had filed his application in November, 1864, and that his patent was allowed on December 27, but was not issued until the following June, when the specification became public.

I should here also observe that the writer of the article in the *Mining Journal*, in his anxiety to be exact, has given the date of Wurtz's process as December 27, 1864, and that of Crookes's process as August 12, 1865. The date which he gives as August 12 should have been August 11, and is the date of Mr. Crookes's *final* specification, which was an amplification only of his *provisional* specification filed on February 11, 1865, and long before anything of Dr. Wurtz's American patent was known in this country. At the time Mr. Crookes's final specification was filed, no copy of Dr. Wurtz's specification had reached this country.

With regard to the insinuation of plagiarism, it is sufficient to say that Mr. Crookes can produce ample evidence, documentary and oral, to show that in 1861 he gave a full written description of the sodium process, drawing attention to its value in amalgamating gold ores, to an American gentleman, for the express object of transmission to New York. However, the disorganisation of trade, consequent on the outbreak of the American war, prevented the publication at that time of his discovery in the United States. It is therefore clearly impossible that Mr. Crookes should have appropriated the alleged invention of Dr. Wurtz, of which he had never heard, and the particulars of which he could not possibly have known.

It may not be unimportant to mention that Dr. Wurtz applied for an English patent in June last, which was successfully opposed by Mr. Crookes in the following October, when the Attorney-General allowed the patent to pass upon the condition that all which related to the use of sodium for gold and silver amalgamation should be struck out of the specification. The value of what remained of the patent applicable to the treatment of the other precious metals I leave for those acquainted with the subject to estimate.

It is not my desire, however, in the least degree to detract from such merit as may appertain to Dr. Wurtz as an independent investigator, if the facts will support him in that character. The history of discovery abounds with analogous cases; but I cannot refrain, in the interests of science, from deprecating the indulgence in insinuations and inuendoes such as are evidently intended to be conveyed by the article which has called forth this communication.

I am, Sir,
Your obedient servant,
E. P. H. VAUGHAN."

54, Chancery Lane, April 17, 1866.

Death of Mr. T. G. B. Sloper.—We regret to have to announce the death of this amiable and promising young man, which took place at St. Bartholomew's Hospital on the 7th instant. His friends are requested to accept this intimation.

Methylated Spirit in Holland.—A correspondent informs us that the Dutch Government is about to allow the use of methylated spirit free of duty for manufacturing purposes on the same plan as allowed by our own Government. The excise duty on spirit is very high in the Netherlands.

Ventilation.—Liebig suggests the use of hydrate of lime to absorb the carbonic acid in ships' cabins and other close apartments.

On the Evolution of Hydrogen at the Positive Electrode of a Voltameter.—Wöhler and Beetz have noticed an evolution of hydrogen at the positive pole when aluminium wires are used as electrodes. Beetz has found the same thing to happen when magnesium wires are employed, and has found that it is the consequence, not of the direct, but of a secondary current. The positive pole becomes covered with a black covering, probably of a suboxide, which he has proved is not the result of the action of the current, but is produced by a purely chemical action. As soon as this black deposit is formed, a local current is set up between it and the positive pole of magnesium, in which the wire is the negative electrode, and which results in an abundant current of hydrogen.—*Les Mondes.*

How to See the Wind.—A correspondent of the *Scientific American* gives the following directions for rendering cold air visible:—"Take a polished metallic surface of two feet or more with a straight edge. (I used a large hand saw.) Take a windy day, whether hot or cold, clear or cloudy, only let it not rain or the air be murky—in other words, let the air be dry and clear; it is better if the wind be steady, but this is not essential. Hold your metallic surface at right angles to the direction of the wind—*e.g.*, if the wind is north, hold your surface directed east and west, but instead of holding the surface vertical, incline it about 45° to the horizon, so that the wind striking, glances and flows over the edge (keeping it straight) as water over a dam. Now sight carefully over the straight edge at some minute and sharply defined object, and you will see the air flow over as water flows over a dam. Make your observations carefully, and you will hardly ever fail to see the air, no matter how cold; the result is even better when the sun is obscured."

Transformation of Nitrate of Soda into Nitrate of Potash.—M. Condurie has patented the following processes. He makes concentrated and equivalent solutions of nitrate of soda and chloride or sulphide of barium, and mixes the solutions. Nitrate of baryta, which is but sparingly soluble, is precipitated. It is well washed and then boiled with sulphate of lead, whereby nitrate of lead and sulphate of baryta are produced. The nitrate of lead is now boiled with sulphate of potash, and so nitrate of potash is formed and sulphate of lead reproduced.

Process for the Condensation of Ammoniacal Gas.—Knab has found that chloride of calcium absorbs its own weight of ammoniacal gas, which is again evolved on the application of heat The chloride will serve an indefinite time. M. Knab considers that his discovery will be found very useful 1. Because chloride of calcium saturated with ammonia is dry powder easy of transport. 2. Because chloride of calcium is of very little value; and 3. While water will only hold in solution 20 per cent. of ammonia, the chloride will have 50 per cent., so that the cost of sending ammonia about will be greatly diminished.

Meetings of the Week.

Saturday, April 21.

Royal Institution, 3 p.m., G. Scharf, Esq., "On National Portraits."

Tuesday, April 24.

Medical and Chirurgical, 53, Berners-street, 8½ p.m.
Civil Engineers, 25, Great George-street, 8 p.m.
Zoological, 11, Hanover-square, 8 p.m.
Ethnological, 4, St. Martin's-place, 8 p.m.
Royal Institution, 3 p.m., The Rev. C. Kingsley, "On Science and Superstition."

Wednesday, April 25.

Society of Arts, John Street, Adelphi, 8 p.m.
Geological, Somerset House, 8 p.m.
London Institution, Finsbury Circus, Anniversary.

Thursday, April 26.

Royal Society, Burlington House, 8½ p.m., Professor Abel, "On Gun Cotton."
Royal Institution, 3 p.m., The Rev. C. Kingsley, "On Science and Superstition."

Friday, April 27.

Royal Institution, 8 p.m., The Very Reverend the Dean of Westminster, "On Westminster Abbey."

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. XII. 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., II., and VII. are out of print. All the others are kept in stock. Vol. XIII. commenced on January 5, 1866, and will be complete in 26 numbers.

J. B.—Rosin oil will discolour. We cannot say whether simple redistillation would prevent it.

W. Gruming.—Mr. Tuck's test solution is made according to the following form:—Biniodide of mercury, 15 grains; iodide of potassium, 25 grains; water, 1 oz.; solution of potash (sp. gr. 1·063), 1 oz. Dissolve the biniodide of mercury and iodide of potassium in the water, and then add the solution of potash. Besides the process of Mr. Tuck, there is one by Mr. Reynolds, which will be found at p. 55, Vol. VII., of the CHEMICAL NEWS. The quantitative estimation of wood spirit in a mixture is, so far as we know, an impossibility at present. In the case referred to the amount of ethylic and methylic alcohol together is obviously meant, and not that of the latter alone.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Experiments and Observations on Oxygen and Binoxide of Hydrogen, by M. A. BAUDRIMONT.*

BARIUM and manganese, which chemists agree in classing among the bodies improperly called *diatomic*, and which the author proposes to call *diplotypic*, present remarkable differences in their binoxides. Binoxide of manganese, for example, when treated with hydrochloric acid, gives chlorine, while binoxide of barium under the same circumstances gives binoxide of hydrogen.

Binoxide of hydrogen remains intact in the presence of the binoxide of barium which served to produce it; but in the presence of binoxide of manganese it decomposes into oxygen and water, the binoxide of manganese undergoing no change.

The oxygen which peroxidises the manganese decomposing the hydrochloric acid to take the place of the chlorine and form water, it is clear that the oxygen of the binoxide barium cannot do the same, at all events under ordinary circumstances. No chemist who has prepared binoxide of hydrogen by Thénard's process has obtained chlorine. It must be admitted, then, that chlorine has more affinity for hydrogen than for the oxygen which peroxidises the barium, while the contrary is the case with the oxygen which peroxidises the manganese. This is demonstrated by the following experiments.

If we fill with chlorine gas a bottle into which a little water and some very finely powdered binoxide of barium has been introduced, a lively effervescence is seen when the mixture is shaken, the colour of the chlorine disappears, and in the end the bottle is found to be full of oxygen, which does not act on ozone paper.

The following experiments show still further differences between the binoxide of barium and that of manganese. We know that sulphovinic acid gives aldehyde when heated with binoxide of manganese. In the presence of binoxide of barium, however, sulphovinic acid gives ether and bicarburetted hydrogen mixed with oxygen and sulphurous acid, the reaction commencing at 103° and ending at 150°.

Pushing the analogies still further, the author has succeeded in preparing oxygenated water by means of peroxide of manganese. This water is destroyed by the simple presence of binoxide of barium, just as that obtained by the latter body is destroyed by binoxide of manganese, an experiment which clearly demonstrates the difference that exists between these two products. But the difference is rendered still more evident by the following fact: The oxygenated water obtained by means of binoxide of barium and that obtained by means of binoxide of manganese destroy each other; the effervescence produced when they are mixed is not violent, but it is continuous, certain, and indubitable.

After referring to tne physical investigations which the author intends to make, he states that oxygenated water prepared by means of binoxide of barium when submitted to the action of four large Bunsen's elements gives equal volumes of hydrogen and oxygen, even when far from being saturated, showing that the binoxide of hydrogen is decomposed in preference to the water.

Lastly, the author remarks that if oxygen presents two allotropic states it is eminently probable that the bodies with which it unites may do the same; and hydrogen giving birth to two distinct binoxides, it is probable that it also may present itself in two distinct states, complimentary one to the other, in the two binoxides. Further, it seems probable that barium may present itself in one of these states and manganese in the other, which will account for the differences observed in their binoxides, and that the two bodies may be found in the opposite state to that in which we know them, and, indeed, that all elements may exhibit this sort of allotropy.

Comptes-Rendus, vol. lxii., p. 829

Researches on Acids of the Lactic Series.—No. I. *Synthesis of Acids of the Lactic Series, by* E. FRANKLAND, *F.R.S., and* B. F. DUPPA, *Esq.*†

IN the first part of this paper the authors give the details of the synthetical production of numerous acids of the lactic family, which have been briefly described in a series of notes already published in the *Proceedings* of the Royal Society, during the years 1863, 1864, and 1865. In the concluding portion of the present paper, they discuss the theoretical considerations which arise out of these investigations. They call attention to the existence of a group of elements, to which they give the name oxalyl and the formula (COHo), and which exists not only in all acids of the lactic series, but also in nearly every known organic acid. The isolated molecule of this radical is oxalic acid,

$$\left\{\begin{matrix}COHo\\COHo,\end{matrix}\right.$$

in proof of which they show that when oxalic ether is acted upon by nascent amyl, it is converted into caproic ether—

$$\begin{array}{ccccc}\left\{\begin{matrix}COEto\\COEto\end{matrix}\right. & + & \left\{\begin{matrix}CBuH_2\\CBuH_2\end{matrix}\right. & = 2 & \left\{\begin{matrix}CBuH_2\\COEto.\end{matrix}\right.\\ \text{Oxalic ether.} & & \text{Amyl.} & & \text{Caproic ether.}\end{array}$$

Oxalyl is closely related to cyanogen, the two radicals passing into each other in a host of reactions; hence the production of cyanides from the ammonium salts of the fatty acids on the one hand, and the synthesis of acids from certain cyanogen compounds on the other—a reaction first pointed out by Kolbe and Frankland‡, and which has of late yielded such important results in the hands of Maxwell Simpson§ and of Kolbe and of Hugo Muller‖.

$$\begin{array}{cc}\left\{\begin{matrix}CN'''\\CN'''\end{matrix}\right. & \left\{\begin{matrix}COHo\\COHo.\end{matrix}\right.\\ \text{Cyanogen.} & \text{Oxalyl.}\end{array}$$

The researches of these chemists prove that the introduction of cyanogen into an organic compound, and its subsequent transformation into oxalyl, converts that compound into an acid, or, if already an acid, increases its basicity by unity (for each atom of oxalyl so developed), this result being apparently quite independent of the position of the oxalyl in the molecule. The atom of oxalyl (as the above molecular formula shows) may be regarded as methyl (CH_3), in which two atoms of hydrogen have been replaced by one of oxygen, and the third by hydroxyl (Ho).

It may be objected that the group of elements, which is thus invested with radical functions, lacks one of the fundamental characteristics of a radical by its proneness to change; but this characteristic is exhibited by the commonly received radicals in a very varied degree. And even methyl itself, which certainly possesses it in the

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† Abstract of paper read before the Royal Society.

‡ *Memoirs of Chem. Soc.*, vol. iii. (1847) p. 386.

§ *Phil. Trans.*, 1861, p. 61, and *Journ. Chem. Soc.*, vol. xviii.

‖ *Journ. Chem. Soc.*, vol. xvii., p. 109.

most marked manner, readily permits of its hydrogen being replaced by chlorine or bromine on the one hand, and by sodium on the other. All compound radicals, the authors remark, are purely conventional groupings of elements intended to simplify the expression of chemical change; and in this respect they believe the group oxalyl, entering as it does into the constitution of nearly every organic acid, has as valid a claim to a distinct name as the most universally recognised radical. Its admission renders possible the following very simple expression of the law governing the basicity of nearly all organic acids—an organic acid containing n atoms of oxalyl is n basic.

The authors classify all acids of the lactic series at present known, or which could be obtained by obvious processes, into the following eight divisions :—

	General formula.
1. Normal acids	$\left\{\begin{array}{l}\mathrm{C\overset{+}{R}HHo}\\\mathrm{COHo}\end{array}\right.$
2. Etheric normal acids	$\left\{\begin{array}{l}\mathrm{C\overset{+}{R}H\overset{\pm}{R}o}\\\mathrm{COHo}\end{array}\right.$
3. Secondary acids	$\left\{\begin{array}{l}\mathrm{C\overset{+}{R}_2Ho}\\\mathrm{COHO}\end{array}\right.$
4. Etheric secondary acids . . .	$\left\{\begin{array}{l}\mathrm{C\overset{+}{R}_2\overset{\pm}{R}o}\\\mathrm{COHo}\end{array}\right.$
5. Normal olefine acids	$\left\{\begin{array}{l}\mathrm{C\overset{+}{R}HHo}\\\mathrm{(CH_2)_n}\\\mathrm{COHo}\end{array}\right.$
6. Etheric normal olefine acids . .	$\left\{\begin{array}{l}\mathrm{C\overset{+}{R}H\overset{\pm}{R}o}\\\mathrm{(CH_2)_n}\\\mathrm{COHo}\end{array}\right.$
7. Secondary olefine acids . . .	$\left\{\begin{array}{l}\mathrm{C\overset{+}{R}_2Ho}\\\mathrm{(CH_2)_n}\\\mathrm{COHo}\end{array}\right.$
8. Etheric secondary olefine acids . .	$\left\{\begin{array}{l}\mathrm{C\overset{+}{R}_2\overset{\pm}{R}o}\\\mathrm{(CH_2)_n}\\\mathrm{COHo.}\end{array}\right.$

A normal acid of the lactic series may be defined as one in which an atom of carbon is united with oxalyl, hydroxyl, and at least one atom of hydrogen. In the above general formula for these acids $\overset{+}{R}$ may be either hydrogen or any alcohol hydrogen.

An etheric normal acid is constituted like a normal acid, but contains a monatomic organic radical, chlorous or basylous, in the place of the hydrogen of the hydroxyl.

A secondary acid is one in which an atom of carbon is united with oxalyl, hydroxyl, and two atoms of an alcohol radical.

An etheric secondary acid stands in the same relation to a secondary as an etheric normal does to a normal acid.

A normal olefine acid is one in which the atom of carbon united with oxalyl is not united with hydroxyl, and in which the atom of carbon united with hydroxyl is combined with not less than one atom of hydrogen. In this formula $\overset{+}{R}$ may be either hydrogen or a monatomic alcohol radical, and the olefine, or diatomic radical of these acids, may belong to either the ethylene or the ethylidene series.

An etheric normal olefine acid differs from a normal olefine acid only in having the hydrogen of the hydroxyl replaced by an organic radical positive or negative.

A secondary olefine acid is one in which the atom of carbon united with oxalyl is not combined with hydroxyl, and in which the atom of carbon united with hydroxyl is also combined with two monatomic alcohol radicals. In the above formula $\overset{+}{R}$ must be a monatomic alcohol radical.

An etheric secondary olefine acid is related to the secondary olefine acids in the same way as the etheric normal olefine acids are related to the normal olefine acids.

The numerous cases of isomerism in the lactic series are next examined and explained; and the authors then show how the radicals which are employed for the production of the synthesised acids may again be separated, thus affording analytical as well as synthetical proof of the constitution of these acids.

These investigations have conducted the authors to the following conclusions :—

1. All acids of the lactic series are essentially monobasic.

2. These acids are of four species, — viz., normal, secondary, normal olefine, and secondary olefine acids; and each of these species has its own etheric series of acids, in which the hydrogen of the hydroxyl contained in the positive or basylous constituent of the acid is replaced by a compound organic radical, either positive or negative.

3. The normal acids are derived from oxalic acid by the replacement of one atom of oxygen, either by two atoms of hydrogen, or by one atom of hydrogen and one atom of an alcohol radical.

4. The secondary acids are derived from oxalic acid by the replacement of one atom of oxygen by two atoms of monatomic alcohol radicals.

5. The olefine acids are derived from oxalic acid by a like substitution of two monatomic positive radicals for one atom of oxygen, with the addition of a diatomic radical (C_nH_{2n}) between the two atoms of oxalyl.

6. The acids of the lactic series stand in the very simple relation to the acids of the acetic series first pointed out by Kolbe—viz., that by the replacement, by hydrogen, of the hydroxyl, ethoxyl, etc. contained in the positive radical of an acid of the lactic series, that acid becomes converted into a member of the acetic series.

7. The acids of the lactic series stand in an almost equally simple relation to those of the acrylic series, as is seen on comparing the two following formulæ :—

$\left\{\begin{array}{l}\mathrm{C(CH_3)HHo}\\\mathrm{COHo}\end{array}\right.$	$\left\{\begin{array}{l}\mathrm{C(CH_2)''H}\\\mathrm{COHo.}\end{array}\right.$
Lactic acid.	Acrylic acid.

On a New Acetylic Radical, by M. BERTHELOT.*

THE oxide of *mercuracetyle* is obtained by means of a solution of red iodide of mercury in iodide of potassium, to which ammonia is added, but not sufficient to produce any turbidity. The liquid introduced into a bottle filled with acetylene gradually absorbs the gas, and a glistening crystalline white precipitate is produced, resembling in appearance bimargarate of potash. This precipitate is washed with a concentrated solution of iodide of potassium to remove the ammonio-mercuric compounds. The appearance of the precipitate is thus changed to that of a white powder, which is extremely explosive, and which constitutes the new derivative of acetylene.

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* *Comptes-Rendus*, t. lxii., p. 909.

TECHNICAL CHEMISTRY.

On Sodium Amalgamation;[*] *in a letter from* HENRY WURTZ *to Professor* B. SILLIMAN.

(Continued from page 186.)

IX. Applications to the Transportation of Quicksilver.—The ordinary mode of packing and transporting quicksilver in bulk is very expensive and troublesome, and in its ordinary form its transfer from one vessel into another is accompanied by great liability to loss. It will therefore be found very convenient and useful to possess simple, cheap, and practicable modes, such as those described above, of converting it into solid forms, susceptible of transportation in vessels of lighter and cheaper material than the ordinary wrought-iron bottles; such, for instance, as glass or earthenware jars, wooden kegs, bags or bottles, or other envelopes of caoutchouc or gutta-percha, &c., &c.

This plan also enables quicksilver to be packed, stored, transported, and sold in convenient forms, such as bars, ingots, cylinders, blocks, cubes, spheres, or pellets, of definite sizes and weights, the convenience of which for many uses, and particularly for that of miners, is at once obvious. When the quicksilver is to be used in any of the arts above specified, it will then be already in a suitable condition or will merely require admixture with some fluid quicksilver; and when to be used as pure quicksilver, the sodium may be removed by throwing the solid amalgam in fragments into hot water, preferably mixed with a little sulphuric or acetic acid.

The modes of packing such ingots for preservation and transportation are already sufficiently set forth in a preceding paragraph.

Claims.—The claims attached to this specification are twenty-three in number, and those only are here given which directly concern the miner and amalgamator.

What I claim as my inventions are:—

1st. The combination with quicksilver when used for the extraction by amalgamation of any metal or metals from ores, slimes, and mixtures with other materials; of metallic sodium, or metallic potassium, or any other highly electro-positive metal equivalent in its action thereto, as above set forth.

2nd. In those amalgamators in which amalgamated plates of copper or other metal are used; the substitution therefor of plates or surfaces of iron, coated with quicksilver combined with sodium or other highly electro-positive metal, as above set forth.

3rd. The coating of iron surfaces, between or under which ores or other materials are crushed, with quicksilver combined with sodium or other highly electro-positive metal, as above set forth.

4th. The prevention of the granulation or flouring of quicksilver, when used in any method of amalgamating ores or other materials, by addition thereto of sodium or other highly electro-positive metal, as above set forth.

5th. The separation of intermixed iron from double amalgams of gold and sodium, or of silver and sodium, by fusion with excess of quicksilver and skimming, as above set forth.

6th. The separation of intermixed iron, platinum, osmiridium, and other non-amalgamable metals, from amalgams containing sodium or its equivalent, by action thereupon of water or other oxidating liquid, as above set forth.

7th. The separation of intermixed iron from amalgams containing sodium or its equivalent, or from any metal or metals extracted from such amalgams, by magnets, either permanent or electro-magnetic, as above set forth.

8th. The combination with quicksilver, when used in conjunction with iron or other reducing metals, for reducing to an amalgam silver from its chloride or other compound, or any other metal from any saline compound or solution, of sodium or other highly electro-positive metal, as above set forth.

. . . .

12th. In all cases in which metallic surfaces, such as copper plates, the zincs of voltaic batteries, &c., are to be amalgamated, the use of quicksilver combined with sodium or other highly electro-positive metal, as above set forth.

13th. The more rapid and convenient application of quicksilver to surfaces with metallic brushes, by virtue of its previous combination with sodium or other highly electro-positive metal, as above set forth.

14th. The use of metallic brushes, enfilmed with an amalgam of sodium or its equivalent, for incorporating together particles of quicksilver, gold, silver, or any other metal, scattered throughout ores, slimes, or any other materials, as above set forth.

15th. The more convenient transportation, handling, and subdivision of quicksilver, by conversion into solid forms, in the manner herein substantially described.

. . . .

Editorial Note.—At the session of the National Academy of Sciences, held in Washington in January last, Prof. Silliman read a paper upon the sodium amalgamation, detailing the results of a series of experiments conducted by him upon a scale of sufficient magnitude to test the value of this discovery upon gold quartz. In one experiment made on over 500 pounds of low grade ores, worth about $15 per ton, the sodium amalgam extracted practically all the gold not existing in the sulphides. This experiment was conducted in a large-sized Freiberg amalgamator, and was continued through one hour, the sodium amalgam being added in four successive portions of one ounce each, dissolved in a portion of the 20 pounds of mercury employed. The loss in mercury was about one ounce in this experiment, the quantity of the sodium amalgam being 1·2 per cent. of the total quantity of mercury in use.

In a second series of experiments, conducted on carefully prepared samples of richer ore, worth $320 per ton, treated in a revolving barrel, the saving by ordinary mercury was from 40 to 60 per cent. of the total quantity of gold present. With the aid of sodium amalgam 83·3 per cent. were recovered. The results in the large way in actual practice would probably be more satisfactory than those last named. Professor Silliman stated that experiments had also been set on foot in California to test this process on a large scale in the actual working of quartz mills. The results of these experiments will be noticed hereafter.

Varnish for Photographs.—M. Bussi first brushes the prints over with a solution of gum arabic, and when this is dry, applies a coating of collodion. The following are the proportions recommended:—

1.	Clear transparent gum arabic	25 grammes
	Distilled water . . .	100 cub. cents.
	Dissolve and strain.	
2.	Gun cotton	3 grammes
	Alcohol	60 „
	Ether	50 „

By this double varnish the inventor insures the preservation of the proofs.

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[*] *American Journal of Science and Arts*, vol. xli., p. 216. March, 1866.

PHYSICAL SCIENCE.

Notes on the Production of Low Temperatures.

In chemical research it is frequently desirable to have the means of producing a very low temperature; but, owing to the trouble and delay in preparing a freezing mixture, it is seldom employed. I have lately used an instrument in which a very low temperature is produced by forcibly blowing a mixture of air and volatile liquid through a fine jet.

The instrument is one made by Messrs. Krohne and Sesemann for the purpose of producing local anæsthesia in surgical operations, and the liquid recommended to be used is perfectly pure ether. The following notes of experiments made with this apparatus, using different liquids, may be found useful. Two ounces of each liquid were put into the four-ounce bottle belonging to the instrument; the air was forced in by means of a small india-rubber hand pump, and the jet was about the size of that of an ordinary mouth blowpipe. By means of small wires the inner orifice of the jet could be contracted at pleasure.

Liquid used.	Distance of bulb of thermometer from jet.	Lowest temperature.	Remarks.
Ordinary ether from methylated spirit	½ inch	—20°·7	Bulb of thermometer quickly coated with ice, condensed from atmosphere.
Ditto . . .	½ inch	—20·1	
Ditto . . .	½ inch	—15·0	Bulb of thermometer wrapped in cotton wool.
"Pure" washed and rectified ether .	½ inch	—21·0	Water in a test tube held in front of the jet commenced to freeze immediately.
Pure ether, sp. gr. ·720, prepared expressly for anæsthetic purposes .	½ inch	—21·6	Considerable quantity of ice condensed round the bulb of thermometer, so as to impede the cooling, unless occasionally removed.
Absolute alcohol .	½ inch	+ 8·0	
Ditto . . .	½ inch	+ 8·0	
Ditto . . .	½ inch	+ 8·0	Second-sized jet.
Ditto . . .	½ inch	+ 8·0	Third-sized jet.
Ditto . . .	½ inch	+ 8·0	Smallest jet.
Pure methyl alcohol, sp. gr. ·803 . .	½ inch	+ 1·1	
Solution of ammonia, sp. gr. ·880 . .	2 inch	+ 1·0	
Ditto . . .	½ inch	—11·0	
Ditto . . .	½ inch	— 9·2	
Chloroform . .	½ inch	— 5·1	
Bichloride of carbon	½ inch	— 2·2	
Bisulphide of carbon	½ inch	—17·6	Large quantities of ice condensed on the bulb, coating it nearly ½-in. thick. In a few minutes the sulphide of carbon ceased to issue regularly from the jet, and miniature snowballs were blown out at intervals. The bisulphide of carbon apparently contained water.
Benzol . . .	½ inch	+ 3·9	
Kerosolene . .	½ inch	—11·0	
"Potassium" napht.	½ inch	+ 8·3	

The temperature of the room was 18°. All the temperatures are Centigrade. Except where the contrary is stated, the full aperture to the jet was used.—W. C.

Pure Chromate of Potash for analytical purposes, according to Kletinsky, may be prepared by fusing 125 parts of bichromate with 100 parts of nitrate of potash to a clear liquid. The salt will then be free from NO_5 and NO_3.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, April 19.

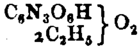
Professor W. A. Miller, *M.D., F.R.S., President, in the Chair.*

The business of the evening was opened as usual, and there was a very full attendance of members. Mr. W. Carr Stevens was formally admitted a Fellow of the Society, and the undermentioned were duly elected—viz., Mr. J. T. Brown, Oxford Villa, Sudbury; Mr. James Gale, Belsize Park, Hampstead; Mr. William Huggon, Park Row, Leeds; Mr. Joseph Richardson, Dawson Street, Manchester; and Mr. W. Marshall Watts, B. Sc., Glasgow University. The names of the following candidates were read for the first time:—Mr. J. Robinson, Oxford; Mr. Marshall Hall, barrister-at-law, Halstead, Wilts; and Mr. J. James Lundy, Leith.

The President read the bye-law referring to the election of honorary and foreign members, and, on the part of the Council, proposed the admission of Professor Rammelsberg, Dr. Walcott Gibbs, and Professor Weltzien as honorary members.

A communication "*On Picric Ether,*" by H. Muller, Ph.D., and J. Stenhouse, LL.D., was read by the secretary. The authors state that the product formerly described by Mitscherlich under this name was not the true picric ether, but that the compound may be produced by acting upon picrate of silver with the iodide of ethyl. In order to avoid a too energetic action it is recommended to employ a large excess of the latter—not less than five parts by weight—and subsequently to distil off the excess of iodide of ethyl. The picric ether is then dissolved out by alcohol, and is obtained in the form of long, nearly colourless, needle-shaped crystals, which become slightly yellow on exposure to light, and are fusible at 78° C. Analysis established the formula—$C_6N_3O_7H_2,C_2H_3$.

A paper "*On Styphnic or Oxypicric Ether,*" by Dr. Stenhouse, was then read by the secretary. The styphnic acid employed by the author was prepared by the action of nitric acid upon the concentrated extract of sapan wood, and purified by conversion into the potassium salt. From this the styphnate of silver was prepared by double decomposition, and this salt furnished the ether in question by digesting with the iodide of ethyl and extracting with alcohol. Like the corresponding picrate, the crystals of styphnic ether—long laminæ, nearly colourless—are affected by light, changing to brownish yellow. Analysis furnished numbers agreeing with the formula—



$$\left.\begin{array}{r} C_6N_3O_6H \\ 2C_2H_5 \end{array}\right\} O_2.$$

Specimens of the above, and also some magnificent red crystals of *Chrysammic Ether*, prepared in a similar manner, were exhibited by Dr. Stenhouse.

The President moved a vote of thanks to the authors, and then invited Professor G. Cary Foster to address the Society on the subject of "*The Thermal Phenomena of Chemical Action.*" The lecturer gave an historical account of the early experiments and deductions of Crawford, Lavoisier and Laplace, Dalton, Count Rumford, and Despretz, and exhibited by diagrams the construction of the calorimeters employed in their researches. As illustration of the diversity of results arrived at in years prior to 1828, Professor Foster quoted the following:—

Units of Heat evolved by the Combustion of Carbon in Air.

A.D. 1779	Dr. Crawford . .	5761
1784	Lavoisier and Laplace	7624
1828	Despretz . . .	7915

Researches characterised by greater accuracy were published in 1843 among the posthumous works of Dulong;

but it was to be regretted that many important details of his experiments had not been placed on record. These results paved the way for the elegant researches of Favre and Silbermann, Andrews, Grassi, and Hess, whose several determinations of the heat given out during the combustion of hydrogen approximated within very close limits. The later experiments of Thomsen (of Copenhagen), Graham, and others, furnished comparative rather than absolute results. The most efficient calorimeter was considered to be that of Favre, as improved by Raoult. In the next place, the lecturer gave an account of the rival theories regarding the nature of heat, and referred to the thermal capacity usually called "specific heat." Under this head the views of Davy and Berzelius were mentioned, and the general laws relating to the development of heat in chemical action were thus stated :—

I. The thermal effect of a given chemical change is proportional to the quantity of matter affected by that change, and independent of the time occupied in its accomplishment.

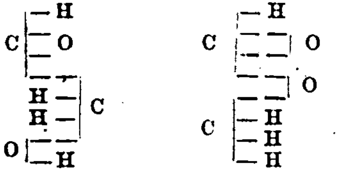
II. The thermal effect of a given chemical change is the same whether that change occurs all at once or takes place by two or more successive stages.

III. The thermal effect of a reversal of a given chemical change is equal and opposite to the thermal effect of that change.

Several interesting considerations, such as changes in the specific heat resulting from physical structure and isomerism, the increased energy conferred by the employment of electrical force, as in the combination of oxygen and nitrogen by the Ruhmkorff spark, &c., were then treated of somewhat fully by the lecturer. As illustrations, the allotropic varieties of carbon and sulphur were selected, and the anomalous results observed in the combustion of the bisulphide of carbon were explained by the liquid condition of the elements.

	Units.
Carbon as charcoal	8080
Carbon as graphite	7797
Carbon as diamond	7770
Sulphur, native	2220
Sulphur, plastic	2260
Isomeric hydrocarbons—	
Oil of turpentine	10852
Oil of lemons	10959
Terebine	10662

Professor Foster concluded by sketching the molecular constitution of acetic acid and formiate of methyl, which, although isomeric, gave out sensibly different amounts of heat upon combustion. The respective formulæ were thus indicated :—


Acetic acid. Formiate of methyl.

Time did not permit of a lengthened discussion, and consequently

Dr. Williamson limited himself to a single remark in reference to the use of term "specific heat," which the speaker would prefer to call "total heat," inasmuch as this word was intended to denote the sum of all heat down to the absolute zero. The extension of calorimetrical experiments to the lowest possible temperatures appeared likely to furnish valuable results.

A vote of thanks having been passed to the lecturer, the meeting was adjourned until May 3, when Dr. J. H. Gladstone will read a paper "*On Pyrophosphodiamic Acid.*"

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, March 23, 1866.

Sir Henry Holland, *Bart., M.D., D.C.L., F.R.S., President, in the Chair.*

Henry Bence Jones, *A.M., M.D., F.R.S.*

On the Existence in the Textures of Animals of a Fluorescent substance closely resembling Quinine.

When I last year brought to your notice the fact that "a single dose of lithium in a few minutes passes, through the circulation, into all the ducts, and into every particle of the body, and even into the parts most distant from the blood circulation, and when I showed you that it remains there for a much longer time than it took to get into the textures (probably for three or four days, varying with the quantity taken), and that then it diminishes, and finally, in six, seven, or eight days, the whole quantity is thrown out of the body," I little expected that by prosecuting an investigation into this chemical circulation in the body I should come upon that discovery which forms the title for this evening's discourse.

No imagination could have anticipated that this line of research into the rate of passage of substances into and out of the textures would lead to the supposition that man and all animals possess, in every part of the body, the most characteristic peculiarity of the bark of the cinchona trees of Peru.

After determining the rate of passage of lithia and other mineral matters into and out of the body, Dr. Dupré and I proceeded to endeavour to trace the rate of passage of quinine into and out of the textures of animals.

We chose quinine because of that splendid test which led Professor Stokes to the discovery of the change of refrangibility of light.

Here, for example, are different solutions of quinine of different strengths, and by means of the production of fluorescence in the electric light, you see how we can determine which of these solutions contains the greatest quantity of quinine; and by forming standard solutions it would be easy to measure how much quinine existed in each of these solutions. Moreover, Professor Stokes discovered that when a solution of common salt was added to this quinine solution, the fluorescence entirely disappeared. Though this may be so for sun light, it does not disappear in this electric light; and, moreover, on adding a solution of sulphate of soda to a solution of chloride of quinine, the fluorescence in great measure returns.

Still further, Professor Stokes showed that one solution of quinine entirely stopped these rays from passing into a second solution of the same substance, so that you must almost tell whether you had a solution of quinine by seeing whether it cut off the fluorescence from a second solution of quinine.

Our first object was to determine the delicacy of this reaction for quinine. We arrived at the following results, when the spark from a Ruhmkorff coil was the source of light :—

Sulphate of quinine gave slight fluorescence when $\frac{1}{800000}$ of a grain was present.

Sulphate of quinine gave feeble fluorescence when $\frac{1}{500000}$ of a grain was present.

Sulphate of quinine gave distinct fluorescence when $\frac{1}{250000}$ of a grain was present.

One grain of sulphate of quinine in one million eight hundred parts of water showed the blue fluoresence distinctly in twenty grains of the solution. In another experiment, the same amount of quinine in one million four hundred and forty-four parts of water showed fluorescence very distinctly.

Having thus got our test, we proceed to apply it to determine the passage of quinine into and out of the textures of guinea-pigs.

A guinea-pig was given quinine, and for comparison another guinea-pig was killed at the same time, having had no quinine.

In the pig that had taken quinine each organ was heated in a water-bath, with very dilute sulphuric acid. This extraction was repeated over and over again. The acid extracts were mixed and filtered after cooling, neutralised with caustic soda, and repeatedly shaken up with their own bulk of ether. The residue left after evaporation of the ether was taken up by dilute sulphuric acid, filtered and tested for fluorescence.

The pig that had taken no quinine had each organ treated in a precisely similar way. To our great disappointment, at first we found that not only had the pig that had taken quinine a fluorescent substance in the textures, but that an almost exactly similar substance was extracted from the organs of the pig that had taken no quinine. Every texture was examined, and in every one this fluorescent substance occurred.

We then endeavoured, in every possible way, to find a means of separating the natural from the induced fluorescence. And as every method failed, and we were compelled to recognise the close similarity of the substance that exists in the textures to quinine itself, we for a time dropped the original inquiry, and proceeded to a more complete investigation of the natural fluorescent substance in animals.

Without any preparation this substance can be shown to exist in the living and in the dead textures. There is one transparent substance which is above all most suited for this inquiry.

Here are some lenses removed from the eyes of bullocks, guinea-pigs, and man. You see how clear, white, and transparent these substances are; and if I take a bullock's eye, which by gentle pressure has been flattened so that the structure can be distinctly made out, there is plainly no colouring matter. As in quinine, nothing is seen until the blue rays of the electric light fall on the lenses; then look at the splendour of the reaction. Here, with the guinea-pig's lenses, the same is seen; and here, with the flattened bullock's eye. You might be tempted to think that this is a post-mortem change, a result of decay; but here is a fresh bullock's eye, look at this blaze of bluish-green light; but still more full of suggestion is an experiment with a dilated pupil in a living animal or in man. Let me show you my own eye, for in it you can see the lens shining with this unnatural, because unaccustomed, light, looking like an opaque substance, a blue green cataract.

Life and death then have nothing to do with the existence of this substance; here, it is present in the living lens; it does not disappear from lenses that have been kept for months in glycerine.

I have already said that this substance not only exists in the lens, but that it can be found everywhere by treating any animal substance, first with dilute acid, then neutralising with alkali, and then extracting with ether: thus we obtain solutions having exactly the same properties as you see in the lens. Here, for example, is such an extract from the liver. Here, from the kidney. Here, from the heart. When an acid solution of this substance is treated with ether, no fluorescent substance is obtained. First, as with quinine, the acid must be neutralised before this substance or the quinine can be taken up by the ether.

Having then obtained these solutions, we were able to compare them with solutions of quinine in their actions on the spectrum. And first, the solution of the natural substance begins to fluoresce a little before the solution of quinine; but on carrying it on through the spectrum it ends where quinine ends.

The fluorescent light of the natural substance is a little more greenish than the fluorescent light of quinine.

If a quartz cell containing this fluid is interposed between the source of light and a solution of quinine, no fluorescence takes place in the quinine; and if quinine is interposed between the light and this natural solution, scarcely any fluorescence is observed in it.

When a solution of salt is added to the naturally fluorescing substance, it is almost entirely destroyed, as happens with quinine.

If the natural solution is boiled with permanganate of potass, it does not lose its fluorescence, nor does quinine; but when permanganate with excess of alkali acts upon this substance or upon quinine, the fluorescent substance is entirely oxidised.

Hence this substance, by the mode of its extraction and by its remarkable action on light, is very closely related to quinine; and this led us to apply the chemical tests for quinine to this natural fluorescent substance, after extraction from the body.

The different tests for alkaloids like quinine, as morphia, strychnine, veratrine, atropine, you may see in the following reactions. First, quinine gives, as you see, a precipitate with iodine in iodide of potassium. Secondly, iodide of mercury in iodide of potassium also gives a precipitate. Thirdly, phosphomolybdic acid also gives a precipitate. Fourthly, bichloride of platinum gives a precipitate. Lastly, terchloride of gold causes a precipitate, and this precipitate is soluble in alcohol.

Now each and all these different reations are obtained with these same reagents acting on the fluorescent substance that is extracted from animals.

So that here again we have chemical proof that this substance is an alkaloid, and that it is closely related to quinine.

We have named it Animal Quinoidine because we have not as yet been able to crystallise it nor to obtain enough for an analysis.

Having satisfied ourselves that an alkaline fluorescent substance resembling quinine existed in the different textures, we endeavoured to determine the proportion that was present in different parts. For this purpose standard solutions of quinine of known strength were prepared, and equal amounts of substance were treated in precisely similar ways, and then the fluorescence was compared with the standard solutions of quinine. No very accurate estimations could thus be made, but comparative results could be obtained, and these are represented in the following tables:—

On the amount of fluorescent substance in different parts of guinea-pigs and of man, measured by the number of grains of quinine in 100 *litres* (= 176 *pints*) *of water, that gave the same fluorescence.*

	IN GUINEA-PIGS.			IN MAN.		
Liver	6 to 3	6	2	2	2	2
Lenses	3	2	2	2		
Kidney	3	2	2	2	2	3 to 6
Urine	3	2	2			
Bile	3	2	2			
Blood	3	2	2			
Brain	3	2	2			
Nerves	3	2	2	1	1	2
Muscles	3	2	2	1	2	2
Humours of the eye	2	2	2			
Cartilages	..	..	..	3	1	
Spleen	..	..	..	1	1	3
Lungs	..	..	..	1	1	2

What, then, is the meaning of this widely diffused substance in animals which so closely resembles quinine? At present we are far from a perfectly clear answer. It is not thirty years yet since the presence of ammonia in the products of distillation of coal was considered "curious," because nitrogen was thought to be the characteristic of an animal substance, and absence of nitrogen was considered as the distinctive mark of vegetable creation. Gradually, year by year, each substance that has been thought to be the special property of the vegetable world has been found to occur in animals. Thus sugar, starch, woody fibre, vegetable colouring matter, as indigo, albuminous substances, are common to animals and vegetables; and at length we have arrived at the fact that no distinction can truly be drawn between the three kingdoms of nature. In the body, salt and phosphate of lime and phosphate of soda are animal substances as much as fibrin and albumen. Sugar is as much an animal substance as albumen is a vegetable substance, and no separation can be made by chemical analysis between animal, vegetable, and mineral.

The processes which take place in the three different kingdoms are, however, very different. The vegetable generally from carbonic acid, ammonia, and water can synthetically build up acids, neutral hydro-carbons, fats, alkaloids, and albuminous substances. Whilst the animal generally from albumen analytically produces alkaloids, fats, neutral hydro-carbons, acids, and ultimately water, ammonia, and carbonic acid.

Thus the following table of synthetically and analytically produced substances common to both kingdoms may even now be formed:—

From Carbonate of Ammonia and Water. Synthetically formed substances, by the plant or by the chemist.	*From Albumen passing down to Carbonate of Ammonia and Water.* Analytically formed substances.
Oxalic Acid	Albumen
Formic	Casein
Lactic	Animal Quinoidine
Acetic	Indican
Valerianic	Glycocol
Glycerine	Taurin
Sugar	Leucin
Starch	Urea
Cellulose	Caprylic Acid
Cholesterin	Caproic
Butyrin	Capric
Palmatin	Olein
Stearin	Stearin
Olein	Palmatin
Capric Acid	Butyrin
Caproic	Cholesterin
Caprylic	Cellulose
Urea	Starch
Leucin	Sugar
Taurin	Glycerine
Glycocol	Valerianic Acid
Indican	Acetic
Quinine	Lactic
Casein	Formic
Albumen.	Oxalic.

From this point of view, then, our so-called animal quinoidine is descended from albumen, and its ultimate progeny are carbonate of ammonia and water, out of which substances the cinchona tree, under favourable circumstances, is able to build up quinine.

$$C_{40}H_{24}N_2O_4.$$

From the large number of carbon atoms in quinine, it may be regarded as one of the early substances produced in the downward passage of albumen, and from this we shall very probably find the key to the question how quinine acts in the body.

When sulphate of quinine is taken, like the lithium and other substances which I brought before you last year, it rapidly passes from the blood into the textures.

Even in a quarter of an hour, after four grains of sulphate of quinine the fluorescence may rise to 75 grains to 100 litres. It is found in greatest amount in the liver and kidney; rather less in the blood, urine, and muscles; still less in the brain, nerves, and bile; and is perhaps even in this time increased in the lens of the eye.

In three hours the maximum effect of the quinine may be reached. It amounts then to from 100 to 200 grains of quinine in 100 litres of water, and it occurs to this amount in the liver, kidney, urine, bile, blood, brain, and muscles. The nerves and aqueous humour showed much less increase, and the lenses showed the least increase of all the textures.

In six hours the amount of fluorescence was rather less than in three hours.

In twenty-four hours it was considerably less than half as much as in three hours.

In forty-eight hours, except in the liver and blood, there was but little more fluorescent substance in the textures than naturally exists there.

And in seventy-two hours the liver showed no trace of increase of fluorescence.

Hence, in fifteen minutes the quinine had passed everywhere. In three hours it was at its maximum, and remained in excess for six hours. In twenty-four hours it was much diminished, and in forty-eight hours scarcely perceptible.

These results were obtained by extracting the natural fluorescent substance and the quinine together from the textures, determining the joint fluorescence by standard solutions, and by comparing the numbers thus obtained with the numbers given when no quinine was taken.

The following table of the fluorescence of the different textures after four grains of quinine had been taken by guinea pigs was made:—

	Experiment 1, ¼ hour.	Experiment 2, ½ hour.	Experiment 3, 1 hour.	Experiment 4, 3 hours.	Experiment 5, 4½ hours.	Experiment 6, 5½ hours.	Experiment 7, 6 hours.	Experiment 8, 8 hours.	Experiment 9, 24 hours.	Experiment 10, 32 hours.	Experiment 11, 48 hours.	Experiment 12, 72 hours.
Liver . . .	75	40	20 to 40	100 to 200	100		100 to 200		50	4	6	6
Lenses . .	6 to 3	5	—	3	2		3 to 1		3		3	3
Kidney . .	75	40	20	100 to 200	100		100		50		3	3
Urine. . .	50	20 to 10	20	100 to 200	100		100	4 to 6	12 to 6	2	3	3
Bile . . .	12	20	5	100 to 200	13		75	5	12		3	3
Blood. . .	50	20	20	100 to 200	12 to 25	20 to 40	100 to 50		12		6	3
Brain. . .	12	10 to 5	5 to 3	100 to 200	6 to 12		25		6			3
Nerves . .	6	5	least	6	2		6		3		3	3
Muscles . .	50 to 25	20	5	100 to 200	50 to 100		25		12 to 6		3	3
Humours . .	—	5	—	6 to 3	2		3		6		3	least

We have been able also to find some trace of the passage of the quinine even into the lens of the eye of man.

The following table, which we owe to the kindness of Mr. Bowman, who gave us the cataracts, makes this evident.

On the increase of fluorescence in cataracts after quinine.

Natural fluorescence of lens	=1·6	grs. of quinine per	100 lit. water
1 hour after 5 grs. quinine; cataract	=1·6	,,	,,
1½ ,, ,, ,,	=1·6	,,	,,
2 ,, ,, ,,	=1·6	,,	,,
2½ ,, ,, ,,	=2·1 to 3·1	,,	,,
After many days taking quinine	=6·2 to 3·1	,,	,,

The figures represent the number of grains of sulphate of quinine in 100 litres, 176 pints of water, required to give a fluorescence equal to that of the substances extracted.

Thus, then, the quinine goes everywhere; and wherever it goes it meets with the natural fluorescent substance like quinine which most probably is constantly forming and undergoing oxidation. The incoming quinine causes a temporary excess of quinine in the textures. Probably it causes a stoppage of the fresh formation of quinine from albumen; a temporary arrest of the changes going on; a transfer of action probably to the quinine introduced, so that with large doses deafness and great prostration and almost imperceptible pulse are produced in man, whilst in guinea-pigs death even is caused by the extreme prostration. In small doses, quinine probably, like alcohol, gives an immediate stimulus when the first chemical action takes place; but soon the quinine retards the chemical changes in the nitrogenous substances, just as alcohol, by its secondary action, retards the chemical changes in the hydro-carbons in the different textures.

Possibly the increased resistance to changes in the textures and in the blood produced by excessive doses of quinine or alcohol, is analogous to that state well known to medical men under the very indefinite and probably incorrect name of uremia.

From these experiments two hopeful prospects of possible discovery arise—1st, as to the explanation of the cause and cure of ague; 2nd, as to the treatment of diseases in parts of the body external to the blood vessels.

1. Assume that a substance like quinine exists, in health, in the textures, can its rapid destruction and removal through the action of marsh miasm give rise to ague? Does quinine cure ague by furnishing a substance which retards the changes which go on in the textures? and in the well-known property of arsenic to preserve organic substances have we also the explanation of its power in curing ague?

2. If the chemical circulation can carry alkaloids even into the non-vascular tissues, is it not reasonable to suppose that medicines pass through the blood and act on the textures? and is it not most probable that they take part in every chemical change that occurs outside the blood vessels, as well as in the blood itself? Still further, may we not expect that among the multitude of new substances which synthetical chemistry is now constantly forming, some medicines may be discovered which may not only have power to control the excessive chemical changes of the textures in fevers and inflammations, but may be able to remove the products of insufficient chemical action even in those diseases which affect the non-vascular textures, as, for example, in cataract and in gout?

It remains that I should in a very few words tell you what was already known regarding this fluorescent substance, and on the rate of passage of alkaloids into and out of the body, before we begin our work.

In 1845, Professor Brücke stated that the lens absorbed the blue rays of light to a very great extent, and that the cornea and aqueous humour did so to a less extent. In 1855, Professor Helmholtz examined for fluorescence the retina of the eye of a man who had been dead for eighteen hours. The first experiment showed that it was very feebly fluorescent. The colour of the light dispersed though the retina he found greenish-white.

In 1858, M. Jules Regnauld, using sun light, found in man and the mammifera that the cornea fluoresced in a very slight degree. In the sheep, dog, cat, and rabbit the crystalline lens possessed in the highest degree fluorescent properties. In these animals, and also in many birds, the central part of the lens, preserved by dessication at a low temperature, retained this property. The central portion of the crystalline of many aquatic vertebrata and mollusca he found almost entirely without fluorescence. The vitreous humour possesses only a very feeble fluorescence, due to the hyaline membrane. The retina possessed a certain fluorescence which was not at all comparable in intensity to that of the crystalline lens.

In 1859, I. Setschenow, of Moscow, a pupil of Helmholtz, at his request, experimented on the eyes of men and rabbits. The first retina showed the same phenomenon as the dead human retina. It diffused a greenish-white light, which, examined by a prism, gives a spectrum in which the red is wanting. The vitreous humour in a thin glass vessel showed only traces of fluorescence. The lens, on the contrary, fluoresced very strongly, the colour of the dispersed light being white-blue, exactly like quinine, only the quinine was a little stronger. Examined by a prism, the dispersed light gave a spectrum in which the red was wanting, and in which the blue tone predominated. The fluorescence begins as in quinine solutions between G and H, and is strongest at the outer edge of the violet rays, and extends into the ultra violet to the same distance in the case of the lens as in the case of the quinine solution.

When the cornea was cut out, it fluoresced much feebler than the lens; the aqueous humour did not fluoresce at all.

The appearances in the three last media, he says, can be shown with the greatest ease, even in the eye of the living man. When the eye is brought into the focus of the ultra violet rays immediately the cornea and the lens begin to glimmer with a white blue light. The cornea in the living eye is much more fluorescent than when dissected out, probably from the loss of transparency, consequent on contraction of the texture, and from evaporation.

Professor Donders has carefully investigated the time in which atropine and Calabar bean act on the iris in man.

A solution of atropine dropped on the cornea in fifteen minutes begins to act, and attains its maximum in from twenty to twenty-five minutes. In forty-two hours the pupil is rather smaller, and even after thirteen days the pupil was not quite its natural size.

The fluid extracted from the aqueous humour, injected into another eye, caused dilatation of the pupil.

A solution of Calabar bean began to act in from five to ten minutes; attained its maximum in from thirty to forty minutes. At the end of three hours it began to diminish, and disappeared entirely in from two to four days.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, April 3, 1866.

R. Angus Smith, *Ph.D., F.R.S., &c., President, in the Chair.*

Messrs. Wm. Brockbank and G. C. Lowe were appointed auditors of the treasurer's accounts.

Mr. Binney, F.R.S., said that he had observed the humming bird hawkmoth (*Macroglossa Stellatarum*) during the past summer in far greater abundance than he ever remembered having seen it before.

A paper was read "*On a Logical Abacus*," by W. S. Jevons, Esq., M.A. The author believed that this was the first attempt, or at all events, the first successful attempt, to reduce the processes of logical inference to a mechanical form. The purpose of this contrivance is to show the simple truth, and the perfect generality of a new system of pure qualitative logic closely analogous to, and suggested by, the mathematical system of logic of the late Professor Boole, but strongly distinguished from the latter by the rejection of all considerations of quantity. This logical abacus leads naturally to the construction of a simple machine which shall be capable of giving with absolute certainty all possible logical conclusions from any sets of propositions or premises read off upon the keys of the instrument. The possibility of such a contrivance is practically ascertained; when completed it will furnish a more signal proof of the truth of the system of logic embodied in it. Still the more rudimentary contrivance called the "abacus" will remain the most convenient for explaining the nature and working of formal inference, and may be usefully employed in the lecture-room, for exhibiting the complete analysis of arguments and logical conditions, and the exposure of fallacies.

In the description of his balance given in the last number of the *Proceedings*, Dr. Joule omitted to mention a fixed support against which the scale rests when the counterbalance is removed. By this means the wires are kept constantly in the same state of tension, and are thus preserved from the derangement which might otherwise ensue.

MICROSCOPICAL AND NATURAL HISTORY SECTIONS.

March 26, 1866.

A. G. Latham, Esq., *President of the Sections, in the Chair.*

The following objects were exhibited:—Eight mounted specimens of hair of Australian animals for the cabinet; one of them, a species of Phascogale, very remarkable.—Mr. Latham. A large collection of rare beetles from Ceylon, recently presented to the Natural History Society by —— Braybrooke, Esq.—Mr. Latham. Many specimens of remarkable foraminifera from Dogs Bay.—Mr. Linton. A sample of the Guano lately imported from Malden Island in the Pacific, for distribution among the members.—Mr. Latham.

Dr. Alcock showed mounted specimens of Embryonic shells of Mollusca, including fifty species collected by him from Dogs Bay sand, and named by J. Gwyn Jeffreys, Esq.

ACADEMY OF SCIENCES.

April 16.

M. L. Cailletet presented a note "*On the Dissociation of Gases in Metallurgical Furnaces.*" The author, by peculiar contrivances which we need not describe, drew air from blast furnaces and submitted it to analysis. The first analysis is of gas taken from the hottest part of a blast furnace, and rapidly cooled by a stream of water on the plan of M. St. Claire Deville. The mixture was composed of

	I.	II.
Oxygen . . .	15·24	15·75
Hydrogen . .	1·80	„
Carbonic oxide .	2·10	1·30
„ acid . .	3·00	2·15
Nitrogen . .	77·86	80·80
	100·00	100·00

These results confirm those of Deville, and show that oxygen does not combine with hydrogen, carbon, or carbonic oxide at very high temperatures. The author afterwards took air from furnaces at lower temperatures, and the results show the gradual disappearance of the oxygen with the abasement of the temperature, and of course the increase of carbonic acid. M. Cailletet concludes that compound gases cannot exist at high temperatures.

M. Berthelot communicated the first part of a note "*On the Action of Heat on Some Carbides of Hydrogen.*" In the course of his experiments the author was astonished to find that acetylene was easily destroyed by heat. When this gas was heated in a *cloche courbe* over mercury up to a temperature at which the glass began to soften, the volume of gas was observed to diminish, and some tarry matter was seen to deposit. The heat being continued for some time (half an hour) the volume was reduced to one-fifth, 97 hundredths of the acetylene had disappeared, and the gaseous residue was formed of hydrogen and the remaining 3-hundredths of acetylene with some ethylene and a little hydride of ethylene. Nearly the whole of the elements of the acetylene were found in the liquid and solid products of the reaction. These consisted of a volatile liquid which the author proved to be *styrol* $C_{16}H_8$, and a resinous body which appears to be *metastyrol*. It must be added that a trace of napthaline was formed, and a little free carbon was left, which accounts for the free hydrogen in the gaseous residue.

M. Berthelot next studied the transformation of acetylene under the influence of heat in the presence of other bodies. In the presence of carbon (coke extinguished under mercury) the acetylene disappeared rapidly, but nearly all the hydrogen was disengaged in the free state; the acetylene was, in fact, resolved principally into its elements. The presence of iron caused a more rapid destruction of the acetylene at a lower temperature. The results were carbon, free hydrogen occupying about half the volume of the original acetylene, and empyreumatic carbides, differing from those formed by heat alone. From the amount of carbon deposited on the iron, the author concludes that these carbides are richer in hydrogen than acetylene and its polymers. Acetylene mixed with its own volume of nitrogen, carbonic oxide, marsh gas, or hydride of ethylene, is more slowly transformed than when alone, and seems to give rise to special phenomena, which the author at present does not describe. Mixed with hydrogen, acetylene is more slowly transformed than when alone, and a quantity of ethylene is produced, as if the hydrogen combined with acetylene at a high temperature. The above results show that the transformation of acetylene is not comparable to the phenomena of dissociation; nor does it result from the destruction of the affinity which holds the carbon to the hydrogen. It is, in fact, not a decomposition, but a combination of a higher order determined by the reciprocal union of several molecules of acetylene. The action of heat on ethylene or hydride of ethylene, either pure or mixed with hydrogen, may be regarded as typical. Ethylene C_4H_4 is slowly destroyed, giving rise to hydride of ethylene, tarry carbides, and acetylene. With hydride of ethylene C_4H_6, an inverse decomposition takes place, and ethylene is produced. When ethylene is treated with hydrogen, the two gases combine at about a red heat, and produce the hydride. At the same temperature, the hydride splits up into ethylene and hydrogen. We shall give a longer abstract of this paper in an early number.

M. Berthelot also made a short communication "*On a New Acetylic Radical,*" which will be found in another part of our columns.

NOTICES OF BOOKS.

On Inhalation as a Means of Local Treatment of the Organs of Respiration by Atomised Fluids and Gases. By Hermann Beigel, M.D., L.R.C.P.L., &c. London: Hardwicke. 1866.

We may dismiss this work with a very few words. It has the merit of showing clearly, what must be obvious to every one, that the inhalation of atomised fluids deserves serious notice as a means of treatment for diseases of the respiratory tract. The time will probably come when an inhalation-room will be considered as necessary an adjunct to an hospital as a bath-room. It may be, too, that that long-suffering organ, the stomach, may be relieved of much of its disagreeable duty as a receptable for physic, to the comfort and other advantage of the patient. We hope Dr. Beigel's book will be extensively read. It appears to be the first that has been devoted to the subject, and we wish it may lead to more extensive trials of the means of cure described.

Zeitschrift für Chemie, &c. March, 1866.

In this number Fittig describes *Valerolactic Acid, a new Acid homologous with Lactic.* It is obtained by boiling pure bromovalerianic acid with more than the calculated quantity of oxide of silver. The decomposition takes place rapidly, and bromide of silver is separated. The filtered liquid is treated with sulphuretted hydrogen to remove dissolved silver, and then evaporated to dryness to get rid of free valerianic acid. To completely purify the new acid a calcium salt is first formed, and then, by double decomposition, a zinc salt. This salt, decomposed by sulphuretted hydrogen, gives the free acid. A solution of the acid evaporated to a syrup over sulphuric acid yields large colourless transparent crystals, which fuse to a colourless liquid at 80°, and volatilise at 100°. They are soluble in water, alcohol, and ether. An analysis gave the formula $\Theta_5H_{10}\Theta_3$. The author further describes the salts of sodium, calcium, zinc, silver, and copper.

A paper by Martius and Griess describes *Amidodiphenylimid, a new Organic Base* — $\Theta_{12}H_{11}\Theta_3$ — isomeric with the diazoamidobenzol described by Griess, which latter the author supposed to be identical with aniline yellow. Diazoamidobenzol, when boiled with hydrochloric acid, gives phenol, aniline, and nitrogen. Aniline yellow, treated in the same way, gives the new base, oxalic acid, and a little insoluble resinous substance. The new base is precipitated from the hydrochloric solution as a yellow crystalline powder by supersaturating with ammonia. Amidodiphenylimid and diazoamidobenzol are both formed by the action of nitrous acid on an alcoholic solution of aniline—the latter when the acid acts on a cold solution, the former at a higher temperature. The authors have proved that the new base is identical with a yellow colouring matter formed by the action of stannate of soda on a salt of aniline. A mixture of three parts stannate of soda, and one part nitrate of aniline, with ten parts of water, is heated to 100°. Caustic soda being added by degrees, a lively reaction ensues. As soon as a drop of the liquid treated with an acid gives a deep red colour the operation is stopped, and the mixture allowed to cool. After dissolving the separated stannic oxide by hydrochloric acid, a considerable quantity of reddish-brown resin deposits. This is digested with dilute caustic soda to remove some phenol, and then boiled with dilute hydrochloric acid. This solution decomposed by ammonia gives amidodiphenylimid. All the slightly acid solutions of this base dye wool and silk an intense lemon-yellow colour. A picric salt dyes wool a colour comparable with cochineal red. The most remarkable fact relating to these colours is that they are all volatile, and may be driven off by heat from the dyed stuffs. Amidodiphenylimid heated with hydrochlorate of aniline gives a blue colour. We shall probably return to this paper, and now only add that toluidine treated with nitrous acid as well as with stannate of soda gives a compound homologous with the new base.

Martius and Griess have also described *Amidodinaphthylimid and Diazoamidonaphtol.* The best way of obtaining the latter is by the action of a weak alkaline solution of nitrite of sodium on crystallised neutral hydrochlorate of naphthylamin. The new body separates from an alcoholic solution in yellowish-brown plates, which quickly fuse to a resin on a waterbath, and at a higher temperature decompose with an explosion. On heating even with most dilute acids the new body splits up into naphthylamin and naphthylalcohol. With strong mineral acids it gives a violet colour. The author gives the following as the formula of diazoamidonaphtol—

$$\left.\begin{matrix}\Theta_{10}H_9N\\ \Theta_{10}H_6N_2\end{matrix}\right\}$$

Amidodinaphthylimid is the *nitrosonaphthylin* of Church and Perkin, whose description of its properties is confirmed by Martius and Griess. This base is formed by the action of nitrous acid on a warm alcoholic solution of naphthylanin, as well as by the action of stannate of soda on the same base.

The next paper is "*On the Solid Hydrocarbons from Coal Tar,*" by J. Fritsche, describing *chrysogen*, which the author separated from a mass of paranaphthalin obtained from Miller and Co., of Glasgow. We shall give an abstract of this paper. The other papers call for no notice.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

646. G. Prentice and A. B. Inglis, Glasgow, N.B., "Improvements in the annealing of metallic plates, and in the apparatus or means employed therefor."—Petition recorded March 3, 1866.

812. T. Routledge, Ford Works, near Sunderland, T. Richardson, Newcastle-upon-Tyne, and W. H. Richardson, Jarrow-on-Tyne, "Improvements in treating the waste liquors resulting from the preparation of Esparto grass, alfa straw, and other fibrous substances, and in purifying the alkali recovered therefrom, and in furnaces or evaporating pans connected therewith."—March 19, 1866.

828. W. Clark, Chancery Lane, "A new or improved compound or preparation to be used in the treatment of jute and China grasses."—A communication from G. Hanot, Boulevart St. Martin, Paris.—March 20, 1866.

905. T. Ryder, Manchester, "An improved apparatus for mashing malt or grain to be used in the processes of brewing and distilling."—March 28, 1866.

915. J. C. Martin, Barnes, Surrey, "An improvement in treating bones, and in the manufacture of the products thereof."

919. C. Pardoe, Brierley Hill, Staffordshire, "Improvements in the construction of coke ovens."—March 29, 1866.

925. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in bleaching books, engravings, paper, cotton, and other similar articles and substances."—A communication from J. H. David, Paris.

927. R. Hineson, Manchester, "An improvement in aërated waters."—March 31, 1866.

933. W. B. Collis and E. J. Collis, Stourbridge, Worcestershire, "Improvements in coke ovens."

941. E. Brooke, Huddersfield, "Improvements in the construction and arrangement of apparatus and material for effecting the deodorising of noxious gases arising from sewers and drains, and for the more effectual ventilation of such sewers and drains."—April 2, 1866.

949. A. G. Lock, Roseland, Millbrook, Hants, "Improvements in the preparation and application of malt grains or brewers' refuse as a manure."—April 3, 1866.

983. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the production of white or of semitransparent glass."—A communication from Dr. H. Kunherin, Berlin, Prussia.—April 5, 1866.

Notices to Proceed.

3105. D. Hall, Wharton, Cheshire, "Improvements in the manufacture of salt, and in machinery or apparatus for that purpose."

3111. A. Paraf and R. S. Dale, Manchester, "A new colouring matter for producing scarlet colours upon woven fabrics and yarns."—Petition recorded December , 1865.

3183. E. Morewood, Stratford, Essex, "Improvements in coating metals, and in apparatus to be used for this purpose."—December 9, 1865.

3219. The representatives of the late R. A. Brooman, Fleet Street, "The manufacture of pulp from lygeum spartum."—A communication from A. Escubos, Barcelona, Spain."—December 13, 1865.

3256. C. Pengilly, Church Street, Falmouth, "Improvements in the treatment of sulphurous and arsenical pyrites containing copper and tin."—December 16, 1865.

3268. H. Planck, Manchester, "Improvements in apparatus for regulating heat obtained by the combustion of gas."—December 18, 1865.

301. C. Delafield, Staten Island, Richmond, New York, U.S.A., "Improvements in the manufacture of saltpetre and white lead."—January 31, 1866.

500. W. Wood and J. W. Wood, Monkhill, near Pontefract, Yorkshire, "Improvements in the manufacture of pomfret or liquorice, cakes, rolls, and pipes, and of lozenges and other similar articles of confectionery, and in apparatus to be used in the manufacture of such articles."—February 16, 1866.

896. W. A. Lyttle, General Post Office, London, "Improvements in the means and apparatus for the distillation and rectification of hydrocarbon and other volatile oils."

897. J. Higgin, Manchester, "Improvements in dyeing and printing textile fabrics and yarns."—March 27, 1866.

CORRESPONDENCE.

Continental Science.

PARIS, April 26.

Let me, first of all, do an act of justice to a lady. In one letter I mentioned the admirable translation of Dr. Hofmann's Report published in the *Moniteur Scientifique*, and gave M. E. Kopp all praise for his perfect execution of a somewhat difficult task. I now learn that the translation was made by Madame Kopp, to whom all the praise must be transferred with some addition. Ladies, we know, make excellent translators—witness Miss Otte's translation of Humboldt's "Cosmos," and, if report speak true, an important and well-known chemical work which bears another name. A good knowledge of English, however, is not a common acquirement with French ladies, still less the scientific knowledge necessary for undertaking successfully such a work as the one I mention.

The *Journal de Pharmacie et de Chimie* is not usually lively reading. Made up in general, and for the most part, of stale papers from the *Comptes Rendus*, there is but little that comes before the reader with any air of novelty, except it be the *Proceedings* of the Pharmaceutical Society of Paris, of which, perhaps, the less said the better. I don't think these *Proceedings* half so interesting as those of your London Society, which is not saying much for them. The last number of the *Journal*, however, will have some amusement for an English pharmaceutist. I have told you before, I think, that there are some French pharmaceutists who wish to see the trade or profession freed from the absurd restrictions under which it is now placed, and the retailing of drugs made as free as the retailing of any other commodities. Naturally there are conservatives in the trade anxious to maintain the *status quo*. The *Journal* is the organ of this party, and in the present number I find an article commencing as follows:—"The following facts, among many others, prove the dangers of the liberty of pharmacy." I will give you one or two of the incidents, which, of course occurred in England:—"A person went to the pharmacy of Mr. Kright, of Alton, for syrup of violets and oil of almonds for a little girl two and a-half years old. The person was served by a lad 15 or 16 years old, who put essential oil of bitter almonds." The result may be guessed. "An individual, aged 68, took a certain quantity of a preparation (said to be) known in England as *Batlle's venning illing powder*—a powder containing strychnia. He died in frightful agony. This preparation is sold freely, although the sale is not authorised by law." A man named Richard gave his wife a lavement made with hemlock, which killed her. The hemlock was sold by a herbalist named Traitant, who was brought before a magistrate and discharged, because it was not proved that he sold the poison. A dose was given to an infant from a phial labelled "pectoral syrup;" the bottle contained oil of vitriol, but the pectoral-syrup label had not been removed. A farmer in Essex bought some arsenic to kill rats; the poison got into a cooking utensil, and in the end one individual died from the effects. The Coroner returned a verdict of "accidental death." How these cases prove the danger arising from free trade in physic, I am at a loss to see, but I daresay it suits the purpose of M. Robinet and others to publish them at the present time.

There is to be an international Congress of pharmaceutists next year, during the Exhibition—or, perhaps I ought to say, a congress of delegates from properly constituted pharmaceutical societies, from whom I expect M. Robinet hopes to get a strong vote against freedom in Pharmacy. There are some in London, I dare say, who would be happy to assist.

I cannot leave the *Journal de Pharmacie* without mentioning that Dr. A. Cattani has discovered a new disease—*acetonemie*—which comes of the spontaneous development of acetone in the organism. The acetone arises, he says, from the fermentation of organic matters, and especially of grape sugar, in the stomach. I will not trouble you with the symptoms of the disease, which sometimes proves fatal in a few hours, although the patient in general recovers. Stimulants and purges are the remedies for the disease.

"Dr. Muspratt's Chalybeates" in Harrogate.

To the Editor of the CHEMICAL NEWS.

SIR,—I sent you in July last my results on a water at Harrogate in which I discovered *protochloride of iron* (FeCl). The presence of this compound in a potable water renders it without a prototype. Lately *Galignani* gave the following paragraph on this spring, showing how even on the Continent this chalybeate is becoming known:—"The directors are contemplating the enlargement of the pump-room, in order to provide for that increased consumption of the water which is sure to follow the discovery of the great English chemist. There is said to be no spa like it in the world, and its curative properties in a very large class of cases are becoming widely appreciated by the medical profession since the CHEMICAL NEWS, *Lancet*, and other leading journals made Dr. Muspratt's analysis public." Is it not strange that within one yard of this spring (containing chlorides of iron and barium) there is another without a trace of either of these salts? Moreover, its water only yields 41·471 grains of solid matter per gallon; whereas that of the ferrous chloride gives 465·049 grains—more than eleven times as much! It is proposed to call one the "mild" and the other the "strong" chalybeate. Appended are the results obtained from both spas:—

	Grains in the imperial gallon. Strong.	Mild.
Chloride of iron . .	16·011	none
Chloride of sodium . .	208·468	11·650
Chloride of magnesium .	84·716	13·148
Chloride of calcium . .	133·642	2·311
Chloride of potassium .	4·013	0·150
Chloride of barium . .	7·717 !	none
Chloride of lithium . .	trace	none
Sulphate of lime . .	none	7·625
Carbonate of iron . .	10·842	6·042
Carbonate of lime . .	none	0·341
Silica, manganese, &c. .	traces	0·204
Total per gallon .	465·049	41·471

It is most remarkable the great dissimilarity in the composition of these two springs collaterally placed! Hoping you will oblige me by inserting the above,

I am, &c.,
SHERIDAN MUSPRATT, M.D.,
Professor of Chemistry.

College of Chemistry, Liverpool, April 21, 1866.

MISCELLANEOUS.

Royal Society.—The following chemists are candidates for election into the Royal Society this year:—Dr. Hugo Müller, Mr. W. H. Perkin, Dr. T. L. Phipson, Mr. Thomas Richardson, and Mr. Henry Watts. Another candidate well known by his writings on physiological chemistry is Dr. B. W. Richardson.

Auriferous Ores, and Sodium Amalgam.—An interesting series of experiments with sodium amalgam in the treatment of auriferous ores has been conducted under the superintendence of Professor Silliman, and the results obtained have been highly satisfactory. He states that having at his disposal a considerable quantity of California gold quartz from a mine in Calaveras county, he proposed to Mr. Wurtz to subject these ores to his method of amalgamation, under conditions subject to control, both as expressing the actual value of the material experimented on, as well as giving the value of the results and the loss in the process. The crushing and grinding was effected in the apparatus of Mr. M. B. Dodge, of New York, which doing its work dry gives unusual facilities for exactness. The details obtained in these experiments as to the degree of comminution reached by this apparatus have been very carefully worked out, but are reserved for a future communication, having no bearing on the subject now before us, although believed to be of value to the art of ore-dressing. After detailing the several experiments which were actually concluded, Professor Silliman continues that the experiments are still in progress, but the results show that with unaided mercury the gold saved is less than 60 per cent. of the whole quantity of gold known to be present. In one experiment less than 40 per cent. was saved, while by the aid of the amalgam of sodium the saving is increased to 80 per cent., or 80·3 per cent., or an increase of more than 20 per cent., leading to the reasonable expectation that in the large way at least 80 per cent. of the gold present in a given case may be saved, and in many cases, where the gold is coarse and free, that even better results than this may be attained. The first experiment detailed in which a different amalgamating apparatus was used gave results surprisingly close. He does not think the barrel as good a form of apparatus for this description of amalgamation as some one of the numerous forms of pan now in use. It was employed in these experiments simply because it was a convenient means of treating small quantities of ore in making comparative experiments. Experiments in California, under his direction, have been set on foot upon a scale of magnitude adequate to test the value of this discovery in the metallurgy of gold in a satisfactory manner, the results of which may now be looked for at no distant day. With regard to the mode in which the sodium acts, Professor Silliman remarks that the action of the sodium in this case appears to be in a manner electrical, by placing the mercury in a highly electro-positive condition towards the electro-negative gold, seeming to give some reason for the term magnetic amalgam, adopted by Mr. Wurtz as the trade-mark of the alloy. The quantity of sodium is entirely too small to allow of the supposition that it acts by its chemical affinities. It is well known to chemists that the metallic sulphides are decomposed by amalgam of sodium, but no one supposes that an inventor could be found so Quixotic in his chemical notions as to seriously propose the use of sodium amalgam as a means of effecting the reduction of the sulphides of silver, &c., since not less than one equivalent of sodium would be required to set at liberty one equivalent of silver. The use of the sodium amalgam for silver amalgamation must depend, if found really useful in the large way in the silver reduction process (which still remains to be proven), upon a like power of electrical action to that seen in its action on gold, and also to the well-known power of preventing the granulation (flouring) of mercury, or of saving the mercury when thus changed. Indeed, there is good reason for believing that a most important part is played by the sodium amalgam in this last particular. The amalgam of gold or silver is very liable, as every millman knows to his loss, to granulate and disappear from the plates of the battery, or from the riffles, after it has been formed. If this granulation takes place it is almost impossible, by the existing modes of amalgamation, to recover the minute particles, which float off with the currents of water and are lost. The action of the sodium in recovering the mercury which has passed into this condition is, perhaps, its most remarkable property.—*Mining Journal, April 21, 1866.*

Fleitmann's Method of Preparing Oxygen.—H. Reinsch has made experiments with Fleitmann's process. He rubbed chloride of lime with water to form a cream, poured this from the lumps, and then shook up the cream with water. He then allowed the mixture to deposit, and poured off the clear solution. This he heated in a retort to 30 or 40° C. with a piece of peroxide of cobalt the size of a pea. At this temperature oxygen was freely evolved. At a greater heat the liquid passed over. Peroxide of nickel behaved like the peroxide of cobalt. With copper salts a stronger heat was required, and less oxygen was obtained. On treating a saturated solution of chloride of lime with chloride of manganese only traces of oxygen were evolved, but the solution took a magnificent dark violet colour. Perchloride of iron gave as little oxygen. A small amount of manganese with it gave a violet colour. Chloride of lime is therefore a good test for detecting manganese in iron.—*N. Jahrb. f. Pharm.*, 24, 94. *Zeit. f. Chemie*, 1866, 31.

Meetings of the Week.

Saturday, April 28.

Royal Institution, 3 p.m., G. Scharf, Esq., "On National Portraits."

Monday, April 30.

Medical, 32A, George Street, Hanover Square, 8 p.m.

Tuesday, May 1.

Anthropological, 4, St. Martin's Place, 8 p.m.
Pathological, 53, Berners Street, Oxford Street, 8 p.m.
Royal Institution, 2 p.m., Annual Meeting.

Wednesday, May 2.

Society of Arts, John Street, Adelphi, 8 p.m.

Thursday, May 3.

Chemical, Burlington House, 8 p.m.
Royal, Burlington House, 8½ p.m.
Royal Institution, 3 p.m., Professor Huxley, "On the Methods and Results of Ethnology."

Friday, May 4.

Royal Institution, 8 p.m., Professor Abel, F.R.S., "On Recent Progress in the History of Proposed Substitutes for Gunpowder."

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.

Received.—Dr. Herapath F.R.S., &c.; "[illegible]."

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

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

PART II.

THEORY OF TYPES AND ATOMICITY.

SECTION IV.—*Atomicity of the Elements.*

(Continued from page 182.)

In glycol, as we have above observed, the remains of 2 molecules of water are joined together by the diatomic radical ethylene. But whence has this radical the power, if not from the tetratomic carbon it contains? We find there Ꞓ_2 united to H_4; two units of combination are then wanting. In glycol one is furnished by 1 atom of oxygen, the second by the other atom of oxygen, and the 2 atoms of hydrogen which remain are seized by either atom of oxygen. Thus the 2 atoms of the latter element which are both retained by the hydrocarbonated nucleus, serve to unite the latter to the two remaining atoms of hydrogen. We may express these relations by representing glycol by the following formula:—

$$\begin{array}{c}\mathrm{H}\\ |\\ \Theta\\ |\\ \text{Ꞓ}\mathrm{H}_2\\ |\\ \text{Ꞓ}\mathrm{H}_2\\ |\\ \Theta\\ \mathrm{H}\end{array}$$

But is it not plain that this formula is only a typical formula slightly lengthened, and that the two poles of this group of atoms are none other than the two typical remainders $H\Theta$, proceeding from 2 molecules of water, 2 atoms of whose hydrogen have been replaced by the diatomic radical ethylene?

$$\begin{array}{l}\left.\begin{matrix}\mathrm{H}\\ \mathrm{H}\end{matrix}\right\}\Theta\\ \left.\begin{matrix}\mathrm{H}\\ \mathrm{H}\end{matrix}\right\}\Theta\end{array}\qquad\qquad \begin{array}{r}\left.\begin{matrix}\mathrm{H}\\ \text{Ꞓ}_2\mathrm{H}_4\end{matrix}\right\}\Theta\\ \left.\begin{matrix}\mathrm{H}\end{matrix}\right\}\Theta\end{array}$$

The same remark applies to the formula of glycolic acid, $\text{Ꞓ}_2H_4\Theta_3$—one of the products of the oxidation of glycol. Whether we seek to express the relations existing between the atoms by the formula

$$\begin{array}{c}\mathrm{H}\\ \Theta\\ |\\ \text{Ꞓ}\Theta\\ \text{Ꞓ}\mathrm{H}_2\\ \Theta\\ |\\ \mathrm{H}\end{array}$$

or whether we adopt the typical formula*

$$\left.\begin{matrix}\mathrm{H}\\ \text{Ꞓ}_2\mathrm{H}_2\Theta\\ \mathrm{H}\end{matrix}\right\}\begin{matrix}\Theta\\ \Theta\end{matrix}$$

deduced from the reactions of glycolic acid, in both cases we see the typical remainders $H\Theta$ united by a group of atoms which we regard as a radical.

The glycolic group:

$$\left\{\begin{matrix}\text{Ꞓ}\Theta\\ \text{Ꞓ}\mathrm{H}_2\end{matrix}\right. \text{ or } \text{Ꞓ}_2\mathrm{H}_2\Theta,$$

which is shown in the formula of glycolic acid, and which results from the oxidation of the ethylene group

$$\left\{\begin{matrix}\text{Ꞓ}\mathrm{H}_2\\ \text{Ꞓ}\mathrm{H}_2\end{matrix}\right.$$

contains 1 atom of oxygen whose two affinities are saturated by the carbon. From this point of view this atom of oxygen differs from the two others which are partly saturated by the hydrogen. The typical formula perfectly expresses this difference, since it places the first atom of oxygen in the radical, and the two others without. It is an important fact that M. Hermann Kopp† has proved that this difference in the position of the atoms of oxygen corresponds to a difference in their specific volume, the specific volume of oxygen situated inside the radical being 12·2, and that of oxygen situated outside the radical being 7·8. Thus the typical formulæ have received a double confirmation. On the one hand they are supported by the considerations on the specific volumes of the liquid bodies; on the other hand by the theory of atomicity. The latter has revealed the important property of the polyatomic elements of serving to unite different portions of the molecule, a property which is shown in a great number of typical formulæ. The following are very significant in this respect:—

$\left.\begin{matrix}\mathrm{Cl}\\ \mathrm{H}\end{matrix}\right>\Theta$	$\left.\begin{matrix}\mathrm{K}\\ \mathrm{H}\end{matrix}\right>\Theta$	$\left.\begin{matrix}\text{Ꞓ}_2\mathrm{H}_5\\ \text{Ꞓ}_2\mathrm{H}_5\end{matrix}\right>\Theta$	$\left.\begin{matrix}\text{Ꞓ}_2\mathrm{H}_3\Theta\\ \text{Ꞓ}_2\mathrm{H}_3\Theta\end{matrix}\right>\Theta$	$\left.\begin{matrix}\text{Ꞓ}_2\mathrm{H}_5\\ \text{Ꞓ}_2\mathrm{H}_5\\ \text{Ꞓ}_2\mathrm{H}_5\end{matrix}\right>\mathrm{N}$
Hypochlorous acid.	Hydrate of potassium.	Oxide of ethyl.	Anhydrous acetic acid.	Triethylamine.

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[*] I gave these formulæ in a note inserted in the *Annales de Chimie et de Physique*, 3rd series, vol. lxvii., p. 108, January, 1863.

[†] *Annalen der Chemie und Pharmacie*, vol. c., p. 19. *Annales de Chimie et de Physique*, 3rd series, vol. xli., p. 468. The specific or atomic volume is the volume occupied by quantities of matter corresponding to the atomic weights. It is obtained by dividing the atomic weights by the densities. By comparing the specific volumes of homologous combinations. M. H. Kopp perceived that, for each increase of $\text{Ꞓ}H_2$, the specific volume of the molecule increased on an average by 22. He found in the second place, that two combinations, one of which contains $n\text{Ꞓ}$ more and nH_2 less than the other, possess the same specific volume, so that Ꞓ can replace 2H without producing any change in the specific volume. From this he concluded that the specific volume of Ꞓ was equal to that of H_2, and was able to deduce this volume from this known specific volume (22) of $\text{Ꞓ}H_2$. He thus found for the specific volume of Ꞓ the value $\frac{22}{2} = 11$, and for that of H the value $\frac{22}{4} = 5{\cdot}5$. He then determined the specific volume of the oxygen contained in a radical by comparing the specific volume of an acetone or an aldehyde, for example, with that of the corresponding hydrocarbide. Thus, by subtracting from the specific volume of the acetone—

$$\left.\begin{matrix}\text{Ꞓ}_2\mathrm{H}_3\Theta\\ \text{Ꞓ}\mathrm{H}_3\end{matrix}\right\} = \text{Ꞓ}_3\mathrm{H}_6\Theta(77{\cdot}3-77{\cdot}6)$$

that of the carbide—

$$\text{Ꞓ}_3\mathrm{H}_6(66),$$

he found for the specific volume of Θ the number $11{\cdot}3-11{\cdot}6$. By subtracting from the specific volume of the aldehyde—

$$\left.\begin{matrix}\text{Ꞓ}_2\mathrm{H}_3\mathrm{O}\\ \mathrm{H}\end{matrix}\right\} = \text{Ꞓ}_2\mathrm{H}_4\Theta(56{\cdot}0-56{\cdot}9)$$

that of

$$\text{Ꞓ}_2\mathrm{H}_4(44),$$

he found for the specific volume of Θ the numbers $12{\cdot}0-12{\cdot}9$. He therefore took the mean, the number 12·2, for the specific volume of the oxygen contained in a radical. To find the specific volume of typical oxygen, he subtracted from the specific volume of water (calculated for the boiling point) the specific volume of $H_2 = 2 \times 5{\cdot}5$. He thus found the specific volume 7·8 for the oxygen Θ situated outside the radical—that is to say, forming part of a typical residue $H\Theta$. These numbers being thus determined, he could calculate the specific volume of a combination $\text{Ꞓ}_aH_b(\Theta_c)\Theta_d$‡ by means of the formula—

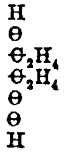
$$a.11 + b.5{\cdot}5 + c.12{\cdot}2 + d.7{\cdot}8.$$

In the formula $\text{Ꞓ}_aH_b(\Theta)_c\Theta_d$, (Θ) denotes the oxygen contained in the radical, and Θ that contained outside the radical. The values thus calculated *à priori* coincide satisfactorily with those given by experiment, a fact which verifies the theory, and particularly the supposition that oxygen has a different specific volume when it forms part of a radical—that is to say, when it is entirely united to the carbon, to what it has when placed outside.

[‡] *Comptes Rendus*, vol. lvii., page 283.

But the theory of atomicity has allowed us to make a further step in advance, for it gives account of the manner in which the atoms hold together the radicals themselves. The latter are represented in the typical notation as compact groups; it is now possible to resolve them, so to say, into their elements. That is the object and meaning of the formulæ we have given above (pages 11 and 12), in which the symbols are, as it were, distributed. Are we, then, to say that formulæ so lengthened out should be employed in preference to the clear and simple typical formulæ? I am far from thinking so, for under the pretext of wishing to represent everything by such a formula, we run the risk of becoming embarrassed by an obscure or arbitrary representation. I will show this by a single example.

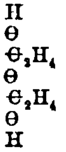
We attempted further back to give an account of the respective relationships of the atoms in glycol. This attempt was successful since it referred to a simple compound. But take a slightly more complicated compound, diethylenic alcohol $\text{Ꞓ}_4H_{10}\Theta_3$. We know by its mode of formation, and by its reactions that this body contains 2 ethylene radicals. They are joined to 2 atoms of hydrogen and to 2 atoms of oxygen. The considerations relating to atomicity allow us to represent in the following manner the relations of these different elements to each other:—



$$\begin{array}{l} H \\ \Theta \\ \text{Ꞓ}_2H_4 \\ \text{Ꞓ}_2H_4 \\ \Theta \\ \Theta \\ H \end{array}$$

The 2 ethylene groups which, for the sake of simplicity, we have not thought right to decompose, exchange one affinity. There remains, then, another in each group to be disposed of; it is satisfied on either side by an affinity of each of the atoms of oxygen which are connected with the ethylene. The other affinity of these latter serves to unite on the one side with the hydrogen, on the other with another atom of oxygen, which in its turn unites with the hydrogen.

But we might also suppose that the two ethylene groups are joined together by 1 atom of oxygen. If this were the case, the molecular arrangement of the diethylenic alcohol would be expressed by the following formula:—



$$\begin{array}{l} H \\ \Theta \\ \text{Ꞓ}_2H_4 \\ \Theta \\ \text{Ꞓ}_2H_4 \\ \Theta \\ H \end{array}$$

This corresponds to the typical formula:—

$$\left.\begin{array}{r} \left[\left.\begin{array}{l}\text{Ꞓ}_2H_4 \\ \text{Ꞓ}_2H\end{array}\right\} \Theta\right]'' \\ H_2 \end{array}\right\} O_2 .$$

The more simple formula

$$\left.\begin{array}{r} (\text{Ꞓ}_2H_4) \\ (\text{Ꞓ}_2H_4) \\ H_2 \end{array}\right\} O_3$$

which I have hitherto adopted, merely indicates in a general manner that the 3 atoms of oxygen serve to unite 2 ethylene radicals and 2 atoms of hydrogen. But what are the precise relations of these 3 atoms of oxygen with the other constituent elements? Are the atoms of ethylene joined together directly, or through the medium of an atom of oxygen? It is impossible to solve these questions *à priori*.

The second of the formulæ of constitution given above, perhaps better accounts for the fact that in diethylenic alcohol the 2 ethylene radicals do not form a single radical (Ꞓ_4H_8).§

But, on the other hand, we see that it may be so, merely by supposing that the 2 ethylene radicals are directly contiguous, as we have above allowed. In fact, if it is true that the combining power of a group or of a radical depends on the atomicity of its elements—if it is true that such a group possesses the property of uniting with other elements only because it contains one or more imperfectly saturated element, experience teaches us, on the other hand, that the elements thus attached are often retained by an affinity less strong than that which joins together the elements of the group itself. The effect, then, is as if the whole group were to act according to the resultant of all the affinities residing in it. Doubtless the ethylene radical can unite with chlorine and bromine only because it contains an imperfectly saturated atom of carbon. But I consider it probable that under these circumstances it acts not so much by this atom of carbon as like an entire group, for we know that carbon possesses only a slight affinity for bromine or chlorine. Certainly it possesses a greater affinity for hydrogen than for these two elements, and though ethylene does not combine directly with hydrogen as it does with chlorine, yet this is doubtless due to the fact that the hydrogen of the ethylene group contributes its share in attracting the chlorine. It is, then, the whole group that is active, and that acts by the resultant of all the affinities of its elementary atoms.‖

Thus we may imagine one group united to another group without being confounded with it.

It results, then, from this discussion that when it is necessary to represent the molecular constitution of certain complicated combinations by starting from the data relative to the atomicity of the elements, we can often construct different and equally satisfactory formulæ, and we should run the risk of being arbitrary by selecting exclusively one of them without justifying such a choice by reasons derived from experience. Thus, then, while I recognise in it a new method, I think it should only be used with prudence. Here, as in all else, abuse does not exclude use, and these formulæ of constitution or of structure, as M. Boutlerow calls them, by which we seek to express the relations existing between atoms and groups in chemical compounds, are destined to render great service in explanation of the facts of isomerism.¶

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§ When hydriodic acid is made to act upon diethylenic alcohol, the ethylene radicals are separated again, and iodide of ethylene is formed.

‖ This idea appears to me important, for it serves to explain a certain number of cases of isomerism. It enables me especially to account for that which I have discovered between the alcohols, properly so called, and the hydrates of the carbonated hydrogens. In amylic alcohol

$$\left.\begin{array}{r} \text{Ꞓ}_5H_{11} \\ H \end{array}\right\} \Theta$$

the eleven atoms of hydrogen are in direct connexion with the carbon. We may suppose that in the hydrate of amylene

$$\left.\begin{array}{r} [(\text{Ꞓ}_5H_{10})''H]' \\ H \end{array}\right\} \Theta$$

the eleventh atom of hydrogen in the radical is less strongly held than the corresponding atom of the amyle group Ꞓ_5H_{11}, and in that case this eleventh atom of hydrogen would be in connexion with the whole amylene group, whose atomicity would thus be reduced by a unit.

¶ To pursue this point would lead us beyond the plan we have laid down for this work. On this subject should be consulted an important article published by M. Kekulé under the title "Considérations sur quelques cas d'isomérie" (*Annales de Chimie et de Physique*, 3rd series, vol. lxvi., page 482); the remarks I have published on the "Isomerism of the Hydrocarbons" (*Comptes Rendus*, vol. lvi., p. 354) an article by M. Boutlerow, entitled "Sur l'explication de divers cas

But there is another consequence of the theory of the atomicity of the elements, and especially of the atomicity of carbon. We have long known, and Laurent and Gerhardt have dwelt much on these facts, that in organic compounds the number of atoms of hydrogen is always even, and that, further, the sum of the atoms of nitrogen, hydrogen, chlorine, &c., is always an even number.

How could it be otherwise since the other elements of organic combinations, carbon and oxygen, are of even atomicity? Either can combine only with an even number of atoms of hydrogen, and if nitrogen is also present, as it is of uneven atomicity, evidently an uneven number of atoms of hydrogen, chlorine, or other monoatomic elements must unite with nitrogen or with the other triatomic elements so as to saturate the elements of even atomicity.

In that which precedes we have considered the atomicity of the principal elements of organic compounds, especially that of carbon. But it is evident that the reasoning we have pursued would apply to the other chemical elements, metalloids, and metals. Among the works which have helped to generalise these ideas on the atomicity of the elements, we will mention those of Dr. Frankland, on the organo-metallic radicals, and the researches of MM. Baeyer and Cahours on the same subject.

In his fourth article on the organo-metallic compounds, whose important discovery is owing to him, Dr. Frankland[**] first compared iodide of stannethyl[††] $(SnC_4H_5)I$, and stannodiethyl with diiodide of tin:

$$\mathrm{Sn}\left\{\begin{matrix}\mathrm{I}\\\mathrm{I}\end{matrix}\right. \qquad \mathrm{Sn}\left\{\begin{matrix}\mathrm{C_4H_5}\\\mathrm{I}\end{matrix}\right. \qquad \mathrm{Sn}\left\{\begin{matrix}\mathrm{C_4H_5}\\\mathrm{C_4H_5}\end{matrix}\right.$$

Diiodide of tin. Iodide of stannethyl. Stannodiethyl.

He observed that stannethyle $Sn\ (C_4H_5)$, like iodide of tin SnI, combines with iodine in the same way as the latter to pass to the type of stannic iodide (saturated compound). To this type belongs also stannodiethyl, which is incapable of combining with an electro-negative element without first losing at least one equivalent of ethyl.

(To be continued.)

On the Action of Platinum, Ruthenium, Rhodium, and Iridium, on Chlorine Water, Aqueous Solution of Hypochlorites, Peroxide of Hydrogen, and Ozonised Oxygen, by C. F. SCHÖNBEIN.[‡‡]

ON introducing platinum black into strong chlorine water, numerous bubbles of oxygen are developed. The richer the chlorine water and the larger the amount of platinum black the more active is the evolution of oxygen. From eighty grammes of chlorine water and five grammes of platinum the author in the course of twelve hours obtained fifteen c.c. of oxygen. Freshly prepared spongy platinum exerts the same action, a smaller amount sufficing to produce the effect. Spongy ruthenium acts much more powerfully than platinum; 0·15 grm. placed in strong chlorine water caused such an active disengagement of oxygen that the pieces of spongy metal were carried to the surface by the gas, and after ten minutes 5 c.c. of oxygen were obtained. The activity of the metal is not diminished by long contact with the chlorine water, and it is as powerful in the dark as in diffused light. It appears, then, that ruthenium and light exert the same action on chlorine water, only the action of the metal is the stronger. Rhodium acts similarly to ruthenium, and also stronger than platinum. Pulverulent iridium appears to bring about only a feeble decomposition. On iodine and bromine water the four metals, like light, act very slowly. Solutions of hypochlorous salts, on the contrary, are very quickly decomposed, even in the dark an active disengagement of oxygen taking place. The four metals in these cases appear to act with the same degree of power as in the transformation of chlorine water into hydrochloric acid and oxygen.

It is a well-known fact that ozonised oxygen on being heated to 150° C. becomes ordinary oxygen. The same change is effected by the four metals platinum, ruthenium, rhodium, and iridium at the ordinary temperature. Strongly ozonised air left in contact with platinum black for only a few minutes loses completely its power of acting on iodised starch paper. The platinum not being in the least degree oxidised, it cannot be supposed to take the ozone away; and therefore we must believe that the four metals possess the power of changing it into ordinary oxygen. If, then, we suppose that these metals also possess the power of changing the combined ozone in the peroxide of hydrogen and the hypochlorous salts, it is easily seen that the changed element can no longer remain in combination, but must separate as ordinary gaseous oxygen. Lastly, if we admit what the author holds to be probable, that chlorine is a compound of *murium acid* with oxygen, and that this oxygen is in the ozonised condition, the decomposition of chlorine water by the metals admits of the same explanation.

On a Process of Elementary Analysis Admitting of the Determination of Carbon, Hydrogen, and Nitrogen at a Single Combustion, by C. GILBERT WHEELER.

THE processes of ultimate organic analysis heretofore employed, when applied to substances containing carbon, hydrogen, and nitrogen, contemplate the determination of the latter element by a separate and distinct operation, and are therefore often embarrassing where the chemist has but a small amount of the substance to be analysed at his disposal. A method by which these three elements might be determined at a single combustion would appear to be desirable, and, if equally accurate with other approved processes, and also admitting of a not less expeditious execution, might with advantage be employed, not only in the special class of cases referred to, but also in general, as a substitute for those now in use. For some time past I have made use in my laboratory of a method of analysis which apparently is of universal application when carbon, hydrogen, and nitrogen are to be determined, and which I can recommend as yielding quite satisfactory results.

The method in question may be considered as a combination, with necessary modifications, of that ordinarily used in determining nitrogen, as will be seen from the description which I now proceed to give, first in outline, then more in detail.

The operation commences with expelling the air from the combustion tube by means of a stream of oxygen gas. As in the anterior portion of the tube there is placed a quantity of metallic copper, to prevent the formation of deutoxide of nitrogen, the former cannot be heated without the copper oxidising and the tube again becoming wholly or partially filled with air. This is prevented by expelling in turn the oxygen by means of

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d'isomérie (*Bulletin de la Société Chimique*, vol. vi. page 100); and an article by M. Erlenmeyer, headed "Hypothèses sur l'isomérie Chimique, et sur la Constitution Chimique (*Zeitschrift für Chemie und Pharmacie*, vol. vii., p. 1).

[**] *Proceedings of the Royal Society*, vol. ix., page 672, March, 1859. *Répertoire de Chimie Pure*, vol. i., page 416.

[††] C=6. Sn=59.

[‡‡] Abstract *Zeitsch. für Chemie, &c.*, No. 6, 1866.

a known quantity of carbonic acid gas, which effected, the combustion proper is commenced, and carried on in the ordinary manner with this modification—viz., that at the close a current of oxygen gas is again employed for the purpose of forcing into the appropriate apparatus the residuary products of combustion, as also, when necessary, to complete the oxidation of particles of the substance yet unconsumed. The water and carbonic acid resulting from the analysis are absorbed in the usual apparatus and weighed, while the nitrogen, unmixed with oxygen, is conducted into a special apparatus, where it is measured over mercury.

The simplest method would be to conduct the gases into a Bunsen's eudiometer, and in the same perform the necessary further determinations. However, the capacity of such a eudiometer is not sufficient in the great majority of cases, even where it has a length of 800 to 1000 millimetres. I have therefore made use of Bunsen's gasometer, and found the same exceedingly well adapted for the purpose. It has, however, proved desirable to make one or two trifling alterations which in practice I have found to enhance its value and usefulness.

Both the gasometer above described and the eudiometer, in which the mixture of nitrogen and oxygen is to be analysed, are graduated, and their cubic capacities referred to a common standard (cubic centimetres). This is necessary, as only an aliquot part of the total gas obtained is submitted to analysis, the greater portion being held in reserve, in case any disaster should occur to that under investigation.

I pass now to a detailed description of the mode of procedure in performing an elementary analysis by the process under consideration.

A combustion tube 2·2½ feet in length is sealed up at one end. From three to five grammes pure, well-dried, and pulverised chlorate of potassa are introduced and thoroughly mixed with the aid of a mixing wire, with at least an equal volume of freshly ignited oxide of copper. It is important that the mixture be as uniform as possible, in order that the supply of oxygen may be easily regulated. Then follows about two inches of oxide of copper, and thereupon a weighed portion, from 0·2 to 0·3 grammes, of oxalate of lead, which is likewise thoroughly mixed with oxide of copper. This salt is the substance I find the most convenient from which to obtain a known amount of carbonic acid gas.

I adopt oxalate of lead in preference to other substances that have hitherto been employed in organic analysis for evolving carbonic acid, as more completely free from the various practical objections presented by the latter, and in particular by the following—viz., carbonate of magnesia (magnesite), carbonate of manganese, carbonate of copper, bicarbonate of soda, and oxalic acid. The use of these substances is impracticable, as they either fail to give the theoretical percentage of carbonic acid on being heated, partially decompose when exposed to the air in a moist condition, yield, also, water with carbonic acid, are too hygroscopic, or present other difficulties that render their use in this process inexpedient. Carbonate of lead is less objectionable than the above mentioned, and it is mainly on account of the greater amount of carbonic acid furnished by the oxalate that I prefer it.

I prepare the latter salt by adding to a solution of acetate of lead a slight excess of oxalic acid, and thoroughly wash the precipitate obtained by decantation. It has the formula PbO,C_2O_3, and yields, on gentle ignition with oxide of copper, precisely two equivalents of carbonic acid.

As a mean of several nearly identical results, I obtained 29·83 per cent. of carbonic acid, instead of 29·81, as required by theory. A greater amount of this salt than 0·3 grm. being never used, the maximum error, therefore, possible in a carbon determination would be 0·00001643 grm.

After introducing, as previously explained, the oxalate of lead into the combustion tube, about two inches of pure oxide of copper are added, then a mixture of the substance for analysis with oxide of copper, and thereupon again several inches of the oxide. Finally, the remaining space in the tube, which should never be less than four inches, and need not exceed, except in rare cases, eight inches, is filled with metallic copper freshly reduced in a stream of hydrogen gas. I prefer for the purpose a compact roll of copper wire gauze.

After a channel has been secured in the usual manner throughout the whole length of the tube—at the posterior end it is well to have the channel larger than elsewhere—a chloride of calcium tube and potash bulbs are placed in communication as in an ordinary combustion and the anterior end of the latter is connected by means of a thick piece of gutta-percha tubing, about four inches in length, with a glass tube bent at one end so as to admit of being conveniently placed into the tubulure of the gasometer. [For a description of this gasometer, the reader is referred to Bunsen's method of gas analysis; see page 20 of Roscoe's translation.] The gasometer being filled with mercury is placed in a suitable vessel, and in a slightly inclined position directly before the potash bulbs. The tubulure of the gasometer being submerged in the mercury, the upright tube is removed. A small porcelain mortar is a convenient receptacle for the gasometer.

The apparatus then put together, and it having been ascertained by the usual method that no leakage exists, the combustion may be commenced. The chlorate of potassa is first heated, and the evolution of oxygen gas continued until its presence is ascertained at the anterior end of the apparatus by the inflaming of a taper, for which purpose about ten minutes are required. Heat is now applied to the mixture of oxalate of lead, and oxide of copper, and the necessary carbonic acid evolved to displace the oxygen at least as far as to the anterior portion of the combustion tube. In order to be certain that the metallic copper is surrounded by an atmosphere of carbonic acid gas, the heating of the oxalate of lead is proceeded with until an absorption usually occurring in from five to eight minutes is clearly perceptible in the potash bulbs. At this stage of the process it is necessary that the bent tube at the extremity of the apparatus be immersed in the mercury contained in the mortar, in order that during the absorption of the carbonic acid by the potassa no air may again enter the apparatus. Fire is now applied to the metallic copper, then the oxide of copper is heated, and the analysis is thenceforward performed precisely as by the ordinary method.

(To be continued.)

Description of the English Method of Assaying Copper by the Dry Way, by M. L. MOISSENET.*

EACH of the large Swacsea copper works keeps an assayer at Cornwall, whose duty it is to determine the richness in copper of all the lots of minerals of the county sold every Thursday at the *Ticketing*, and of all the samples of foreign minerals and copper products which may be useful to the smelter.

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* *Annales des Mines*, vol. xiii., p. 183, 1858.

It may be asserted that in the course of a year there are but a few copper mines being worked on the surface of the globe of which some sample has not been addressed to the master assayers of Cornwall, and in the same interval each laboratory has made not less than 8000 to 10,000 assays.

In consequence of the great number and variety of the matters to be treated and the necessity of having a prompt answer, we see the necessity of a simple and expeditious method. It is natural, then, that the dry way should be preferred to the wet way; besides, other considerations support this choice.

The copper being obtained in the state of prill or metallic button, the impurities (generally tin, antimony, &c.) are thus made evident, and the hammer soon proves the quality of the metal which we ought to expect to obtain by metallurgic treatment. As for the accuracy of the method, as far as regards the whole of the metal obtained, I shall revert to this later on. I would, however, observe that within certain limits the method would not be less practical on account of being inexact, for we must not forget that it has chiefly for its object to teach the smelter the *value* of the mineral even more than its true richness.

For example, if we get too low an assay from a sample of 2 or 3 per cent., we should only from this assent to the opinion of the metallurgist, whose interest it is not to work upon very poor minerals. The same remark will apply to the case of minerals very antimonial, &c. Besides, in the description of the method we shall discover the principal phases of the Welsh process, so that it is more just to consider the Cornish assay as a metallurgy on a small scale than as a scientific laboratory method. From thence result also the necessity of long practice and the almost uselessness of theoretical knowledge for those who purpose employing this method alone.

Sir Henry De la Beche ("Report on the Geology of Cornwall," &c., p. 595), in giving a sketch of the method, declares it to be rather rough and uncertain, and fails not to add at the conclusion a translation of a passage relative to the assay of copper pyrites from M. Berthier's treatise on assays by the dry way.

These drawbacks upon the scientific value of the English method cannot injure the power of facts; they constitute but another reason which we may have for giving an account of the manner in which the first basis of the valuation of the greater part of the copper minerals has been fixed since so long a period.

Division Adopted.—The rather complex operations through which we have to pass will be better apprehended I think by explaining in succession—

1. The order of the operations, the nature and influence of the fluxes employed, the kind of products obtained (reactions).
2. The manipulations to which each operation gives rise, the furnaces and apparatus used, the characters of the principal products during the chief phases and at the end of each (manipulations).

I shall add to these—

3. Some information upon the influence of the principal foreign metals (tin, antimony, zinc, lead), and upon the treatment of some special coppery matters.
4. Summary considerations on the result of the English method compared with those of the analysis by the wet way.

SECTION I.—*Reactions*.

At the very outset we distinguish two kinds of assays—

1. The roasted sample.
2. The raw sample.

The first only applies to cupreous pyrites or to samples essentially formed of it—that is to say, which contain sulphur in excess; the process begins by a roasting.

In the raw assay we dispense with the roasting; we have recourse to the addition of reagents, either oxidising or sulphurising, according to the minerals; we endeavour to place them by these mixtures in the condition of a properly roasted pyritic mineral.

From this point, at least in general, the operations become identical. They consist in—

1. Fusion for regulus (regulus).
2. Calcining the regulus (calcining).
3. Fusion for coarse copper (coarse copper).
4. One or two fusions with fluxes (washings).
5. Trial by striking with a hammer, last refining (testing, refining).
6. Treatment of slags for prill.

All the slags except those of the fusion for regulus have been preserved. The fusion No. 6 gives a small supplementary button of copper, which again undergoes if necessary one or two washings.

As I have said, the roasting is used only for pyrites. I shall return later on to the duration and the circumstances of this operation. Its evident aim is to drive off the excess of sulphur, so as to cause the whole of the copper, with a part only of the iron which abounds in the pyrites, to pass into the state of sulphuret at the time of the fusion for regulus.

I. *Regulus*.

1. **Pyrites.**—The fusion for regulus of a properly roasted pyrites is made by mixing with it equal volumes of the three fluxes, borax, fluor spar in powder, lime slaked in powder, of each one ladle, and covering the mixture with a layer of moist common salt. The matters composing the gangue of the roasted mineral consist principally of quartz, silica, and in general of more alumina and magnesia than lime; oxide of iron, resulting from the roasting of the pyrites, is also present.

The borax only serves to give fusibility, the fluor spar contributes to the same end by forming a fluosilicate. I do not think that it otherwise plays an important part in the decomposition—that is to say, that there may be a production of fluoride of silicon and calcium, for this last base is added here in considerable proportion, so as to form immediately a silicate which may combine with the fluoride of calcium.

The peroxide of iron being reduced to pass into the slag, and the different metallic oxides to pass into the regulus, yield oxygen, which reacts on the remaining sulphur. The disengagement of sulphurous acid which results from this, joined to the water contained in the fluxes, justifies to a certain extent the use of a bed of common salt, designed to prevent the boiling over. Besides this, the common salt being without action on the metallic sulphides, does not here produce those important effects which I shall point out in the later fusions.

If the pyrites appear insufficiently roasted, we must add a little nitre, the oxidating action of which again gives off sulphur; the opposite case, that of a roasting too much prolonged, is rare; we remedy it by the addition of sulphur and tartar, as I shall indicate for other sorts of minerals.

2. **Very Poor Pyrites.**—In a very poor pyrites—that of Bear Haven, in Ireland, for example—the proportion of sulphur does not require us to have recourse to the roasting; we employ the three fluxes and one ladle of nitre.

3. **Variegated Copper.**—Peacock ore, contains less

sulphur in proportion to the copper than pyrites; we also fuse with a little nitre.

4. **Sulphuret of Copper.**—The sulphur is here insufficient.

We add together sulphur ½ to 1 ladle, according to the valuation; tartar ¼ to ½ ladle—that is to say, half the volume of the sulphur. The tartar is a powerful reducing agent, and is supposed in small quantities to favour the action of the sulphur by preventing its disengagement as sulphurous acid by the oxidating matters in the mineral; but if used in excess, it acts as a desulphuriser, as well by its carbon as by its alkali.

5. **Carbonated Minerals.**—The addition of sulphur and carbon is evidently still more necessary here.

5. **Native Mixture:** ⅔ sulphuret copper, ⅓ pyrites.—We add, in this case, nitre for the pyrites and sulphur and tartar for the sulphuret of copper; although these reagents appear sure to neutralise each other, it is possible that their simultaneous employment may be logical. The nitre probably decomposes the pyrites, which would, without it, fuse and give a very ferrous regulus, whilst the free sulphur would be of little use, on account of the sulphuret of copper. Be this as it may, this is the plan adopted.

During the progress of the fusion for regulus we have still to introduce other matters, some accidentally, and others in all cases.

If a blue flame persists in escaping from the crucible, an index of the formation of sulphurous acid, we project into it sulphur 1 ladle, tartar ½ a ladle. When the fusion appears almost finished, in order to render the bath more liquid, and to facilitate the collection of the button, we throw in a little dried salt and a flux composed beforehand of lime, a little fluor spar, and a very little borax—that is to say, of the elements in different proportions of the mixture introduced originally.

The regulus obtained is composed principally of copper, iron, and sulphur. I shall return to the aspect and the richness which it ought to have according to the minerals treated.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, by Dr. Percy, F.R.S.

Lecture No. IV.

Gentlemen,—We will proceed this morning to the study of the subject of dolomite—an exceedingly interesting department of chemical geology, about which a great deal has been said and written, and about which, it may be added, very little in regard to its formation is positively known.

We have studied the subject of carbonate of lime. We have seen it occur in three distinct states—the amorphous state, represented by chalk, and the two crystallised states, as represented respectively by arragonite, which crystallises in the prismatic system, and by common calcspar, which crystallises in the rhombohedral system.

Carbonate of magnesia is thrown down from a solution of the sulphate of magnesia by an alkaline carbonate as a white amorphous powder. This form of carbonate of magnesia is well known to us all under the name of calcined magnesia. Here it is. It is a very light body, which will decompose at a gentle heat. We will make the experiment before you. Here it goes down as a white precipitate, which, collected on a filter and properly washed, becomes a light, porous, dry, white, almost insipid powder. From what we observe in nature, it would appear that this carbonate of magnesia has a great tendency to combine with carbonate of lime. I say "from what we observe in nature." We shall find that there is a great difficulty in making this combination satisfactorily on a small scale in the laboratory of the chemist. When it combines in the ratio of equivalent to equivalent, we have then the characteristic dolomite about which we have heard so much of late. There is a very interesting and artistic book which has been published recently under the title of "The Dolomite Mountains." It is an examination of those mountains, and every structure is fully discussed and also represented by artistic sketches.

Pure dolomite contains 47·83 per cent. of carbonic acid, 30·43 of lime, and 21·74 of magnesia. It occurs well crystallised. It contains occasionally carbonate of protoxide of iron and also carbonate of protoxide of manganese, which is well known to metallurgists under the term "bitter spar," the well known German term for it. We have it not only well crystallised—distinctly crystallised—but also in what is termed the granular crystalline state, and also in other varieties to which I shall call your attention presently. This is not the only recognised combination of carbonate of lime and carbonate of magnesia occurring in nature. There are some others, to which I will call your attention for a moment, but they are of no special interest to us in a geological point of view.

There is one combination, for example, composed of 3 equivalents of carbonate of lime to 2 of carbonate of magnesia. It occurs in Bohemia. There is a second, consisting of 2 equivalents of carbonate of lime and 1 of carbonate of magnesia. It occurs in Styria, and also in the Tyrol. There is a third, composed of 1 equivalent of carbonate of lime and 3 of carbonate of magnesia. This occurs in Heissen. Then there is a fourth, composed of 1 equivalent of carbonate of lime and 1 of carbonate of magnesia, the carbonate of magnesia being partially replaced by carbonate of iron. This is known by the name of brown spar.

There are on the table specimens of several well-known varieties of dolomite. We have, first of all, varieties classed according to texture or structure. We have the granular variety. It has a crystalline texture, and sometimes very much resembles white sugar in appearance. Hence the term saccharoidal, or sugar-like, is applied to it. It often consists of small rhombohedral crystals. The second variety is compact and stone-like, or even conchoidal in fracture. Thirdly, there is the cellular variety, yellowish or smoke-gray in colour, containing cavities in all directions, which are often filled with rhombs of spathic iron,—that is, carbonate of protoxide of iron crystallised. Then we have a fourth variety—the schistose or slate-like, which occurs in the Jura. Fifthly, there is an earthy variety, which is friable and easily reduced to powder.

We have other varieties which we may classify according to composition. For example, we may have dolomite with excess of carbonate of lime. It not only contains the one equivalent of lime and the one equivalent of carbonate of magnesia combined chemically, but an excess of carbonate of lime beyond that. Such varieties are termed the calcareous varieties. We have also the siliceous variety; that is, a dolomite containing sand. Thirdly, we have an argillaceous variety—that is, a dolomite mixed with clay. In certain cases we find also dolomite containing quartz and mica, and it may be other things too.

Dolomite occurs in nature distinctly stratified. In this case it clearly has a sedimentary origin. It also occurs compact, without any appearance of stratification. We have, then, the stratified and the massy varieties. The massy varieties are often extremely fissured in all directions. We find it occur usually over or between limestones and marls, and often associated with beds of gypsum. It is met with in geological strata on formations of the most different ages. Occasionally it is seen that a continuous bed shall consist of limestone in one part, which shall pass insensibly into dolomite; and it is deserving of remark that fossils occurring in dolomite are rarely met with, and sometimes they may exist and not be detectable by the eye, but in process of wear from the action of the atmosphere, or by other means, they may be rendered more or less manifest. In the triassic beds it forms regular stratified masses, beds of rock-salt, clays, and gypsum.

Now, let us consider how dolomite has been formed; and here, ladies and gentlemen, I am afraid I must weary you with a little chemical detail; but it is impossible to avoid this if we are determined rightly to attack this subject.

The first question which presents itself for our consideration is, has the dolomite which we find occurring in nature been thrown down as such? Has it been deposited as dolomite, or has it resulted from a secondary action upon a sedimentary rock of different composition—to wit, limestone? For example, has the rock—carbonate of lime—been first thrown down as a bed, and then subsequently, by some means or other changed into dolomite? These are questions which we shall consider in detail.

First I must direct your attention to all that is known of the chemistry of this subject, and for this purpose I have endeavoured to collect and to concentrate into a small compass the various facts which we find scattered through different works on this topic.

I will first lay before you the theory which has been set up by Haidinger. From the frequent association of dolomite with gypsum he concludes that dolomite was produced by the action of a solution of sulphate of magnesia—that is, common Epsom salts—on carbonate of lime—say chalk or limestone—the product being, as he supposes, dolomite and gypsum, which is another name for sulphate of lime. Sulphate of lime is slightly soluble in water—sensibly soluble, I may say—but when a solution of gypsum passes through pounded dolomite this dolomite is converted into carbonate of lime with the formation of sulphate of magnesia—the very reverse of what Haidinger supposes—that is, when this sulphate of lime passes through at the ordinary temperature of the air. Temperature, we shall presently find, may make an immense difference. In order, then, to maintain his view of the formation of dolomite, he was obliged to assume a high temperature at the time of its formation—a temperature of about 392° Fahrenheit, which, when water is employed, requires, of course, great pressure, a pressure of not less than fifteen atmospheres. It was found, according to Morlot, that a mixture of crystallised sulphate of magnesia and pounded calcspar, in the proportion of one equivalent to two, when heated in a sealed glass tube (which was under great pressure), was completely changed into dolomite and sulphate of lime, and that no trace of sulphate of magnesia remained. This supported Haidinger's theory, but only on the supposition of a high temperature existing, and of this no proof whatever is furnished. On the contrary, we shall see there is a reason to believe that such a condition could not have been obtained. Here, again, is another example of the importance of temperature in all these reactions. We see that while one result occurs at the ordinary temperature of the air another and totally opposite result occurs at a temperature of about 400° Fahrenheit. Bischoff, in his work on Chemical Geology, has discussed this matter most ably and at great length. Now, he says that the water of the ocean would be at this temperature of 392° at the depth of 17,600 feet, in order to ensure the requisite pressure; but it so happens that the temperature decreases with the depth. Hence, he properly observes, unless Haidinger can show us good proof of the existence of this temperature his theory must fall to the ground; and no such proof is offered. Moreover, with reference to this theory it is remarked by Bischoff, further, that if the dolomite of the Tyrol, which is cellular throughout and much fissured, had been so formed there ought to have been enormous masses of gypsum in the vicinity, which he states is not the fact. We know that in certain cases there is an efflorescence of sulphate of magnesia in gypsum quarries, which is explained by Haidinger by the decomposition of dolomite by sulphate of lime, which, as I said, occurs at the ordinary temperature. I mentioned in my former course of lectures the fact that sulphate of magnesia was actually manufactured on a large scale, a great many years ago in Nottingham, from dolomite and sulphate of lime. The sulphate of lime was ground to powder, put into a large quantity of water, and brought in contact with gently calcined and pounded dolomite. They then got sulphate of lime and caustic magnesia, the dolomite being only partially deprived of its carbonic acid. Carbonic acid was then passed through, and sulphate of magnesia was the product. I have seen it produced in this way by the ton, but sulphate of magnesia becoming in time much reduced in price, the process was no longer profitable, and was therefore abandoned. There is a statement by Elie de Beaumont, a distinguished French philosopher, that if we take two equivalents of carbonate of lime and replace one equivalent by carbonate of magnesia, owing to the higher specific gravity of the whole, and the lower atomic weight of magnesia, there would remain, or ought to remain, 12 per cent. of hollow space. An examination was made, and he tells us that he actually found 12·9 per cent. of hollow space in natural dolomite, whence it was inferred that the dolomite in this case was produced by the substitution of 1 equivalent of carbonate of magnesia for 1 of carbonate of lime, in every 2 equivalents of carbonate of lime.

The next fact I have to bring to your notice is one to which I am inclined to attach very high importance indeed. It appears to me to be perfectly conclusive of the fact of the production of dolomite from carbonate of lime, from the action of certain salts of magnesia. The fact we owe to Dana, the well-known American naturalist. Dana tells us that in fresh corals he found less than 1 per cent. of magnesia, but that in compact coralline limestone he found as much as 38 per cent. Another rock consisting of the remains of corals gave 5·29 per cent. of magnesia. Now, we may fairly assume, as Dana has done, that there is no reason whatever for supposing that the composition of the ancient corals differed from those now existing. Admitting this assumption, that the composition in both cases was the same, then it is certain that in this case dolomite must have been formed, or at all events carbonate of magnesia must have entered into the composition of these corals by replacing a portion of carbonate of lime, through the action of magnesian salts dissolved in water. I say, admitting the assumption, then there is no doubt that this must have been the case. It appears to me that this fact is one of great significance in our considerations, but its value, of course, rests upon the assumption that these corals had a composition like those now existing; and there can be no doubt from other considerations that they had. Here, again, we have to deal—I need hardly remark—with that most important element upon which I so frequently insist—time. We, in our laboratories, in attempting to imitate the experiments of nature, can only employ time in a very limited degree. We can avail ourselves of the effect of time, it may be, during a few days, or a few months, or a few years; but that is nothing compared with the action of time with regard to geological products.

Another theory of the production of dolomite is that of Sandberger, who explained the production of dolomite in Nassau by the action of water charged with carbonic acid upon a black limestone rich in magnesia, and to this view Bischoff attaches great importance. A portion of the lime was thus supposed to be dissolved away, and the solution went on until at length the residue had the composition and characters of dolomite. The carbonate of lime was supposed to be removed, or again deposited in rocks as calc sinter, or calcspar. Now we have some experiments concerning this solvent action of carbonic acid upon magnesian limestone. Carbonate of lime, for example, was finely powdered and mixed with water, and carbonic acid was passed through for twenty-four hours. The solution was then filtered and evaporated to dryness. In this case there was no solution of carbonate of magnesia, or scarcely any. Practically not a trace was dissolved, but only carbonate of lime; understand this is the case when the two are combined together. I shall have occasion to refer again to the solvent action of water containing carbonic acid upon carbonate of magnesia. Now, in the case of limestones containing only a small quantity of carbonate of magnesia—one containing 10·2 per cent., and another 11·4 per cent., the amount of carbonate of lime dissolved was in the first case 2·93, and in the second case 4·29. Hence it is inferred that by the action of surface water or of sea water upon limestone containing magnesia, the excess of carbonate of lime would be removed, until at last nothing but dolomite remained.

Another view has been put forth by an observer of the name of Nauck. According to him water charged with carbonic acid decomposes certain silicates, silicate of magnesia, for example, which is slightly soluble in water. Well, this may be obtained easily enough from certain igneous rocks—so-called igneous rocks, at all events—by the action of water—say, containing carbonic acid, or even without. This silicate of magnesia when dissolved would be decomposed by carbonate of lime, and we should have carbonate of magnesia dissolved. This would convert the carbonate of lime into dolomite. The silica set free would be deposited as opal or crystallised quartz. That is his view. Now, there is no chemical evidence at present of the formation of dolomite by this process. All these reactions are entirely inferential from geological considerations, or are conceived to be chemical possibilities. You may easily understand how dolomite may be so formed. We get water containing carbonate of magnesia dissolved by carbonic acid percolating for a very long period—a geological period, in fact—through carbonate of lime. One of every two equivalents of carbonate of lime will be replaced by carbonate of magnesia, and the carbonate of lime so replaced is dissolved by the carbonic acid which held the carbonate of magnesia in solution. Thus dolomite would be formed, and carbonate of lime carried away in a dissolved state.

We next come to the theory of Favre and Marignac. They believe that the dolomite of the Tyrol has been deposited as such, and not metamorphosed—has not been the result, in fact, of secondary action, an action we shall hereafter consider in detail. They are obliged to suppose that certain volcanic irritations occurred, attended with the evolution say of sulphurous acid—that acid which is produced when we burn sulphur in contact with air, and attended also by the action of this acid upon magnesia with the production of sulphite of magnesia. This magnesia is supposed to be present in augitic tufa thrown out and spread over the sea bottom. They also suppose that there may have been volcanic emanations of hydrochloric acid, which, acting upon the tufa, may have formed chloride of magnesium. We then get sulphite of magnesia and chloride of magnesium. If air be present—and they must suppose that—this sulphite of magnesia would be converted eventually into sulphate of magnesia or Epsom salts. They have to suppose in this way the formation of two magnesium salts. By heating carbonate of lime and chloride of magnesium in a closed tube—that is, under pressure at 200° Centigrade for six hours—that is a pretty high temperature, double that of boiling water—Marignac got a precipitate consisting of 48 per cent. of carbonate of lime and 52 per cent. of carbonate of magnesia. This precipitate may be virtually regarded as dolomite. The cavernous character of the Tyrol dolomite is explained by Favre as the result of volcanic action after deposition, and not as arising from dolomite being due to a metamorphic action on a previously deposited rock. This is an opinion strongly combatted by Bischoff, who supposes that in every case dolomite is to be accounted for by secondary action. Here, again, we get the formation of dolomite at a high temperature, and the same objection as I mentioned before exists as regards this theory. The onus of proof of the high temperature lies upon Favre and Marignac, and they have not attempted to bring any evidence in support of the supposition. Failing such evidence, the theory must be considered, of course, as extremely doubtful.

Quite recently—indeed, a very short time ago—a paper was read on the formation of lime and dolomite at the Academy of Sciences, at Toulouse, by M. Le Maré. He makes no difficulty whatever in explaining the formation and deposition of carbonate of lime rocks and of dolomite; but then, in order to explain it, he is driven to the necessity of certain strong hypotheses. Thus, he says, in ancient times the water of the ocean contained a very large proportion of chloride of calcium and chloride of magnesium in solution—much larger than at present—and that then terrestrial water was rich in carbonate of soda, or some other alkaline carbonate. This alkaline carbonate flowing into the sea-water, threw down carbonate of lime, thus forming the great beds of chalk, or limestone, or dolomite, as the case might be. Here, then, are two hypotheses, which must be assumed before we get at this explanation; first of all, that of the extreme richness of the ocean in chloride of calcium and chloride of magnesium, and secondly, that of the richness of terrestrial streams in those days in carbonate of soda, or, it may be, carbonate of potash. But even supposing this richness of the ocean in these chlorides and the terrestrial water in alkaline carbonate, it may be asked, Have we any direct chemical proof that when these two carbonates—carbonate of lime and carbonate of magnesia—are thrown down simultaneously they will form dolomite? Well, many experiments have been made in the laboratory of the chemist to determine this, but all without success. We get simply mixtures of carbonate of lime and carbonate of magnesia. Whether, if we kept them under water for a thousand years, the two things would combine is another matter. Of course we have no means in this century of making this experiment.

Next comes the view advocated by a very able chemical geologist—in fact, he has done as much, if not more than certainly the majority of observers in this particular line—Mr. Sterry Hunt. Many of his papers are to be found in the *Transactions* of the Canadian Geological Survey. Mr. Hunt is a very highly original and very active and energetic man, and, I believe, a very conscientious man too. According to him, the formation of dolomite may be explained by the action of water containing bicarbonate of soda upon sea-water. The lime salts therein are first decomposed, throwing down carbonate of lime with, it may be, ·02 or ·03 per cent. of carbonate of magnesia. Then, when all the soluble salts of lime have been thus decomposed, a further addition of bicarbonate of soda, he supposes, throws down bicarbonate of magnesia, which, by evaporation, separates as a hydrated carbonate. Then the two carbonates subsequently unite to form dolomite; but upon that point we have no proof. The comments I made in the former course of lectures, upon this view of Mr. Hunt, whom I know very well, have reached him, and he has set to work to see whether he can furnish proof that dolomite is formed when carbonate of lime and carbonate of magnesia are thrown down simultaneously. You may ask, How can you tell us whether the two salts are in combination or not? Now, that is a very proper question to put, and it is one, I think, not very easily answered; but in the case of dolomite there is no doubt about the matter. The action of certain weak acids—say acetic acid—on dolomite is very feeble indeed; and this feeble action gives us the means of ascertaining whether the two things are in combination or not. As an illustration of this, I may state that if you take a dolomite containing a quantity of carbonate of lime in excess, reduce it to powder, and then act upon it by dilute acetic acid, you dissolve out only the carbonate of lime in excess, and what will remain will be pure dolomite.

(To be continued.)

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

PHYSICAL AND MATHEMATICAL SECTION.

March 29, 1866.

ROBERT WORTHINGTON, *F.R.A.S., Vice-President of the Section, in the Chair.*

Mr. W. L. DICKINSON read a paper containing the results of calculations relative to the Eclipse of the Sun, and to two Occultations of the star Aldebaran by the Moon, visible here this year. The calculations have been made for the observatory of Robert Worthington, Esq., F.R.A.S., Crumpsall, near Manchester, Lat. 53° 30′ 50″·0 N., Long. $0^{h}\ 8^{m}\ 56^{s}$, 16 W. The elements used in the computations have been obtained from the Nautical Almanack. The partial eclipse of the sun, October 8, 1866, is partly visible at the observatory, and

	h.	m.	s.	
Begins	4	19	39	Mean time at Greenwich.
Greatest phase . .	5	21	35	

At Crumpsall the sun will set at 5h. 27m. Magnitude of the eclipse (sun's diameter = 1) 0·480.

Angle, from North Pole, of first contact, 43°	towards the West for direct image.
Angle, from Vertex, of first contact, 76°	

Mr. BROTHERS, F.R.A.S., stated that when a solution of nitrate of silver, which, from long use, has become contaminated with organic matter from collodion plates, is neutralised, or made alkaline with carbonate of soda, exposed to strong daylight in an evaporating dish, and heat applied, a scum is quickly formed on its surface. This scum, when broken by a puff of air, exhibits in a remarkable manner all the appearances of solar spots as seen in good telescopes. So long as the current of air is continued the scum remains open at the spot, but immediately closes partially on the cessation of the cause, and streams of the film stretch across the opening, illustrating the bridges over the sun spots. At the same time, a secondary scum commences to form at the edges of the opening, and may be called the "penumbra," and in time closes the opening. The centre is occupied by the "umbra" formed by the carbonate of silver (white when first formed) which has in the course of the experiments turned black. It was found that when a current of the solution was forced upwards these effects could not be produced, and the film was not affected when a small body was dropped into it. When the solution has been exposed to the heat for a few hours the film becomes too thick to exhibit the experiment, and when cold the appearances described could not be produced. This experiment was referred to merely as illustrating the appearances of sun spots, and in no way as explaining their cause. At the same time it suggested the idea that if the luminous photosphere of the sun is formed of bodies, named by various observers, "willow leaves" (Nasmyth), "rice grains" (Stone), "bits of straw" (Dawes), and of the existence of distinct bodies of some kind on the visible surface of the sun there can now be very little doubt, they may be floating in a fluid sufficiently dense to sustain them, but at the same time easily thrust aside by some disturbing cause below the surface. The existence of an external cause at the surface of the sun being improbable, may not the cause of the sun spots arise from a current or force, such as the "red flames," which are supposed to be connected with the formation of spots? This force acting on the "willow leaves" would raise them from the level at which they may be supposed to float, they would slide under and over each other, and thus leave an opening; and, upon the gradual cessation of the disturbing cause, the tendency of the "willow leaves" would be to gradually assume their former positions and close up the spots in a way similar to the closing of the film in the simple experiment referred to. Mr. Brothers also stated that, while observing the moon with his five-inch achromatic telescope at about eight o'clock on the evening of March 25, he observed a small dark body cross the disc diagonally, from left to right, a little below the spot Copernicus. The motion was very rapid, and similar to the passage of a luminous meteor across the field of view. He conceived it might be a meteoric body passing through space at a distance considerably beyond the limits of the earth's atmosphere.

PHARMACEUTICAL SOCIETY.

Wednesday, April 4.

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

(Continued from page 188.)

THE last paper was by Dr E. J. WARING, "*On the Purgative Action of Certain Euphorbiaceous Seeds.*" Dr. Waring commenced by remarking on the interest and importance of the Euphorbiaceæ, an order comprising upwards of 2500 species, differing widely in appearance, and presenting as great differences in properties. From this one order the physician draws purgatives and astringents, emetics and tonics, anthelmintics, diuretics, and emmenagogues, rubefacients and counter-irritants; while other species yield an emollient tallow, a valuable article of diet, tapioca, and lastly, and commercially the most important of all, india-rubber. The author then passed in review the more commonly known purgatives belonging to the order. Referring to the violent action of the seeds of Ricinus communis in comparison with an equivalent amount of expressed oil, and also the fact that after the expression of the oil and subsequent extraction by ether and alcohol, the mass still retains active purgative properties, the author contended, for the presence of an acrid principle, the seat of which he gave reasons for believing to be the cotyledon. Dr. Waring expressed a hope that the euphorbiaceous seeds would undergo a fuller chemical examination than they have yet been submitted to. Lastly, the author mentioned the antidotal powers of fresh lime- or lemon-juice in cases of poisoning by these seeds, of which he has had some experience. The *rationale* of its action he did not attempt to explain, but of its antidotal power he has no doubts.

After proposing a vote of thanks to Dr. Waring, the President announced that this was the last meeting of the season, and expressed a hope that all present might meet again next year with greatly increased numbers.

The annual *conversazione* of the Society is announced for Tuesday, the 15th.

ACADEMY OF SCIENCES.

April 23.

M. WURTZ presented a note "*On a New Class of Compound Ureas.*" The author has formed an *amylurea*, and a *pseudo-amylenic urea*, the former by fixing the elements of ammonia on cyanate of amyl. The latter is derived from cyanate of amylene prepared by treating cyanate of silver with hydriodate of amylene. The mixture, which must be made at as low a temperature as possible, is distilled, and the product, a liquid with a very irritating odour, is collected in a well-cooled receiver. This liquid is then shaken with liquor ammonia. After a day or two it becomes a solid mass of the new urea. This new urea, heated in a sealed glass tube with caustic potash, splits up into carbonic acid, ammonia, and a volatile liquid alkaloid isomeric with amylamine, which the author intends to describe more particularly under the name *isoamylamine*. The pseudo-amylenic urea combines with nitric acid to form an oily liquid, which, left in a dry atmosphere, becomes covered with crystals, and seems to lose nitric acid. The acid mother liquor on evaporation yields crystals of nitrate of urea. Thus it seems that under the influence of the excess of nitric acid, the amylenic urea loses amylene and becomes converted into urea, which remains combined with the nitric acid. For a further account of these bodies we must refer the reader to the *Comptes Rendus*.

M. Berthelot continued his paper "*On the Action of Heat on Some Carbides of Hydrogen.*" The author next tried the reactions of acetylene on unsaturated carbides, or those which have the power of fixing nascent or free hydrogen. He first heated equal volumes of acetylene and ethylene, and found the two gases to disappear simultaneously, and in about equal proportion. Several carbides were formed by this reaction, the principal one being apparently *Crotonylene* C_8H_6. Acetylene heated with benzine disappears more rapidly than when heated alone. The gaseous residue is only a fifth of the original volume, and consists of hydrogen with ethylene and hydride of ethylene. The principal portion of the elements of the acetylene remain combined with the benzine. Spontaneous evaporation leaves a crystallised carbide which appears to be altogether new. With naphthaline, acetylene disappears even more rapidly and completely. The gaseous residue is nearly the same as in the case above. The results of the combination are not described. Lastly, the author states that ethylene heated with benzine shows signs of combination; but the results he is not at present certain about. We shall give this paper, as well as that of last week, at length, and need now only mention that the facts described by M. Berthelot throw an unexpected light on the mode of formation of the various bodies produced in processes of dry distillation.

The same indefatigable author presented another note "*On the Origin of Carbides and Combustible Minerals.*" It is purely theoretical, and very original. M. Berthelot, starting with the hypothesis of M. Daubrée that free alkaline metals may possibly exist in the interior of our globe, supposes that carbonic acid everywhere infiltrated in the crust of the earth, may come in contact with the alkaline metals, and give rise to the formation of acetylides. The alkaline acetylides acted on by steam would give free acetylene. But acetylene cannot continue to exist under the conditions supposed, and in its place we obtain the products of its condensation—bitumens, tars, petroleum, &c. Thus the author conceives a purely mineral origin for these natural carbides.

NOTICES OF BOOKS.

Zeitschrift für Chemie, &c. No. 6. March, 1866.

This number contains Dr. Hofmann's paper "*On the Action of Trichloride of Phosphorus on the Salts of the Aromatic Monamines,*" and several papers already noticed in our pages. Among the papers we meet with for the first time is one by Schönbein, "*On the Action of Platinum, Ruthenium, Rhodium, and Iridium on Chlorine Water, an Aqueous Solution of Hypochlorite, Peroxide of Hydrogen, and Ozonised Oxygen,*" and another by O. Loew, "*On Sesquisulphide of Carbon.*" Both of these we transfer to our pages. There are also a long memoir, by H. Rosseler, "*On the Double Cyanides of Palladium.*" "*A Contribution to the Knowledge of Thiodiglycolic (Monosulphacetic) Acid*" by Dr. E. Schultze, and a communication "*On the Chemistry and Technology of Fat*" by Bolley and Borgmann, who have proved that up to 250° C. oleic acid distils with the vapour of water unchanged. Some of the shorter abstracts, of which we may say in passing that this very useful journal always contains a good selection, we give in our miscellaneous paragraphs.

The Chemical Testing of Wine and Spirits. By John Joseph Griffin, F.C.S. London: J. J. Griffin and Sons. 1866.

By the publication of this book, Mr. Griffin has added another item to the debt of gratitude owing to him by practical chemists. It is just such a book as has been wanted ever since the alterations in the wine duties, and it is to be regretted that it was not published earlier. It ought to be in the hands of every one engaged in the testing of wines. It must, however, be understood that the book is not simply concerned with the estimation of alcohol. The author's instructions extend to the determination of the free acid, sugar, extractive matter, tannin, and, as far as possible, of the ethereal constituents. Besides this, we find some "*Chemical Notes on some Particular Points in the Manufacture of Wines,*" which deserve the attention of wine growers as well as manufacturers of cider and perry, and other chapters of as much interest to connoisseurs as chemists.

We are sorry that Mr. Griffin did not include the testing of beer in his book. This is a subject which merits attention. Busy as the chemists at Somerset House appear to be, there is no doubt that an enormous amount of adulteration is allowed to be carried on in this important article. There are no difficulties that we know of in detecting the ordinary adulterants; but the scandal is allowed to go on without the smallest interference from the Excise.

We have wandered, however, from Mr. Griffin's book, of which we hope another edition will soon be demanded, to which he can add the necessary instruction for "persons not much accustomed to the conduct of chemical experiments," to examine the quality of beers.

With a word of praise for the industry shown in compiling the numerous tables given, we must conclude by again recommending the work both to the testers and tasters of wines.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

690. H. F. Davis, Bayham Street, Camden Town, "A new chemical process for manufacturing artificial tea."—Petition recorded March 7, 1866.

871. J. Buckingham, Walworth, Surrey, "The application and use of a certain material to be employed in admixture with india-rubber, oils, resins, or bituminous matters, which combinations may be applied to various useful purposes."—March 24, 1866.

904. A. A. Jaeger, Neilston, near Glasgow, "A new process for obtaining aniline yellow."—March 28, 1866.

921. J. Davis, Southsea, Hants, "An improved method of preventing the putrefactive decomposition of vegetable and animal substances, and for utilising the same for agricultural purposes."—March 31, 1866.

934. E. P. H. Vaughan, Chancery Lane, "Improvements in the methods of solidifying the juice or sap of the bullet tree, otherwise known as balata juice, and the juices or saps of trees yielding similar or analogous elastic products." A communication from S. R. Pontifex, F.C.S., Demerara, British Guiana.

938. A. L. M. Guétat, Lyons, France, "An improved process for obtaining colouring matters from aniline."—April 2, 1866.

944. J. Schweitzer, Thornhill Crescent, Islington, Middlesex, "Improvements in the manufacture of pancreatic emulsions of solid and liquid fats and oils."

951. J. Robey, Newcastle-under-Lyme, Staffordshire, "Improvements in reburning animal charcoal."—April 3, 1866.

960. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of sugar." A communication from F. J. Chauvin and F. M. Légal, jun., Paris. —April 4, 1866.

968. A. A. Jaeger, Neilston, near Glasgow, "A new process for obtaining aniline red."—April 5, 1866.

991. J. Young, Limefield, N.B., "Improvements in distilling."—April 6, 1866.

1002. E. K. Muspratt, Liverpool, "Improvements in burning or calcining and preparing for burning or calcining copper, iron, and other ores containing sulphur, for the manufacture of sulphuric acid."

1005. G. Gordon, San Francisco, California, "Improvements in treating animal charcoal."—April 7, 1866.

1016. P. W. Hofmann, Ph.D., Dieuze, France, "Improvements in separating sulphur from soda waste."

1017. E. Davies, Serle Street, Lincoln's Inn, Middlesex, "Improvements in the process of de-sulphuration, and in the apparatus employed for such process." A communication from A. F. Remond, Brussels.—April 9, 1866.

1021. E. Lichtenstadt, Bermondsey Road, Surrey, "An improved compound volatile oil or spirit for burning in lamps of suitable construction." A communication from P. Lichtenstadt, New York, U.S.A.

1023. J. Sparrow and S. Poole, Frood Iron Works, near Wrexham, Denbighshire, "Improvements in collecting the heated gases from blast furnaces, so as to utilise the same."

1026. E. W. Shinner, Strand, Middlesex, "Improvements in the means of and apparatus for utilising sewage matters and liquids."—April 10, 1866.

INVENTION PROTECTED FOR SIX MONTHS BY THE DEPOSIT OF A COMPLETE SPECIFICATION.

1141. F. Barnett, Rue du Rivoli, Paris, "An improved aquatic firework."—Petition recorded April 23, 1866.

NOTICES TO PROCEED.

3261. S. Whitehouse, the elder, S. Whitehouse, the younger, J. Whitehouse, and W. Whitehouse, Dudley, Worcestershire, "Certain improvements in the means of collecting waste gases arising from blast furnaces."

3267. H. C. Ensell, St. Helens, Lancashire, "Improvements in smelting copper, and in obtaining products from the gases and vapours given off during the said smelting." —Petitions recorded December 18, 1865.

3280. L. Durand, Lyons, France, "Improvements in dyeing and printing."—December 19, 1865.

35. W. Clark, Chancery Lane, "Improvements in preparing and treating wood and wood pulp for the manufacture of paper." A communication from J. B. Neyret, Z. Gaspard, A. N. P. Orioli, and A. A. Fredet, Boulevart St. Martin, Paris.—January 19, 1866.

394. H. E. F. de Brion, M.D., Marlborough Hill, St. John's Wood, Middlesex, "Improved compositions for preserving metals from oxidation, corrosion, and galvanic action, for protecting metals used in the construction of ships against the destructive effects of sea-water, and preventing their fouling, for protecting woods from the attacks of animalculæ, and preserving wood from damp-rot and decay, for excluding damp from walls, and for use in submarine and other telegraphy."—February 8, 1866.

554. C. J. Cannon, Toulouse, France, "Manufacturing iron and steel, and the alloyage of metals, together with preparing ores for the same."—February 23, 1866.

769. G. McKenzie, Glasgow, N.B., "Improvements in obtaining illuminating gas and oil."—March 15, 1866.

859. C. E. Brooman, Fleet Street, London, "A new or improved process of transforming scraps or cuttings of Bessemer steel, and other scraps or cuttings of iron, puddled steel, and cast steel into ingots of cast steel." A communication from E. Martin and P. E. Martin, Paris.—March 23, 1866.

919. C. Pardoe, Brierley Hill, Staffordshire, "Improvements in the construction of coke ovens."—March 29, 1866.

CORRESPONDENCE.

Continental Science.

PARIS, April 31.

You will probably have seen in the *Bulletin* that at the last meeting of our Photographic Society M. Girard described some experiments illustrating the discovery of Mr. Carey Lea of the production of latent photographic pictures by simple pressure, to which I alluded once before. M. Girard showed that if you prepare and sensitise a plate in the usual way, and then having written upon a sheet of note-paper with a style so that the letters may stand in some relief, press this paper on the sensitised plate, you will, on applying the ordinary iron developer to the plate, obtain a copy of the words. All this is done in the dark, so that the action of light is completely excluded. We have thus, as stated by Mr. Carey Lea, a mechanical cause as powerful as light in producing a latent image on a plate. The fact opens the door to some wide speculations upon which I dare not enter; but is it too much to say that Mr. Carey Lea's discovery seems to lend some support to the emissive theory of light?

Does the earth increase in size, and at what rate? M. Dufour, speculating on the cause of the secular acceleration of the moon—a fact, I suppose, beyond dispute—calculates that to account for it the mass of the earth must be increased in a hundred years by $\frac{1}{114,600,000}$th of its weight. The increase must be occasioned by the accession of meteoric dust, about two cubic metres of which must fall on every hectare of the earth's surface annually. This looks enormous, and it is still more astonishing to read that this meteoric dust lies in parts of England a foot deep. Where does it come from? is a question which will arise in every one's mind. From the millions of shooting stars which are burnt to dust every day in the earth's atmosphere. I will not go further into this curious matter, but refer you and any reader interested to the number of *Cosmos* for April 25, in which you will find an interesting paper on the subject by that clever and ingenious writer, M. de Foinvielle.

The lectures given for assisting the funds of the Society for Assisting Scientific Men in need are now concluded, and I am happy to say that they have added considerably to the funds. The lectures, I am told, will be published in a volume, which will be read with interest. M. Fremy's lecture on ozone and oxygen was perhaps the greatest success of the course, the experimental illustrations of it being on a most extensive scale. The continued presence of the Empress at these lectures deserves to be recorded in a scientific journal, for I have not seen that the correspondents of your political journals have noticed the fact.

The Muspratt Chalybeate.

To the Editor of the CHEMICAL NEWS.

SIR,—I have taken a great interest in everything relating to Dr. Muspratt's remarkable discovery of the chalybeate nature of the spring at Harrogate, and I believe many of your readers would be glad to know the exact methods of analysis, both qualitative and quantitative, used in the examination by a gentleman who is so universally known as the "great English chemist."

Anything from the pen of the writer of "Muspratt's Dictionary of Chemistry" cannot fail to be interesting and instructive to the whole chemical world.

I am myself anxious to analyse the said water as soon as possible, and before it shall have undergone another of the remarkable changes in composition which are said to have been noticed during the present century.

I am, &c. A. A. H.

MISCELLANEOUS.

Explosion of Nitro-Glycerine.—The screw steamer *European*, of Liverpool, was destroyed and many persons were killed at Colon on April 3 by the accidental explosion of a large quantity of nitro-glycerine. No particulars of the accident have yet been received.

New Way of Making Lucifer Matches.—M. Gaillard suggests the making of a safety match by dipping the stick into melted sulphur after the application of the phosphorus. The sulphur being insoluble in water, and not melting below 110° C., would hinder the phosphorus from doing any harm if the matches were dropped into food; and the greater friction necessary to ignite such a match would be a safeguard against accidental ignition.

Preparation of Hydrocyanic Acid and a Test for Ammonia.—Cyanic acid may be prepared by mixing in a retort equal parts of commercial tin salt and cyanide of mercury and distilling in a water bath. The double salt crystallised from a concentrated solution of cyanide of mercury and iodide of potassium dissolved in a dilute solution of soda is a very delicate reagent for ammonia. The test is more stable than Planta's.—*Kletinsky, Zeitsch. f. Chem.*, 127.

Relative Importance of Mastication.—In a paper by Mialhe, "*On the Dyspepsia arising from Insufficient Mastication*," read before the Paris Pharmaceutical Society, the author states that it is important that vegetables should be well chewed; but with meat the mastication is not of so much consequence.—*Journ. de Pharm. et de Chim.*, April, 1866, p. 296.

Composition and Quality of the Metropolitan Waters in April, 1866.—The following are the Returns of the Metropolitan Association of Medical Officers of Health:—

Names of Water Companies.	Total solid matter per gallon.	Loss by ignition.*	Oxydisable organic matter.†	Hardness.	
				Before boiling.	After boiling.
Thames Water Companies.	Grains.	Grns.	Grains.	Degs.	Degs.
Grand Junction . . .	20·43	1·31	0·34	15·5	4·5
West Middlesex . . .	19·41	0·90	0·40	14·0	3·0
Southwark & Vauxhall .	20·40	0·80	0·36	15·0	4·0
Chelsea.	20·39	0·95	0·30	15·0	4·5
Lambeth	20·00	1·25	0·38	14·0	3·5
Other Companies.					
Kent	27·62	0·72	0·02	20·0	7·5
New River	19·00	1·10	0·18	13·5	4·5
East London . . .	21·60	1·42	0·37	15·5	4·0

* The loss by ignition represents a variety of volatile matters, as well as organic matter, as ammoniacal salts, moisture, and the volatile constituents of nitrates and nitrites.

† The oxydisable organic matter is determined by a standard solution of permanganate of potash—the available oxygen of which is to the organic matter as 1 : 8; and the results are controlled by the examination of the colour of the water when seen through a glass tube two feet in length and two inches in diameter.

H. Letheby, M.B., &c.

Oleate of Soda for Soap Bubbles.—The commercial oleic acid made by the manufacturers of stearic acid does not afford an oleate of soda that answers the purpose intended, even though it be purified by combination with oxide of lead, and separation by ether, etc. The best results were obtained as follows:—Dissolve two ounces of good white Castile soap in twenty fluid ounces of boiling water, and add about one ounce of sulphuric acid, diluted with two fluid ounces of water, and stir together; the fatty acids of the soap are separated and rise to the surface, where they collect and float as a clear yellowish oily layer. The vessel is now removed from the fire, and, with a siphon, decant the acid solution of sulphate of soda constituting the inferior layer of liquid, carefully avoiding the loss of the oily part by stopping in time. The oily acids are then well washed three successive times in hot water, separating them as before; after which, by exposure to cold, they solidify. The mass is then weighed, put in a suitable dish, and half its weight of finely-powdered litharge added, and the mixture digested at a heat of 212° to 225°, until complete union is effected. The resulting oleo-margarate of lead, which differs from lead plaster only in containing a smaller proportion of oxide of lead, is to be agitated with at least ten or fifteen times its weight of ether, in a bottle, until it is completely disintegrated. The resulting liquid is transferred to a filter and closely covered; an ethereal solution of acid oleate of lead passes through, and a residue of acid stearate or margarate of lead is left on the filter. To the ethereal solution add aqueous muriatic acid as long as chloride of lead is precipitated; shake thoroughly, and pour off the resulting ethereal solution of oleic acid, recover the ether by distillation, and the residue in the retort will be nearly pure oleic acid. To make the oleate of soda, add two fluid drachms of oleic acid to one pint of boiling water, and then solution of pure caustic soda very gradually, until a clear solution is effected, very carefully avoiding an excess of soda, and, when cold, add sufficient water to make the solution measure a pint, if necessary. To this standard solution of oleate of soda add one-half its bulk of glycerine, and the "suds" are ready for use in blowing bubbles. With a funnel about two inches in diameter, our friend has blown bubbles fully sixteen inches in diameter and of remarkable permanency, and so exceedingly beautiful and interesting, that he felt repaid for the time and trouble expended.—*American Journal of Pharmacy.*

Meetings of the Week.

Saturday, May 5.

Royal Institution, 3 p.m., Professor Huxley, "On the Methods and Results of Ethnology."

Monday, May 7.

Royal Institution, 2 p.m., General Monthly Meeting.

Tuesday, May 8.

Royal Institution, 3 p.m., Professor Ansted, "On the Application of Physical Geography and Geology to the Fine Arts."

Photographic, King's College, Strand, 8 p.m.

Wednesday, May 9.

Microscopical, King's College, Strand, 8 p.m.

Thursday, May 10.

Royal Institution, 3 p.m., Professor Huxley, "On Ethnology."

Friday, May 11.

Royal Institution, 8 p.m., Professor Ansted, "On the Mud Volcanoes of the Crimea."

ANSWERS TO CORRESPONDENTS.

Analine.—1. A book has recently been published in German, but there is none in English. 2. Not by any of the patented processes.

C. H. B. L.—What kind of refrigerator?

R.—1. There are no other economic and practical methods. 2. Gesner's "Practical Treatise on Coal, Petroleum, and other Distilled Oils," published by Baillière.

Errata.—In the abstract of the paper entitled "Researches on Acids of the Lactic Series," page 193, *for* "oxalyl," *read* "oxatyl," and at page 194, first column, nineteenth line from bottom, *for* "any alcohol hydrogen," *read* "any alcohol radical."

Books Received.—"Handbook of Natural Philosophy," by D. Lardner, D.C.L.—Electricity, Magnetism, and Acoustics—revised and edited by G. C. Foster, B.A., F.C.S.; "Dictionary of Chemistry," by H. Watts, B.A., F.C.S., Part XXXIV., Potassium—Pyruvic Acid.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On a Process of Elementary Analysis Admitting of the Determination of Carbon, Hydrogen, and Nitrogen at a Single Combustion, by C. Gilbert Wheeler.

(Concluded from page 208.)

When the point where the substance under analysis is situated is reached (by the fire) the tube at the anterior end of the apparatus is introduced into the tubulure of the gasometer, care being taken that the aperture of the same is not raised above the mercury. As fast as the gasometer becomes filled with the gases, thus displacing the mercury, the latter is removed from the mortar. The height of the mercury surrounding the gasometer being thus very moderate, merely sufficient to prevent the admission of air; the internal pressure upon the apparatus is quite inconsiderable. The combustion of the substance having been effected, and the remaining oxalate of lead decomposed, the chlorate of potash is again heated, and the products of the combustion completely carried forward to their respective recipients. When the oxygen reaches that part of the tube previously containing the substance analysed, a rather vivid but entirely harmless incandescence is observed resulting from the re-oxidation of the copper reduced. The same occurs also when the metallic copper at the anterior end of the tube is reached, at which stage of the process great care is necessary, for as the oxidation of the copper commences, there is a sudden cessation of gas through the potash bulbs, and one is easily tempted to accelerate the liberation of oxygen. In this event, when the re-oxidation is completed a very sudden and altogether too rapid stream of gas passes through the apparatus, and disaster results. If, on the other hand, the liberation of oxygen be not sufficiently rapid or, in particular, if it should cease for a few moments, the oxidation of the copper would proceed at such a rate, and so reduce the tension of the gases within the apparatus as to cause the mercury to ascend the tube communicating with the potash bulbs, and even to enter the latter if not timely observed and prevented by accelerating the stream of oxygen. The one extreme as well as the other may be avoided by so regulating the stream of gas that constant but slow oxidation of the copper takes place, which is readily seen by the change of colour that results. Care should be taken that the necessary oxygen be liberated *without interruption* and *uniformly*, which may be easily effected when the chlorate of potash has been sufficiently pulverised, and mixed with at least an equal volume of oxide of copper.

This somewhat critical stage of the process successfully passed, the supply of oxygen is continued until a considerable quantity has entered the gasometer, which one may confidently assume as accomplished on continuing the stream of gas for about five minutes after absorption ceases to be observable in the potash bulbs. The apparatus is now disconnected, and the oxygen remaining in the chloride of calcium tube and potash bulb is expelled (by air previously freed from carbonic acid and moisture) before weighing.

The height of the mercury in and surrounding the gasometer is read off after the same has been placed in an upright position in a mercury trough with glass sides; also the height of barometer and thermometer. A portion of the gas is then transferred to the eudiometer previously filled with mercury in the following manner:—The stopper of wax being removed from the extremity of the bent exit tube of the gasometer,* the tube is introduced into the eudiometer. The upright tube is then inserted in the tubulure, and mercury is poured into the same, until its level in the tube is above that in the gasometer by one or two inches. The screw clip to the india rubber tube connecting the bent exit tube with the gasometer is then gradually opened and the gas flows into the eudiometer. When enough has been transferred for analysis, the screw clip is closed, the gasometer removed, and the amount of gas in the eudiometer is read off. The further analysis of the gas is performed precisely as in an ordinary air analysis.† A quantity of hydrogen is introduced, the mixture exploded, and from the shortly resulting contraction of volume, the volume of oxygen present is calculated.

This deducted from the volume of the mixture of oxygen and nitrogen gives that of the latter. The relation between the volume of mixed gases introduced into the eudiometer and that originally contained in the gasometer expresses also that of the nitrogen in each apparatus, which total volume thus found is reduced to milligrammes and calculated as percentage of nitrogen in the substance under analysis. Should for any cause a repetition of the gas analysis be desirable, a fresh portion is transferred from the gasometer, care being taken that if the exit tube has in the interval been in communication with the air, the first portion of gas be rejected. Ordinarily not more than one-fifth or one-tenth of the gas contained in the gasometer is taken for analysis.

The author then gives the results of his analysis of a number of bodies, such as urea, morphia, narcotine, oxalate of ammonia, &c., all closely agreeing with theory.

In conclusion, he enumerates the advantage of the process. These are,—1. The saving of material and time, a single combustion sufficing where two have formerly been found necessary. Where properly conducted can be performed in a day. 2. The general applicability of the process. 3. The complete oxidation of the substance is perfectly secured. And 4, any carbonic acid passing the potash bulb will be found in the gasometer. To determine this a potash ball is introduced into the eudiometer, and the carbonic acid calculated from the contraction, the amount being added to that already found in the bulbs.—Abridged from the *American Journal of Science*, January, 1866.

On Silicium in Cast Iron, by Edmund G. Tosh.

In a late number of *Comptes-Rendus* (April 2, 1866) Dr. Phipson has given some further remarks upon the existence of silicium in iron, in which he holds to his opinion that it is contained in that substance in two forms. Recent experiments have shown him that what he at first took to be free silicium really exists in the iron as silica combined with ferrous oxide. In his first paper Dr. Phipson stated that a specimen of iron analysed by him gave 3·22 per cent. of β Si. If we are to consider this as present in the state of silicic acid, saturated with ferrous oxide, we arrive at the astounding discovery that this iron contains 23·46 per cent. of slag. Few chemists would accept this statement without strong evidences of its truth. In absence of any such, I have made some experiments on the subject, the results of which are quite irreconcilable with those of Dr. Phipson.

Large quantities of pig iron (3 to 4 grammes) were

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* This tube was, of course, filled with mercury.

† See Bunsen's Gasometry, by Roscoe, p. 66, *et seq.*

heated in a stream of perfectly dry chlorine. All iron and silicium are volatilised as chlorides, while all silica which existed as such in the iron remains behind unaffected. If the carbon be burned off in a stream of oxygen, a small residue containing silica and titanic acid is obtained, weighing only 1 or 2 milligrammes, equal to about 0·3 per cent. of SiO_2, instead of 4, 5, or a larger percentage, as Dr. Phipson would show.

It is still maintained that all silica from so-called β Si is precipitated when the iron is dissolved in *aqua regia*. That this method of estimation was altogether unreliable I think the results given in my previous paper sufficiently show. Did the β Si exist as ferrous silicate, the incorrectness of such process is still more patent; in the analysis of silicates we invariably evaporate to dryness before collecting the silica. Dr. Phipson looks upon this quantity of silica, precipitated when the iron is treated with acid, as representing a portion of silicium which exerts no deleterious action in the manufacture of Bessemer steel. Without any enlightenment as to the course of reasoning by which such conclusion is obtained, we are compelled to take this as a fundamental and established fact. We have had no satisfactory proof that silicium exists in iron otherwise than combined with the metal itself. We have seen that this quantity of precipitated silica is far from being constant, and assuming that silicium existed combined with half-a-dozen different elements, it would be very difficult to settle from which of these compounds silica would be precipitated.

In my last paper I endeavoured to show that the presence of free silicium in iron is very improbable, and the occurrence of large amounts of silicate of iron seems to me equally so. If, then, the learned doctor's primary data are incorrect, no inferences can be safely drawn. Until these obscure points be in some measure explained, the question of the different combinations in which silicium in iron and their deportment in the manufacture of Bessemer steel must be considered open.

Chemical Laboratory, Gottingen, May 4.

*On a New Class of Radical Metallic Compounds,**

by M. BERTHELOT.

I HAVE made some new experiments for the purpose of determining the constitution of characteristic combinations formed by acetylene by its reactions on metallic solutions. They constitute, as I am about to demonstrate, a new class of radical metallic compounds. I will give my observations, with the intention of afterwards developing them further.

I.—We will begin with cuprous combinations. They are derived from a new radical, C_4Cu_2H, which I will call cupros-acetyle.

I have obtained the oxide, chloride, bromide, iodide, sulphide, cyanide, and sulphite of cupros-acetyle, &c., &c.

Oxide of cupros-acetyle, $(C_4Cu_2H)O$ or $(C_4Cu_2H)_2O_2$, I prepared by precipitating an ammoniacal solution of cuprous chloride by acetylene, and washing the precipitate several times by decantation in large quantities of caustic ammonia until all the chlorine was expelled, after which it was washed in distilled water; or the rapidly washed precipitate may be dissolved in hydrochloric acid, the liquid poured into ammonia, and the washings continued as above. Oxide of cupros-acetyle is a brick-red powder, a little lighter in colour than the body called cuprous acetylide. Hydrochloric acid I found dissolved it, reproducing acetylene and cuprous chloride. Nitric acid oxidised and destroyed it. Sulphurous or sulphuric acid dissolved in its volume of water attacked oxide of cupros-acetyle slowly and with difficulty, even when boiling; and the oxide boiled with a concentrated solution of hydrochlorate of ammonia partly decomposed this salt, causing a slow disengagement of ammonia.

Oxide of cupros-acetylo is formed by making a large excess of ammonia react on all the compounds to be afterwards described. All these compounds, boiled in hydrochloric acid, dissolve and reproduce acetylene.

Chloride of cupros-acetyle I obtained by making acetylene act bubble by bubble on the cuprous chloride dissolved in chloride of potassium. The gas was absorbed, the liquid became orange-yellow colour, then deposited a yellow crystalline precipitate (double chloride of cupros-acetyle and potassium). I washed this precipitate with a saturated solution of chloride of potassium; it soon turned purple, and then dark red. When the solution ceased to contain cuprous chloride, I finished the washing with distilled water. Chloride of cupros-acetyle is a brick-red powder, darker than the oxide, soluble in hydrochloric acid, acetylene being reproduced, &c.

The cuprous chloride dissolved in hydrochlorate of ammonia behaved like cuproso-potassic chloride.

Oxychloride of cupros-acetyle I obtained by making acetylene react on the liquid resulting from the saturation of acid cuprous chloride by a small excess of ammonia. The compound hitherto known as cuprous acetylide is chiefly formed of oxychloride of cupros-acetyle. An excess of ammonia will by degrees eliminate the chlorine it contains.

Bromide of cupros-acetyle was obtained by causing acetylene to react on dissolved cuproso-potassic bromide. Part of the gas was absorbed, and a maroon precipitate produced (double bromide of cupros-acetyle and potassium). This was washed with a saturated solution of bromide of potassium, when the precipitate turned blackish-brown. The expulsion of the excess of cuprous bromide was extremely slow.

Oxybromide of cupros-acetyle is brick red, similar to the oxychloride, and may be obtained either by treating the bromide by ammonia or by making cuproso-potassic bromide with the addition of a little ammonia react on acetylene.

Iodide of cupros-acetyle is a beautiful vermilion compound, resembling biniodide of mercury, from which it is, however, distinguished by its insolubility in iodide of potassium. I prepared it by means of acetylene and solution of cuproso-potassic iodide. It offered more resistance than the preceding bodies to the action of ammonia, but ended in being decomposed.

An oxyiodide of cupros-acetyle may also be prepared. The formation of the iodide was preceded by that of an orange-yellow coloured double iodide of cupros-acetyle and potassium.

Cuproso-potassic cyanide in solution, pure or with the addition of ammonia, neither absorbed much acetylene nor was precipitated from it. But a brown-yellow oxycyanide of cupros-acetyle was obtained by the action of acetylene on cuprous cyanide dissolved in ammonia.

Sulphite of cupros-acetyle is brick red. It was prepared by means of cuprous double sulphite and ammonia, with a little ammonia added.

Sulphide of cupros-acetyle I obtained by shaking the oxide with an aqueous solution of sulphuretted hydrogen, kept considerably in excess. The oxide soon turned black, and a certain quantity of acetylene was set at

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* *Les Mondes*, i., 430.

liberty. But a part remained in combination, and could only be separated by the action of boiling hydrochloric acid. The sulphide thus obtained was evidently mixed with cuprous sulphide.

These facts prove that a perfect parallelism exists between the salts of cupros-acetyle and the cuprous salts, properly so called. A similar parallelism has been shown to exist between the derivatives of radical metallic compounds (stannethyl, plumbethyl, mercurethyl, &c.) and the simple metals they contain. A like parallelism will be found in the combinations of the argentic radical.

II.—The argentic combinations of acetylene are derived from a radical, C_4Ag_2H, which I call argent-acetyle.

Oxide of argent-acetyle, $(C_4Ag_2H)O$, is the precipitate formed by passing acetylene through ammoniacal nitrate of silver and washing with caustic ammonia.

I obtained chloride of argent-acetyle, $(C_4Ag_2H)Cl$, by means of chloride of silver dissolved in a slight excess of ammonia. This is a white precipitate analogous to chloride of silver, but insoluble in ammonia. Boiling hydrochloric acid disengages acetylene from it—a reaction which it also exercises on all the following compounds. Boiling nitric acid transforms the chloride of argent-acetyle into chloride of silver, soluble in ammonia. At the same time it dissolves a quantity of silver equal to that contained in the regenerated chloride of silver.

Sulphate of argent-acetyle I obtained by means of slightly ammoniacal sulphate of silver. It is white, cheesy, &c. Boiling nitric acid regenerates the sulphuric acid.

Phosphate of argent-acetyle is dark yellow coloured, alterable by light. Nitric acid regenerates the phosphoric acid.

I have also prepared combinations of acetylene with protoxides of gold and chromium, and combinations derived from acetylene and alkaline metals, &c., &c.

The compounds I have described may be compared with the combinations obtained by the action of ammonia on certain oxides and metallic salts, such as the platinum bases of MM. Magnus, Reiset, Gros, &c., the bases of palladium, ammoniacal oxide of gold, and analogous amidides, M. Millon's ammoniaco-mercuric base, M. Frémy's ammoniaco-cobaltic bases—all bodies in which a part of the hydrogen of hydride of nitrogen is replaced by a metal. The same substitution takes place in the molecule of acetylene. The following formulæ show the analogies between ammonia and acetylene and between oxide of ammonium and the oxides of cupros-acetyle and argent-acetyle:—

Ammonia, NH_3.	Oxide of ammonium, $(NH_4)O$.
Acetylene, C_4H_2.	
Cupros-acetylene, C_4Cu_2H.	Oxide of cupros-acetyle, $(C_4Cu_2H)O$.
Argent-acetylene, C_4Ag_2H.	Oxide of argent-acetyle, $(C_4Ag_2H)O$.

In short, the new radicals are in some sort oxide of ammonium, being constituted immediately by the union of a hydride of carbon and the elements of water with simultaneous metallic substitution.

They moreover present the first examples of radical metallic compounds derived from silver and copper. I believe their number will soon be increased by the introduction of various metals in the place of hydrogen in several other carbides of hydrogen. For instance, allylene likewise precipitates ammoniacal salts of silver and copper. I have observed that this same gas is abundantly absorbed by cuprous chloride, dissolved in chloride of potassium, with the slow formation of a white precipitate, of crystalline appearance. The cuprous iodide dissolved in iodide of potassium also occasions the formation of a special compound. Here probably are some combinations analogous to those derived from acetylene. I have even obtained a chloride $(C_6HAg_2Ag)Cl$, &c. To this subject I shall return.

If we compare the new radicals with the organic alkalies and the metallic radicals already known, it will readily be seen that they constitute a new general class of radicals, essentially distinct from the old ones as well by their generation as by their constitution.

In fact, organic alkalies are derived from hydride of nitrogen—that is to say, ammonia, by the substitution of hydro-carburetted radicals for hydrogen.

Ammonia, NH_3. Triethylamine $= (C_4H_5)_3N$.

The metallic radicals hitherto known are derived, according to their origin and reactions, from metallic hydrides by the substitution of carburetted radicals for hydrogen:—

Tellurethyle	$(C_4H_8)Te_2$	derived from	HTe_2.
Stibmethyle	$(C_4H_3)_3Sb$	,, ,,	H_3Sb.
Phosphorethyle	$(C_4H_5)_2P$	,, ,,	H_2P.
Cacodyle	$(C_2H_3)_2As$	,, ,,	H_2As.

The new radicals, on the contrary, are generated, so to speak, inversely, for they are derived from a hydride of carbon by the substitution of a metal for hydrogen:—

$(C_4Cu_2H)_2$	Cupros-acetyle.
$(C_4AgH)_2$	Argent-acetyle.
$(C_4H_3)_2$	Acetyle.

Description of the English Method of Assaying Copper by the Dry Way, by M. L. MOISSENET.*

(Continued from page 210.)

II. *Calcining.*

The calcination of the regulus is one of the most important operations; it ought to be quite complete.

III. *Coarse Copper.*

To the calcined regulus is added—nitre ¼ ladle, borax ¼ ladle, charcoal ⅛ ladle, dry salt 1 ladle. These quantities remain the same, whatever mineral may be assayed,—tartar 2 ladles. Case of medium richness. Covering of moist salt, 2 ladles.

The nitre is designed to burn the sulphur which may have escaped the calcining, and to ensure the passage of the easily oxidisable metals, especially of iron, into the slag in the state of oxides. It is besides in too small proportion to act upon the copper, especially in presence of reducers whose effect is certainly later than the deflagration of the nitre.

The borax plays simply the part of a flux.

The dry salt has for its object to give fluidity to the slag. Unfortunately, if the addition of the salt attains this object, it is to determine from this operation a sensible loss of copper by carrying it away with the saline vapours. I shall insist upon this point in describing the washing.

The charcoal and the tartar are especially the important reagents in the fusion. The tartar, at the same time that it is one of the most energetic reducers, is also a flux and a desulphuriser. Its use is, then, perfectly justified here, only the proportion of tartar added ought to be regulated according to the quantity of copper which the *weight* and *aspect* of the regulus permit the experienced assayer to estimate sufficiently close; an excess of tartar would reduce the foreign metals, and produce in consequence a very impure coarse copper.

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* *Annales des Mines*, vol. xiii., p. 183, 1858.

When the fusion appears complete we throw in a pinch of white flux,* which gives fluidity to the slag, and determines by its partial decomposition, from which a disengagement of carbonic oxide results, a stirring up of the materials. These two effects facilitate the collection of the metallic button. The carbonate of potash begins also without doubt from this operation to refine the metal a little by attacking the iron, zinc, and tin already reduced. M. Berthier ("Essai par la Voie Sèche," vol. i., p. 393) points out this reaction:—"A part of the carbonic acid which it contains being decomposed and changed into carbonic oxide, a compound is formed consisting of alkali, carbonic acid, and metallic oxide, &c."

Lead, copper, and antimony are not attacked.

IV. *Washings.*

In the operation of washing we put into the crucible at the same time as the coarse copper the following fluxes:—White flux, 1 ladle; dry salt, 2 ladles.

It is evident that the white flux is here employed as an oxidiser of the foreign metals and with a view of the clearest application of the above-mentioned reaction.

As for the salt, it is both useful and injurious. If it were only used with the view of augmenting the fluid mass so as to preserve the metal from contact of air, &c., it would be advantageously replaced by an excess of white flux; but it can form with the arsenic and antimony which the copper has retained in the form of arseniuret and antimoniuret, volatile chlorides. Common salt is, then, to be regarded as one of the principal agents of purification put in operation by the English method. On the other hand, the loss of copper which arises from the carrying off of this metal by the vapours of common salt cannot be doubted. M. Berthier has found that by heating equal weights of copper and salt until the complete volatilisation of this last, 3 per cent. of the metal is carried off.

In the event of the coarse copper appearing too impure, we take care to add a little nitre. According to the appearance of the button we recommence the washing or not.

V. *Testing, Refining.*

The button of metal is flattened on an anvil. We thus recognise tin by the hardness and antimony by the brittleness of the alloy. The button is then put alone in the crucible. When it presents a proper appearance —that is, when the edges assume a bright colour, the centre, which the assayer calls the eye, being dark—we hasten to put into the crucible the fluxes, which are the same as for washing, only taken in rather smaller quantity.

In general, when we have operated well the button obtained is of a fine colour, and is regarded as pure; if we have passed the eye, it is covered with a layer of red oxide; if, on the contrary, we have put in the fluxes too soon, the button is dull.

It is easy to give an account of the reactions which take place during the refining, and which differ a little from those of the washing.

In heating the button alone in the air in the crucible, it is intended to submit it to an oxidation, which ought to act sufficiently on all the foreign metals more oxidisable than copper without acting too much on this last. The proper point is indicated by the appearance of the eye; the projection of the fluxes puts an end to the atmospheric oxidation and determines the scorification of the oxides which expel part of the carbonic acid of the carbonate of potash, for which they substitute themselves, and give rise to triple compounds of metallic oxides, alkali, and carbonic acid.

The oxides of lead, tin, iron, and zinc comport themselves thus. When we have passed the eye, there has been a considerable formation of oxide, which leaves the button reddened, as I have indicated. At the same time the slag is strongly coloured red or green. If, on the contrary, the fluxes have been thrown in in too great haste, the oxidation has been insufficient, and then the refining just falls back upon the preceding operation of washing—an operation less efficacious and even without result in the case of lead and antimony.

As for the physical phenomenon of the eye, perhaps it corresponds to the very short instant when the oxides, less dense than the copper are concentrated at the top of the button, and there make a dark spot before attaining a temperature sufficiently elevated to acquire the brightness of the metal itself.

I shall add that the minerals of Cornwall, generally more impure than foreign minerals, require a notably longer time for the appearance of the eye.

Extra Accidental Washing.—Most often the refining gives a definite product put aside to be weighed with the prill extracted from the slag; let the button be clear, burnt, or dull. Even if the metal appeared too impure we would not recommence the refining, but would have recourse to an extra washing by putting at once into the usual crucible, besides the button and the usual fluxes, the slag from the refining.

VI. *Slags for Prill.*

All the slag from the fusion for coarse copper inclusively having been preserved, we fuse them altogether with

Tartar . . .	1 ladle	Simple reducing mixture.
Charcoal . .	traces	

We obtain a small granule variable with the circumstances of the different operations which have allowed more or less copper to pass into the slag. If the prill is not very small, and its appearance indicates a metal not sufficiently pure, we submit it to one or two washings, as above.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 3.

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 donations to the library announced. Mr. Robert Warington, Jun., and Mr. William Chrispin were formally admitted Fellows of the Society, and the ballot was taken for the admission of the foreign members proposed by the Council at the last meeting, which resulted in the election of Professor Rammelsberg, Dr. Walcott Gibbs, and Professor Weltzien. Mr. Marshall Hall, barrister-at-law, Halstead, Wilts; Mr. John Robinson, Oxford; and Mr. J. James Lundy, Leith, were duly elected Fellows of the Society; and the names of the following candidates were read for the first time:—Mr. William Arnot, Bachelor Street, Liverpool; Mr. Edward H. Davis, Harley Road, Brompton; Mr. William Field Flowers, B.A., Guy's Hospital; Mr. Charles Wilson, Bridgwater Smelting Company, St. Helens; and Mr. C. R. A. Wright, B.Sc., Runcorn, Cheshire.

Dr. J. H. Gladstone gave an abstract of a paper entitled "*Notes on Pyrophosphodiamic Acid,*" which, arranged

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* This white flux is prepared in the laboratory by mixing in a cast iron mortar, tartar 3 volumes, nitre 2 volumes, salt a little, then determining the combustion by the introduction of a red-hot iron rod, which is turned round until the matter ceases to deflagrate.

under the three following heads — characteristic test, methods of preparation, and compounds, constituted a kind of supplement to the joint researches of the late Mr. Holmes and himself, already communicated to the Society. The test relied upon is the production of the white ferric pyrophosphamate in strongly acid solutions. Regarding the modes of preparation the author described no less than eleven different processes, some of which have been previously referred to as methods of forming the pyrophosdiamic acid. The compounds of this acid are generally bibasic, and, after stating the respective formulæ of the ammonium and silver salts, Dr. Gladstone said that he had satisfied himself regarding the existence of the corresponding ether, which was formed by decomposing the chlorophosphuret of nitrogen, either by ether or alcohol. The body in question, termed deutazophosphoric or pyrophosphodiamic ether, was represented by the formula

$$P_2N_2H_4(C_2H_5)_2O_5.$$

The acid itself has never yet been obtained in a crystallised state.

Mr. Robert Warington, jun., then gave an account of his "*Researches on the Phosphates of Calcium, and upon the Solubility of Tricalcic Phosphate.*" The first part of the author's communication referred to the preparation, composition, and properties of several varieties of phosphate of calcium, and the following were particularly specified—viz., Bödeker's salt (dicalcic-hydro phosphate, with four external atoms of water), the octo-calcic triphosphate of Berzelius, and the neutral tricalcic phosphate, as formed by the addition of chloride of calcium to a mixture of ammonia and the ordinary phosphate of sodium. Under the second head, the author determined the degree of solubility of these phosphates, especially the latter, in pure water and in carbonic-acid water, both with and without sal ammoniac, using in these experiments a very ingeniously contrived apparatus for the disengagement of carbonic acid gas and the acetate of uranium, as a means of precipitating the phosphoric acid from dilute solutions. The tricalcic phosphate required nearly 90,000 parts of boiled water for solution; but its solubility was greatly increased by the presence of chloride of ammonium—thus in a 10 per cent. solution, one part of the earthy salt was soluble in 4325 parts. In saturated carbonic water at 10° C., the tricalcic phosphate could be dissolved in 1789 parts, or even less in the presence of a small quantity of sal ammoniac. Such solutions, when exposed to the air, allowed the deposition of the phosphate in different forms, the liquid finally exhibiting an acid reaction. The author confirmed the statement of Bischoff regarding the degree of solubility in carbonic acid water of the pure calcic carbonate (viz., 1000 parts), and found no perceptible alteration in consequence of the presence of ammoniacal salts. From such solutions the calcic carbonate was again thrown down on addition of the carbonate, or even the bicarbonate, of sodium. When a mixture of the triphosphate and carbonate of calcium was acted upon by carbonic acid water, only the latter was dissolved. The author exhibited a specimen of the tricalcic phosphate which had been crystallised from acetic acid solution, and said that he had failed in producing a calcium salt corresponding to the ammonio-magnesium phosphate.

The President moved a vote of thanks to the respective authors, and proposed an early adjournment for the purpose of affording members an opportunity of hearing a paper of Sir Benjamin Brodie's read at the meeting of the Royal Society.

The papers on hand were announced by the Secretary—"*On the Action of Acids upon Naphthylamine,*" by Mr. E. T. Chapman; "*On the Oxidation Products of Propione obtained from Carbonic Oxide and Sodium Ethyl,*" by Professor J. A. Wanklyn; and by the same author, "*On the Preparation of the Ethylamine;*" "*On the Nitroprussides: their Manufacture and Composition,*" by Mr. Hadow. There were papers also expected from Dr. Debus, Messrs. Calvert and Johnson, and Mr. Gibson. On June 7, Mr. A. Vernon Harcourt will deliver a lecture "*On the Rate of Chemical Change.*"

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, *by* Dr. Percy, F.R.S.

Lecture No. IV.

(Continued from page 215.)

Since last year we set to work and made a few experiments upon this subject, but I am sorry to say that, so far, they are all entirely negative; but still negative results are important to those who are prosecuting inquiries in this direction, as the knowledge of them may save them much useless trouble. These experiments were made by my friend on my right, Mr. Beck, in the laboratory above. Now, one would think that by taking carbonate of magnesia dissolved in water by the aid of carbonic acid, and precipitating the magnesia by lime water, we should very naturally get dolomite. Carbonate of magnesia is dissolved by excess of carbonic acid; then we add caustic lime: that lime will lay hold of the excess of carbonic acid, and become converted into carbonate of lime, and the carbonate of magnesia will no longer be held in solution. We shall thus get a precipitation of both carbonate of lime and carbonate of magnesia under the most favourable circumstances, one would suppose, for forming dolomite; but no such result was obtained. I confess I cannot conceive any more favourable conditions than these.

The next experiment was to immerse Wollastonite, a very interesting silicate of lime, in a solution of bicarbonate of magnesia during several weeks, but not an atom of lime passed into solution, as one might have expected. There is a little effervescence of the Wollastonite, it is true, but there is no evidence of the lime having replaced the magnesia in solution.

Then, again, crystallised carbonate of lime was boiled for many hours in a solution of chloride of magnesium. No lime passed into that solution. Then the same experiment was made, and the mixture left through a whole year; yet no change took place during that time. The carbonate of lime underwent no change whatever.

Carbonate of lime was left for a whole year in a solution of carbonate of magnesia in water, the solution being effected by the aid of carbonic acid; but there was no formation of dolomite at all.

Some crystallised bitter spar, that is, a dolomite containing carbonate of iron, was acted upon by water containing carbonic acid, and the matters were dissolved out in the following ratios per cent.:—

Carbonate of protoxide of iron. . .	7·53
Carbonate of lime	58·97
Carbonate of magnesia	33·5

10,000 parts by weight of water dissolved 1·4837 parts of this dolomite, the matter dissolved having the ratio just given.

Then carbonate of magnesia and carbonate of lime were mechanically mixed in the ratio in which they exist in dolomite. In round numbers, 33 grains were dissolved out in 10,000 of water—by the action of carbonic acid, of course. You will please to note this fact, that this is a mechanical mixture, not a chemical compound of the two carbonates. The ratio of the carbonate of magnesia and carbonate of lime dissolved was 86·16 per cent. to 13·84 per cent., showing in this case how much larger quantity of carbonate of magnesia would dissolve, relatively, than carbonate of lime.

We have now to consider the theory put forth and advocated by Forchammer, a very able chemical geologist. In the first place, he designates all limestone containing more than 14 per cent. of carbonate of magnesia, dolomite.

According to him, dolomite may be formed by the action of springs rising through a coralline limestone; and of this supposed action he gives an illustration founded on observation in Denmark. He says a solution of carbonate of lime in contact with sea water deposited dolomite, and he supposes that the reaction in question occurs between the carbonate of lime dissolved in these springs of water, and the magnesian salt existing in the sea water. According to actual experiments made by him, water containing carbonate of lime in admixture, not in solution, with hot sea water, produces a solution containing not less than 12·23 per cent. of carbonate of magnesia. Here, again, comes the aid of heat, but that is easily explained. There is not so much difficulty in this case when we call to our aid these hot thermal springs. The proportion of carbonate of magnesia in the precipitate increases with the temperature, and he supposes that at a sufficiently high temperature a dolomite might be formed as rich in magnesia as that which exists in nature. If the water contains carbonate of soda as well as carbonate of lime, then the precipitate is much richer in carbonate of magnesia. By boiling certain mineral waters with sea water, Forchammer obtained precipitates containing 5·12 per cent. of carbonate of magnesia and 14·45 per cent. of carbonate of lime. Well, this is all very well. Supposing we get the conditions and the temperature required by the observations of Forchammer, there is no difficulty in explaining how dolomite may be produced.

The next theory to which I shall advert, and advert briefly, is one which excited great attention at the time, and was generally maintained. I allude to that of Von Buch. He had a very able advocate, too, of this theory in Carston, the well-known mineralogist, who examined the subject thoroughly. In fact, it was received for a long time as the most satisfactory explanation of the formation of dolomite, and it still has its supporters. It was founded entirely on certain geological considerations—on the position of these dolomitic rocks in reference to certain eruptic rocks containing magnesia. The theory supposes that the magnesia has been introduced into limestone by means of magnesian vapour. You must suppose, first of all, limestone, and then certain eruptic, igneous rocks below that limestone. It is supposed that accompanying the eruption magnesia was actually evolved in a state of vapour, and that it came in contact with the limestone, permeated enormous masses of it, and succeeded eventually in converting the whole of it into dolomite. Well, this is a magnificent theory; but in answer it should be stated that, as far as we know, there is not a shadow of proof that oxide of magnesium, or magnesia, is capable of being thus vapourised. It is one of the most fixed bodies we are acquainted with. We saw, it is true, on the last occasion, some magnesium smoke, but that was not magnesian vapour. It was merely magnesia suspended in the air, which is a totally different different thing from vapourisation. Well, then, if you accept this theory, you must require a very strong hypothesis, which is entirely opposed to all that we know chemically of magnesia. But this will not do alone. Suppose we admit, for the sake of argument, that magnesia can be thus vapourised and brought into contact with carbonate of lime, where is the carbonic acid to come from? The magnesia is not supposed to be vapourised in the form of carbonate of magnesia, which is decomposed at a moderate temperature, and loses its carbonic acid very readily. Where, then, is the carbonic acid to come from? This is a point which has never been explained. I must say that of all the theories in connexion with this subject this, as far as it appears to me, seems one of the least tenable. It is not surprising that under these circumstances Von Buch should be led to propound a theory, especially when he felt himself at liberty to make this outrageous assumption. There are certain geological considerations, undoubtedly, which give a colour to this theory. Now, one of its supporters, who has written a very good book on the composition of rocks, still maintains that in certain rocks which he has examined in Tuscany there is no other possible explanation. Men have said in other cases that such and such an explanation was the only possible one, but others have been given afterwards showing that the former one was entirely wrong. We should, therefore, be very cautious how we commit ourselves to theories of the possibilities of nature. At all events, we should reject this theory until we get some positive proof that the great fact which he requires is capable of demonstration—namely, the vaporisation of magnesia. It is certain that we can attain much higher temperatures in our operations than nature has generally employed. I do not speak of every case. We can melt platinum by the hundredweight, and also wrought iron, with the greatest ease; but all our experiments have shown that magnesia is one of the most fixed bodies in nature. Many mistakes prevail in the geological mind as to the temperature required in the fusion of rocks. No doubt an enormous time has been required to effect the fusion of rocks, but it does not follow that a high temperature has maintained. We can take pieces of igneous rocks and melt them in our furnaces at moderate heats; but when we come to deal with hundreds and thousands of tons, and perhaps millions of cubic yards, it requires a long time for the heat to permeate throughout the whole mass. This is a question of *quantity* of heat, and does not necessarily involve a high *intensity*. A long continued operation at moderate temperatures may effect the grand results which we see in nature in the production, at all events, of igneous rocks.

The next theory is one put forth, I think, by Grandjean, who observed in the dolomite and brown coal measures of the Lower Larne district that wherever fissures through which water could have percolated existed in the slightly inclined limestone strata that there most dolomite has been produced, and that the strata most exposed to this percolating action are the most altered. In the lower beds of limestone there has been but little, if any, formation of dolomite.

There are certain pseudomorphs which are calculated to throw great light upon the formation of dolomite. I allude especially to the pseudomorphs of dolomite after calcspar. Now, here is a positive proof of the replacement of crystals of calcspar by carbonate of lime and carbonate of magnesia. There is a very fine specimen here from the Forest of Dean of crystals having the form belonging to calcspar, but consisting of carbonate of lime and carbonate of magnesia in the ratio in which they exist in dolomite. In fact, these crystals of carbonate of lime have been gradually converted into dolomite, and this could only have taken place by the operation of some solvent containing a magnesian salt—carbonate of magnesia, possibly, dissolved in carbonic acid and water.

According to Bischoff, as I said a short time ago, dolomite is always the result of secondary action, and he says it is never deposited from water, as proved by the analysis of deposits of springs containing magnesia. There is one thermal spring specially mentioned by Dr. Daubeny which deposits carbonate of magnesia, yet there is no proof, as far as I know, of the production of dolomite by such deposition. The deposit from the Carlsbad water, carbonate of lime, contains no magnesia, or no magnesia exists in the water to any considerable extent. Mr. Sterry Hunt found an artificial water containing chlorides of calcium and magnesium, with bicarbonates of these bases, to deposit by spontaneous evaporation 0·805 of carbonate of lime without any carbonate of magnesia. This exactly confirms what we observe in nature in this great thermal spring; but, contrary to what we should have expected, on boiling the same solution the deposit consisted of 0·666 of carbonate of lime and 0·173 of carbonate of magnesia. Then it may be asked why, in the Carlsbad water, we do not find carbonate of magnesia, which has been asserted to be present.

Now, ladies and gentlemen, as far as I can make out, these are all the theories which have been put forth to explain the formation of this remarkable rock. You see that a great deal more remains to be done, and that the chemistry of the subject is by no means exhausted. I do not know any department of geological science more worthy the attention of the chemical investigator than this *questio vexata* of the formation of dolomite.

Now let me give a short *resumé* of the investigations I have laid before you, the only direct experiment in which dolomite appears to have been satisfactorily produced is that of Sandberger and Marignac, who formed it by heating carbonate of lime and chloride of magnesium in a closed glass tube at 200° centigrade; but I observe that nothing like proof is advanced by them in favour even of the probable occurrence of these conditions in nature—at least over a large area, and at the period of the formation of dolomite. Magnesia has a strong tendency to form double salts, many of which are very well known and may be easily made; but all the experiments hitherto conducted with a view to the formation of dolomite artificially in the laboratory of the chemist, as far as I know, have been the reverse of satisfactory. With regard to the question whether dolomite has resulted from chemical action on sedimentary beds, it appears certain that in many cases it must have been so produced.

I think of that there can be no doubt whatever. The evidence rests upon geological observations which are, as far as I know, perfectly conclusive; and although several chemical hypotheses have been put forth as to the *modus operandi*, yet, I repeat, they are at present unsupported by direct chemical proof. That limestone has in many cases been changed into dolomite there be no doubt. We can trace, in the same continuous bed, limestone at one end, passing into dolomite at the other, with the gradual disappearance of the fossils as we approach the dolomite. The occurrence of fossils in the dolomite is excessively rare. One of the most important and decisive observations respecting this change is that of Dana with regard to the greater proportion of magnesia existing in ancient corals than in fresh corals. A clue is thus afforded to us to, at all events, one method by which carbonate of lime may, in the lapse of time, become changed into dolomite. That is, as I said, by the action of magnesian salts, or sea-water, on carbonate of lime at a low temperature. There is no necessity for that violent hypothesis of a high temperature which has been proposed to account for the production of magnesian limestone. Then, again, the pseudomorphs of dolomite after calcspar, furnish evidence of the transformation of carbonate of lime into dolomite in a similar way. It may be said that the crystals of calcspar may have been removed, and left moulds in which carbonate of lime, combined with carbonate of magnesia, may have been infiltrated, but there is no evidence of such an action having occurred. Again, the more or less complete obliteration of fossils in the limestone beds, in proportion as the beds are converted into dolomite, is a proof that secondary action has taken place on previously deposited beds, whereby dolomite has been formed. With regard to the magnesium vapour theory, though, perhaps, it may be very sublime, it is certainly one of the wildest that could be propounded. There is no evidence whatever to show even that magnesia can be volatilised. It remains perfectly fixed at the highest temperatures we can produce. The magnesian vapour theory, therefore, cannot be received.

With these remarks I will dismiss the subject of dolomite. In the next lecture we shall commence the study of the silicates, a very important class of compounds, which furnish us with many conclusions with regard to the formation of rocks, and other geological phenomena.

ACADEMY OF SCIENCES.

April 30.

M. E. BECQUEREL presented a memoir "*On the Thermo-electric Powers of Bodies and on Thermo-electric Piles.*" In his last memoir, our readers will remember, the author stated that bars of sulphide of copper obtained by fusion were very differently endowed with electro-motive energy. He now publishes his discovery that all these bars may be made to exhibit an equal power by simply subjecting them after fusion to a dull red heat for several hours. The second part of the memoir is devoted to an account of the electro-motive force of various alloys, in which he shows that an alloy of equal equivalents of cadmium and antimony may advantageously replace tellurium in the construction of piles for the study of calorific radiation.

M. Des Cloizeaux communicated some "*New Researches on the Optical Properties of Natural and Artificial Crystals, and on the Variations these Properties undergo under the Influence of Heat.*" We content ourselves with giving the title of the paper, which will, however, have much interest for the students of crystallography.

M. Sidot presented a note "*On the Crystallisation of some Metallic Sulphides.*" Sulphides moderately treated are transformed into oxides. Oxides carried to a high temperature in the vapour of sulphur reproduce sulphides. Oxide of zinc under these circumstances produces a crystalline mass of sulphide—hexagonal blende, in fact.

M. Friedel added a description of the crystals obtained by M. Sidot.

M. Ed. Moride presented a note "*On the Carbonisation of Seaweeds and on the Extraction of Bromine and Iodine.*" His process is as follows:—He dries the weeds and carbonises them on the spot in a portable furnace. 100 parts of wet weed, he states, gives 20 parts of dry, which give 5 parts of carbonaceous residue yielding 3 parts of ash. After lixiviating the carbonaceous residue, he separates the sulphates and chlorides, then adds to the concentrated mother liquor a hypochlorite or hyponitric acid, and removes the iodine by means of benzol. The bromine is subsequently separated by treating the liquors with sulphuric acid and oxide of manganese and distilling, or separated in a liquid state from very concentrated liquors. The exhausted carbonaceous residue he mixes with fertilising agents, and makes a manure. The author afterwards describes a process for estimating iodine by means of hyposulphite of soda, which presents no advantages that we can see.

NOTICES OF BOOKS.

The Toxicologist's Guide: a New Manual on Poisons, giving the Best Methods to be Pursued for their Detection—Post-mortem or Otherwise. By JOHN HORSLEY, F.C.S. London: Longmans, Green, and Co. 1866.

IT is no great blame to say that Mr. Horsley has not succeeded in performing an impossible task. It could hardly be expected that an attempt to compress the chemistry of poisons into a small book of seventy pages could be very successful; and yet it would be unfair to the author not to say that he has produced a book which may prove of much value to medical men who have paid no great attention to chemistry, and who, therefore, we feel bound to add, had much better leave the examination of suspected matters to abler hands.

Mr. Horsley is known to have given much attention to the detection of poisons. Our own pages have contained some useful communications from him on the subject. The numerous original tests, therefore, given in this work may be perfectly relied on for their indications.

Mr. Horsley has made a praiseworthy attempt at giving what is greatly wanted—namely, a general scheme for the examination of the contents of the stomach and various organs for all known poisons. The examination of the contents of the stomach is described as the examination for "unabsorbed poison." The scheme, so far as it relates to the examination of mineral poisons, we can approve of; but the examination for vegetable alkaloids is deficient in one important particular. Mr. Horsley directs the removal of animal matter by carbonisation with sulphuric acid and heat "where it is admissible," but he does not tell his readers what alkaloids are liable to be destroyed by this mode of treatment, and thus leaves the way open to a serious error.

We may say, too, that the examination of the organs for absorbed metallic poisons is very complete. It is in general only the part relating to organic poisons that we consider deficient.

The section on poisoning by phosphorus, however, is far from satisfactory. Considering that but very small quantities are likely to be found, the method proposed by Mitscherlich is most easy and reliable, and should have been given. Mr. Horsley concludes his account of the tests for phosphoric acid with a note which will, we fear, prove a stumbling-block to his readers:—"As phosphorus in some form or another enters into the composition of the human body, *allowance* must be made in calculating the amount of *phosphoric acid* obtained in an analysis."

After all, however, we may add that Mr. Horsley's little book may prove useful to readers, and save them the trouble of going to bigger works, in which they may not find much better instruction.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

800. O. W. Jeyes, Stockton-on-Tees, Durham, "An improvement in the manufacture of ice to fit it for making effervescing drinks, &c."—Petition recorded March 17, 1866.

976. E. Ellison, Manchester, "An improved method or means to be employed for preventing and curing disease in cattle."—April 5, 1866.

1009. B. F. Weatherdon, Chancery Lane, "Improvements in treating Lucern root for paper-making and weaving purposes, as well as in abstracting soda, salts, and colouring matters therefrom."—A communication from J. P. Canunade, Rue d'Illiers, Orleans, France.—April 9, 1866.

1041. J. J. Bodmer, Newport, Monmouthshire, "Improvements in the treatment of slag or cinder from blast furnaces, copper smelting and other furnaces, and in apparatus employed therein, which improvements are also applicable to certain processes in the manufacture of iron and steel."—April 12, 1866.

1049. A. Swan, Kircaldy, Fifeshire, "Improvements in apparatus for evaporating or recovering lees."—April 13, 1866.

1063. R. B. Legge, Kilburn Square, Middlesex, "A new or improved mode of printing patterns on dyed silks and all kinds of dyed goods."—A communication from P. Courmons, Rue St. Chatrine, Malines, Belgium.—April 14, 1866.

1078. C. E. 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.

1080. C. J. B. King, M.D., Stone, Staffordshire, "A new unfermented beverage."—April 17, 1866.

1092. C. M. Barker, Kennington Park Road, Surrey, "Improvements in apparatus used in distilling fatty and other matters."

1093. C. A. Girard, Rue des Ecoles, Paris, and G. de Laire, Rue de Sèvres, Paris, "Improvements in the preparation of diphenylamine and analogous substances."—April 19, 1866.

NOTICES TO PROCEED.

3262. W. E. Dobson, Nottingham, "The conversion of the refuse of starch and gumaline into useful gumaline."—Petition recorded December 18, 1865.

3312. D. McGrath, Kilberry, Ireland, "Improvements in the purification, refining, and treatment of the volatile and fixed oils produced from the destructive distillation of peat or turf."

3318. J. A. Cooper, Trowbridge, Wilts, "Improvements in the manufacture of yarns, string, and paper, and in the preparation of dyes, and in dyeing fabrics by the application of vegetable substances not hitherto used for such purposes."—December 22, 1865.

3345. J. Young, Limefield, Mid Lothian, N.B., "Improvements in treating hydrocarbon oils."—December 27, 1865.

953. E. C. Prentice, Stowmarket, Suffolk, "Improvements in preparing and treating gun cotton."—April 5, 1866.

CORRESPONDENCE.

Dr. Muspratt's Chalybeate at Harrogate.

To the Editor of the Chemical News.

Sir,—It is not a rule with me to take any notice of anonymous communications, but I am rather anxious to know who wrote the letter you published in The Chemical News of last Friday, and signed "A. A. H." He says he is anxious "to analyse the water as soon as possible, &c." The water having been so recently analysed by Drs. Herapath, Miller, and myself (you kindly published my discovery of the presence of protochloride of iron in the spring last August), and the results agree so very closely, I do not think that a fourth analysis is at all required, (unless it be by a Dumas, or a Liebig). A sample of the water a fortnight ago gave exactly the same composition as one collected nine months since, so that I do not look for any more "remarkable changes."

Dr. George Kennion, the eminent physician in Harrogate, speaks in the highest terms of the Spa, and in a recent letter remarks—"It will be indelibly associated with your name, and the valuable discovery you have made must give to this place (Harrogate) a new and greater celebrity than it has ever enjoyed."

Your anonymous correspondent writes—"I believe many of your readers would be glad to know the exact methods of analysis used by a gentleman who is so universally known." When the water was evaporated and filtered the filtrate I found to contain a very large quantity of iron (the carbonic acid in combination with the protoxide of iron as $FeOCO_2$, of course, was eliminated during the ebullition, and the FeO precipitated as Fe_2O_3), and as the water only contained besides the carbonate of iron, chlorides of iron, barium, calcium, magnesium, sodium, potassium, lithium (trace), I need not, I think, take upspace in your ably-edited journal to tell your chemical readers "the exact methods" (these are known, or ought to be, to every analyst) employed.

I am, &c.,

Sheridan Muspratt, M.D., &c.,
Professor of Chemistry.

May 7, 1866.

To the Editor of the Chemical News.

Sir,—It is really almost past endurance to hear such fulsome praise bestowed on Dr. Muspratt for his analysis of the ferrous chloride spring. The discovery of ferrous chloride must be the inevitable result of an attempt at its analysis by the veriest beginner in analysis.

1. Taste shows iron abundant enough—sulphocyanide, —no colour; hence no ferric salt, all ferrous, confirm with red prussiate thick paste of prussian blue. What ferrous salt is it? Look for SO_3; behold, there is no trace, but Cl in great abundance. Inference inevitable to a child: the iron salt is ferrous chloride, pure. The water came into my hands, and my query was,—Why is there no sulphuric acid? Perhaps the spring passes through a vein of carbonate of baryta. I examined, and found chloride of barium in the water; hence the freedom from sulphuric acid. Perhaps this may be as great a discovery as that of the protochloride of iron, which is not flattering myself much; still, I am content to remain in humble obscurity, and sign myself Yours, &c., E. A. H.

New Electrical Machine.—The Electricity of Wood.

The communication from Mr. Jerningham which we printed in our number for March 23, was, we are sorry to find, not intended for immediate publication. The writer however, now kindly sends us further information on the subject, which is of great value. We have only to add that a machine on this principle was exhibited at the last *soirée* of the President of the Royal Society, and attracted much attention.

To the Editor of the Chemical News.

Sir,—The only additional information which I am able at present to supply on the subject of the electricity of wood has reference to the different capacity of different kinds of wood of being converted into electrics, and here I would caution any one who may feel tempted to repeat the experiment to bear in mind that though it be true that every kind of wood which I have yet examined would appear capable more or less of this conversion, yet that time is a singular and indispensable condition of this transformation, and that wood can no more be rendered "electric" by holding it to the fire for "a minute or two" than toast is dried because it happens to be coloured. It requires "doing," like meat; and I never think of giving less than from one to two hours. And not only does it take some time, but in general a strong heat as well; and as for tulip wood, and perhaps one or two other very hard woods, they obstinately refuse to become electric for whole hours. After three hours no change could be perceived, till at length, between four and five hours, of a temperature just short of actual carbonisation, this variety then gave pretty strong sparks, and retains its power well.

The following are among the specimens of wood which I have as yet examined, though doubtless there may be many more that might with advantage be submitted for trial:—Pine, white deal, mahogany, cedar, English oak, box, English birch, Hungarian ditto, ebony, satin, white holly, pear, rose, tulip, purple wood, and king wood; likewise "pencil cedar," American walnut, English ditto, Japanese oak, common elm (witch elm), partridge wood (heart and sap), birds' eye maple, sycamore, acacia, yew, lime, sweet chesnut, horse chesnut, lignum vitæ (heart and sap), cocoa, black thorn, "Amboyna," fir-tree, lance, American birch, and "raspberry wood," so called from its strong odour resembling raspberries. A specimen of wood, "name not known," but much resembling the Zebra variety, only much denser and heavier, was also heated, and which was the only one that was characterised by its cracking and splitting in all directions. White deal would, perhaps, form the best wood for the purpose, could it only be obtained wide enough, because I find it possible to get sparks from it with amalgam, no doubt on account of its hard smooth surface, which, however, speedily becomes coated with metal, and so cannot vie with ebonite on account of polish. Were it not for this I believe wood would be found equal to it, as under similar circumstances (as when catskin is used) the power of each appears equal.

The pieces of wood I speak of were exposed between wire work secured by wire to the influence of a good fire, at from six inches to a foot's distance from the bars for from one to two hours—during this operation English walnut and mahogany are very apt to ignite—and in this way ten or a dozen pieces may readily be heated at a time, the pieces of wood measuring 8 inches by 4 or = 32, and ⅓ in. thick.

From this mode of operating it will be seen that the "comparisons" must necessarily be rather rough and only approximate, though the pieces were so arranged as to be heated both sides as nearly equally as possible. Of course, had I possessed at the moment required the necessary conveniences, an oil bath would have given more reliable results; but still I consider the comparison sufficiently near the truth to prove useful. I have already dwelt upon the necessity of heating the woods a sufficient time, &c., because such directions are necessary to success, and without them it often comes to pass that in the hands of another statements and results can no more be reconciled in truth than can those of "Geology" and "Religion." But to return to the woods. The first batch were examined after three weeks or more, and the second after one, a mere matter of accident. Of the whole list but a very limited number retained anything like all their pristine vigour. Among these may be mentioned rosewood, satinwood, kingwood, and perhaps cedar and tulipwood, mahogany not doing so well. Oak was the only wood in which the sparks mostly ran along the surface before discharge could take place, as if it contained metals; while ash (English, if not foreign,) had by this time lost all perceptible power, not only of giving sparks, but even of attraction upon the lightest bodies! This applies also to oak, "pencil cedar," horse chesnut, "Amboyna," blackthorn, sycamore, and perhaps lime; while the rest retained their power very well, as sweet chesnut, acacia, fir, white deal, lignum vitæ, &c., &c. Most woods appear to keep their form pretty well this size, and to be but little affected by the heat as regards "warping," with but two or three exceptions, as boxwood, lignum, &c., and one or two others. As for "hornbeam," it was literally doubled up. When I stated that wood presented more powerful appearances than ebonite under similar circumstances, I referred simply to the phenomenon presented by the former when two eighteen inch discs were laid one upon another and then rubbed gently with catskin, hareskin, or rabbitskin a dozen times or so; if the uppermost plate be now raised, and the knuckle presented, the discharge takes place in a single spark of great length and high intensity, while with the ebonite circulars the sparks appear much shorter though in larger quantity.

In conclusion, I may remark I have always observed that the hardest and driest woods—showing no visible trace of moisture—invariably take the longest time and strongest heat; and this circumstance, in connexion with the fact that I have very frequently obtained very unequivocal sparks from such a wood as pine while still strongly steaming before the fire, would seem to warrant the supposition that this curious conversion of wood—by long-continued heat—into an electric, might depend upon something more than the mere and simple abstraction of water.

I am, &c.,

F. E. S. Jerningham.

52, Cambridge Terrace, Hyde Park, April 27, 1866.

Gale's Protected Gunpowder.—Extensive works are being erected at Woolwich for making a rough kind of glass, and grinding it to powder for use in Mr. Gale's process.

MISCELLANEOUS.

EVIDENCE TAKEN BEFORE THE COMMITTEE OF THE HOUSE OF COMMONS APPOINTED TO INQUIRE INTO THE OPERATION OF THE METROPOLITAN GAS ACT OF 1860.

The evidence taken before the Committee above named presents many points of much interest to consumers and chemists, not in the metropolis alone, but wherever gas is made and consumed. We have, therefore, given a short abstract of some of the evidence, leaving out of sight the special local grievances alleged with but too much truth against the working of the Metropolitan Gas Act, and directing attention only to the scientific points brought forward. It is well for every one to know what gas ordinarily is, and what it might be and ought to be.

The first witness examined was Mr. W. S. Jeffrey, of the firm of Howell and James, Regent Street. We shall only give, and very shortly, the evidence as to the effects of impurities in gas. The firm deals in very delicate goods,—silk and gilt wares. They are supplied by the Western Company, who use cannel coal. The witness stated that during the winter months, when much gas is burned, the colour of silk dyed of delicate colours is taken out. With regard to metal goods, he stated that the gas deposits a thin film on the metal, and unless it is removed every day it eats into the metal, so that the articles must always be regilded. This necessitates the use of air-tight cases for such goods. French goods are much more affected than English. The former are attacked in a day or two; the latter may not show the film for a week or two. At Liverpool, where the witness has also an establishment of the same kind as in Regent Street, the same ill effects are not observed. The witness added that he had a private residence at Clapham, where he believed the gas was of worse quality than in Regent Street.

The next witness was Mr. A. Maclure, of the firm of Maclure, Macdougall, and Macgregor, engravers and lithographers, who have establishments in the City of London, in Westminster, and at Glasgow, Liverpool, and Manchester. His evidence was merely to the effect that the gas supplied in London was much inferior to that supplied in Scotland.

Mr. E. D. Johnson, chronometer maker, of Wilmington Square, Clerkenwell, was afterwards examined. His evidence went to show the pernicious effects of the products of the combustion of gas on unlacquered brass work.

Mr. Slater, of the Fore Street Warehouse Company, gave evidence of the damage done to silk and woollen goods, especially when they are placed on shelves high up towards the ceiling.

Mr. Medwin, bootmaker, of Regent Street, gave evidence on the effects of gas combustion products on leather. He had found them produce perfect rottenness in the leather after having been exposed for a period. The witness exhibited boots so acted on to the Committee. The sulphuric acid, he said, could be tasted on applying the tongue to the leather. He gave two inches out of one pair of boots to Dr. Letheby for analysis, and his report was that the two inches contained ten grains of commercial oil of vitriol. He had also seen wood which had been under the action of gas for fifteen years. It was perfectly rotten, and could be picked to pieces with a finger-nail. Brass also was made rotten. A piece calculated to bear a strain of a hundredweight was in time so rotten that it could be squeezed together in the hand. He believed gas exerted a deleterious influence on pictures. The back part of the canvas is made rotten.

General evidence as to the working of the Act of 1860 was also received from the foregoing witnesses, but we pass over this to come to the scientific evidence.

Dr. Letheby was the first scientific witness examined. His evidence was taken at great length, and we give only a condensation, without reference to the order in which the questions were put. One of the first points was the standard of comparison for illuminating power. This, according to the Great Central Act of 1852, was twelve wax candles. In the Metropolitan Act of 1860 it was changed to twelve sperm candles. The same burner was retained—namely, an argand, having fifteen holes furnished with a seven-inch chimney. The reason the candle was changed was because it had been found that a wax candle never kept the same standard of light for two minutes. It required snuffing, and there was always a difficulty in deciding when the candle was burning properly. A sperm candle does not require snuffing. The proportion of the light of sperm to wax is as 16 to 14, or about one-sixth more; but sperm has now become scarce, and is largely adulterated with paraffin and also by wax. Paraffin raises the illuminating power of a candle in the proportion of 22 per cent. over that of sperm, while wax lowers the illuminating power 14 per cent. Different makers also use different sized wicks. The wicks too, vary according to the quality of the cotton. It is then found difficult to obtain a standard candle, and the witness recommended that a standard lamp, such as is used in Paris, should be adopted—viz., a Carcel lamp, burning colza oil; the particulars and measurement of the flame and of the lamp and of its rate of burning being precisely defined, as in Paris.*

The gas burner was then referred to. The Great Central Gas Company's Act particularised an argand burner with 15 holes, and provided with a 7-inch chimney, gas being burnt at the rate of 5 feet an hour. No measurements of the burner were given. The Metropolitan Act of 1860 contained the same standard, and did not describe the burner more particularly. But since the passing of the Act a burner has been introduced differing from that first used. The internal diameter of the new burner is smaller, the supply of air to the flame is thereby diminished, the carbon is therefore kept ignited a longer time, and the light is increased 11 per cent. The practical result of this is that a gas giving 12 candles light with the old burner, gives 14 candles with the new. According to the Act of Parliament the gas companies have the power of providing the burners at the testing places, and if the burner fulfils the conditions of the Act, having 15 holes and a 7-inch chimney, burning 5 feet an hour, the tester cannot refuse to take it. A burner can be accurately defined for a particular quality of gas. The witness recommended that the best burner that is known for the production of the most light from gas should be used in testing. To prevent disputes the burner should be defined by the Act of Parliament, and a model burner should be deposited with the local authorities for the purpose of comparison. This is provided for by the Birmingham and Staffordshire Gas

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* The instructions for testing the gas in Paris were drawn up by Dumas and Regnault. Among them we find the following description of the lamp to be employed:—

Carcel lamp.

	Inches.
External diameter of the burner...	0·9055
Internal diameter, or diameter of the interior air tube	0·6692
Diameter of the exterior air tube..	1·7912
Total height of the chimney	11·4170
Distance from the neck to the base of chimney ..	2·4015
Exterior diameter at the level of the neck	1·8503
Exterior diameter of the top of the chimney	1·3385
Mean thickness of the glass	0·0787

Wick.

The wick is of the ordinary quality called lighthouse wick. The plait is composed of seventy-five strands. A piece four inches long weighs 55·5 grains. The wicks should be kept in a warm place, or, should the locality be damp, in a box containing quicklime in a double bottom. The lime should be removed before it is completely extinct.

Oil.

Purified colza (rape) oil should be employed. For further particulars we refer the reader to the translation of MM. Andouin and Bérard's book on the different varieties of gas burners used for gas lighting, &c., reprinted from the *Journal of Gas-lighting.*

Act.[†] The witness recommended that a 14 candle gas should be insisted upon. Gas of such an illuminating power could be obtained from Newcastle and Staveley coal without the use of cannel. The use of cannel gas was not advisable, since the extension of its manufacture would hasten the exhaustion of the field of that capable of producing gas, which it is estimated will be complete in 20 years. The Scotch cannels are generally charged with sulphur, and the cost of purification is great.

We pass on to the impurities in gas. The Act of 1860 allowed 20 grains of sulphur in 100 cubic feet of gas. The quantity found in general is in excess of this amount. There are two causes, the witness said, chiefly concerned in the production of this excess. First, the presence of pyrites in undue quantity in the coal, and, secondly, the use of hydrated oxide of iron, instead of hydrate of lime, in the purification. That the sulphur may be diminished is proved first by the fact that before oxide of iron was used there were not 20 grains in London gas. In the towns of England where lime is used there are not 20 grains. Where lime is used experimentally, as at Nottingham, the sulphur is reduced to 6 grains; and, lastly, 7 grains of sulphur can be taken from 100 feet of London gas by simply passing it through a small quantity of lime. The use of oxide of iron in place of lime has injured the gas in every way. The illuminating power is injured because the oxide of iron does not remove carbonic acid, and the presence of carbonic acid in the gas to the extent of 2 per cent. will lower the illuminating power nearly a candle. The use of lime is objected to on account of the nuisance it creates in the neighbourhood of the works.[‡] Lime used after oxide of iron is not offensive, but the use of a double set of purifiers greatly increases the cost of purification. If gas works were removed out of town lime might be used. By picking the coal, however, alone the sulphur may be greatly diminished. The Newcastle Company themselves agreed to a maximum of 15 grains of sulphur. The witness has many times tested Newcastle gas, and found the proportion to be rather less than 5 grains. In Paris the amount of sulphur is seldom over 6 grains. The witness subsequently handed in a table of the proportion of sulphur in the gas of several towns as ascertained himself. It will be found below.

Table of the Proportions of Sulphur in the Gas of the following Towns of England.

Town.	Illuminating power of gas.	Gr. of sulphur per 100 feet.
Ely	11·59	6·96
Chatham	8·46	18·20
Oxford	19·33	7·45
Newcastle-on-Tyne	14·41	4·93
Birmingham	13·00 to 15·94	14·15 to 15·90
Nottingham	16· to 17·	8·9 to 13·4
Derby	15·89	17·81
Burton-on-Trent	15·	20·55
Hanley (Staffordshire)	15·66	14·39
Dublin	14·33	17·92
Littleborough	23·00	8·46
Manchester	24·5	10·94
Hastings	14· to 15·	11·67 to 17·48
Exeter	14·67	3·59
Bath	14·81	12·80
Liverpool	24·41	14·54
Pusey	16·49	3·30
Crystal Palace	15· to 16·	13·70 to 16·92
Chester	18·0	11·87
Uxbridge	12·48	13·7
Brighton and Hove	13·13	22·26
Rochester & Chatham	12·74	14·23
Making an average of		13·16

We conclude this short summary of Dr. Letheby's evidence with the amendments he suggested for the more satisfactory working of the Act of 1860:

1. An improvement of the illuminating power of the gas.

2. An improvement of the chemical quality of the gas.

3. A definition of the place where the testings of the gas shall be made, as—

(*a*) That it shall be at a distance of not less than a thousand yards from the works.

(*b*) That it shall be chosen by the local authority, and if the situation is objected to by the gas company supplying that district, the place shall be fixed by a magistrate, or if in the City, by one of the justices.

(*c*) That there shall be only one place for testing the gas in each district supplied by each of the works of the gas companies.

4. That the methods of testing the gas for illuminating power and chemical quality shall be clearly and precisely described in every particular as—

(*a*) With regard to the testing of the illuminating power of the gas—

The burner shall be precisely described in all its parts and measurements.

The working standard of light shall be defined;[*] and if it be the flame of a Carcel lamp, the particulars and measurements of it, and of the lamp, and of its rate of burning should be precisely defined.

The *actual process* to be followed in making the experiment should be described.

The time for making the experiment should be fixed, as from 5 to 10 p.m. in winter, and 8 to 11 p.m. in summer.

(*b*) With respect to the tests of purity—

The exact means of ascertaining the presence of *ammonia* should be described.

The exact means of ascertaining the presence of *sulphuretted hydrogen* should be described.

The exact process for ascertaining the amount of sulphur, in any form, in the gas should be described, as it is in the Birmingham and Staffordshire Gas Act of 1864.

The period of the day and night when the experiments for estimating the purity of the gas should be fixed, as from 9 in the morning to 9 in the morning of the following day.

5. Provision should be made for ascertaining and recording the pressure of the gas at each of the testing-places during the whole period of from 9 in the morning of one day to 9 in the morning of the next.

6. The cost of maintaining the testing-places and providing the necessary apparatus should be paid by the companies of the respective districts in which the testing-place is.

7. The appointment of the officers to test the gas should rest with the local authority, and the local authority should be empowered to pay the salaries of the officers out of some specified local fund.

8. There should be a chief gas analyst, who should direct the operations of the assistant gas analysts, and he should receive daily the returns of the examinations of the assistant analysts, and submit them and report on them weekly to the local authority.

[†] Dr. Letheby, on our application, has been kind enough to furnish us with the measurements of the burner proposed. They are as follows:—

Argand Burner of 15 holes for 14 candle gas.

	Inches.
Total light of burner	3·00
From gallery rest to top of burner	1·10
Thickness of gallery	0·10
External diameter of burner	1·10
Internal do.	0·48
Centre to centre of holes	0·80
Diameter "	0·05
Height of glass	7·00
Diameter (external) of glass	2·00
Height from top of burner to top of glass	6·00

[‡] Our readers will remember that the Medical Officers of Health of the metropolis several years ago made a strong report on this subject.

9. The local authority should be the Metropolitan Board of Works outside the City, and the Commissioners of Sewers inside the boundaries of the City.

10. The gas companies should be allowed to send an officer to each of the testing-places to witness the testings, but he should not be allowed to interfere with the operations; but he should be allowed to report to his Board.

11. The local authority should have a speedy and certain means of proceeding before a justice or magistrate, and for enforcing penalties in case of any defect of the quality or illuminating power of the gas.

We shall return to some of the other evidence given on a future occasion.

The Royal Society.—The following is the list of candidates selected by the Council for election this year. Our readers will see with pleasure that it contains the names of four well-known chemists:—John Charles Bucknill, M.D., Rev. Frederic William Farrar, William Augustus Guy, M.B., James Hector, M.D., John William Kaye, Esq., Hugo Müller, Ph.D., Charles Murchison, M.D., William Henry Perkin, Esq., the Ven. John Henry Pratt, M.A., Captain George Henry Richards, R.N., Thomas Richardson, Esq., M.A., William Henry Leighton Russell, Esq., Rev. William Selwyn, D.D., Rev. Richard Townshend, M.A., Henry Watts, B.A.

Chemical Society.—The next meeting will be held on Thursday evening next, at 8 o'clock, when the following papers will be read:—Professor Crace Calvert and Mr. Johnson "On the Action of Acids on Metals and Alloys," Mr. E. Chapman "On the Action of Acids on Naphthylamine," Professor Wanklyn "On the Oxidation of Propione from Sodium Ethyl," Professor Wanklyn and Mr. Chapman "On the Formation of Ethylamine," Mr. Hadow "On the Nitro-prussides," and Sir R. Kane "On some Derivatives of Acetone."

Cattle Plague.—The third and final Report of the Commissioners appointed to inquire into the Cattle Plague has just been issued. The appendix contains two reports on disinfectants and disinfection, to which we shall specially direct the attention of our readers.

Explosion of Nitro-Glycerine.—Accounts of the terrible effects of the explosion at Colon have come to hand, and have appeared in the daily papers. They prove but too clearly that the destructive energy of the compound has been by no means exaggerated. It is said that the packages that exploded were shipped in Liverpool as ordinary merchandise, for which infraction of the law it is to be hoped the guilty parties will be made responsible. It is doubtful at present whether the explosion resulted from accident or was, as some believe, the result of spontaneous decomposition, to which it is well known an impure nitro-glycerine is very liable. On this point we shall probably have further information. Other instances of the explosion of this compound, such as that at the Wyoming Hotel, New York, and another at San Francisco, were most probably the result of the spontaneous decomposition.

New Use for Benzole.—M. Ferrere asserts that rectified benzole may be used advantageously for alcohol in the preservation of morbid specimens, anatomical preparations, objects of natural history, &c., &c. He adds that a mixture of benzole and alcohol will dissolve the hardest varnishes much better than benzole alone.—*Les Mondes.*

Pulverisation of Phosphorus.—J. Schiff points out that such liquids as disengage a small amount of gas when in contact with phosphorus are most convenient to use for the purpose of reducing that body to a state of fine division. The minute bubbles of gas prevent, he says, the particles of phosphorus from re-uniting. It is for this reason that urine answers so well, but solutions of carbonates, and especially carbonate of ammonia, answer the purpose just as effectively.

A Useful Cement.—Junemann takes two parts of finely sifted unoxidised iron filings, mixes them with one part of perfectly dry and finely-powdered loam, and kneads the mixture with strong vinegar until a perfectly homogenous, plastic mass is formed, when the cement is ready for use. It must be made as wanted, for it quickly hardens, and once set is never fit for use again. The cement resists fire and water.—*Polyt. Journ.*, 178·461, and *Zeitsch. f. Chem.*, 123.

Volatility of Common Salt.—Mulder states that salt heated with coal in a gas retort to a dull red heat for five or six hours is volatilised to the extent of 60 per cent. The saline residue is poorer in chlorine and richer in sodium than the original NaCl. No carbonate of soda was found in the residue.—*Zeitsch. für Chem.*, 1866, p. 192.

Comparative Analyses of the Mediterranean, Red Sea, and Dead Sea, by Robinet and Lefort. The results give the percentage composition of the solid residue obtained by evaporation:—

	Mediterranean.	Red Sea.	Dead Sea.
Chlorine . .	52·92	50·33	65·78
Bromine . .	1·14	1·11	1·25
Sodium . .	31·15	30·92	11·22
Potassium . .	7·00	3·33	3·71
Calcium . .	1·18	1·16	5·67
Magnesium .	3·62	3·54	12·59
Sulphuric acid .	6·42	6·35	1·05

Meetings of the Week.

Saturday, May 12.

Royal Institution, 3 p.m., Professor Huxley, "On Ethnology."

Tuesday, May 15.

Pathological Society, 53, Berners Street, 8 p.m.

Royal Institution, 3 p.m., Professor Ansted, "On the Application of Physical Geography and Geology to the Fine Arts."

Wednesday, May 16.

Society of Arts, John Street, Adelphi, 8 p.m.

Pharmaceutical, Bloomsbury Square, Anniversary, 11 a.m.

Thursday, May 17.

Royal Institution, 3 p.m., Professor Huxley, "On Ethnology."

Royal Society, Burlington House, 8½ p.m.

Chemical, Burlington House, 8 p.m.

Friday, May 18.

Royal Institution, 8 p.m., the Rev. C. Pritchard, "On the Telescope: its Modern Form and the Difficulties of its Construction."

ANSWERS TO CORRESPONDENTS.

Vol. XII. 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., II., and VII. are out of print. All the others are kept in stock. Vol. XIII. commenced on January 5, 1866, 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.

*** 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. J.—Schwarts's method, as applied to the water-pipes of Leipsic. We have made experiments on short lengths of pipe, and found it successful.

Received.—D. Clifton; E. G. Tosh; J. A. R. Newlands, F.C.S.; J. H. F.; "Assayer."

Books Received.—"Elementary Treatise on Physics, Experimental and Applied;" translated and edited from Ganot's "Elements de Physique," by E. Atkinson, Ph.D., F.C.S.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Constancy of Quantivalence, by JOHN A. R. NEWLANDS, *F.C.S.*

THE object of this communication is to indicate a process by which the quantivalence* of the elementary bodies may be viewed as invariably exerted to its fullest extent. In other words, as Professor Wanklyn has put it in a recent communication to the Chemical Society, that "an atom of an element is invariably combined with the same number of equivalents, and that the apparent contradictions of the law, which occur very frequently, are explained by self-saturation, more or less complete, as the case may be."

In examining some of the exceptions to this law, such as nitric oxide, NO, and carbonic oxide, CO, it is obvious that they cannot be explained upon the principle of self-saturation, for the sufficient reason that the molecules of these bodies contain no second atom of nitrogen in the one case, or of carbon in the other, to partially and mutually saturate the nitrogen and carbon already existing in them. If, however, we double the above formulæ, the principle of self-saturation is at once brought into play, and we may suppose these bodies to be thus constituted.

In nitric oxide, N_2O_2, the two atoms of nitrogen may be supposed to interchange one affinity, and each atom of nitrogen again to interchange two affinities with an atom of oxygen. Or we may suppose that the two atoms of nitrogen interchange two affinities, and each again interchanges one affinity with an atom of oxygen; and lastly, that the two atoms of oxygen interchange one affinity.

In carbonic oxide, C_2O_2, the two atoms of carbon may be supposed to interchange two affinities, and each atom of carbon again to interchange two affinities with an atom of oxygen. Or we may suppose that the two atoms of carbon interchange three affinities, and each again interchanges one affinity with an atom of oxygen; and lastly, that the two atoms of oxygen interchange one affinity.

We should thus have two possible constitutional formulæ for nitric oxide and carbonic oxide respectively. The same may be shown with regard to nitryl, N_2O_4, and other exceptional formulæ.

It is true that if we double the formulæ of nitric oxide and of carbonic oxide, we must also double those of water, ammonia, and, in fact, all, or nearly all, others in order to preserve the relations between their volumes in the gaseous state. But, as Dr. Hofmann has remarked in the work already quoted, "the smallest quantity in which hydrogen combines may, for aught we know to the contrary, be a cluster numbering ten, or a hundred, or a thousand, or a million, of really ultimate atoms," and what is true of hydrogen is true of the other elements. There can, therefore, be no great objection to merely doubling chemical formulæ with the view of getting rid of apparent exceptions to an important scientific principle.

The quantity of an univalent element entering into a compound may then be viewed as consisting of two atoms, the double atom possessing two available affinities. The double atom of a bivalent element would, in like manner, possess four, that of a trivalent element six, and that of a quadrivalent element eight available affinities.

One double atom of an univalent element, such as hydrogen or chlorine, might thus under peculiar circumstances be capable of uniting with another double atom, and we might thus explain the formation of such compounds as chloride of ammonium, pentachloride of phosphorus, potassio-platinic chloride, and quadrantoxide of silver.

I am prepared to show how all these bodies may be represented by graphic formulæ, whilst their elements retain in every case a fixed and unvarying quantivalence. In order to do so, however, a few engraved graphic formulæ will answer better than any amount of mere written expression, and those acquainted with Dr. Crum Brown's excellent system of graphic notation, can by slightly modifying it construct such formulæ for themselves.

The principle of self-saturation suffices to explain a decrease in the apparent quantivalence exhibited by two or more atoms of a multivalent element when united with an univalent element. But how are we to explain the fact that phosphorus, for instance, is capable of uniting with chlorine in the proportion of one atom to five, or, what is the same thing, of two atoms to ten, if phosphorus be really trivalent, and if the chlorine atoms are incapable of partial self-saturation, as they must be if we regard them as being each possessed of only one affinity?

The simplest mode, apparently, for illustrative purposes, would be to consider the univalent atoms as having two affinities, the bivalent atoms four affinities, the trivalent atoms six affinities, and the quadrivalent atoms, eight affinities.

It is indeed possible that the real quantivalence of all elements may be the same, only that, under existing circumstances, some elements retain their state of self-saturation with more tenacity than others.

If we represent two atoms of any element by x x, and suppose them to be perfectly self-saturated to the extent of any given number—say, six affinities, the element in question would possess no apparent quantivalence whatever. If, however, we suppose the atoms x x to be self-saturated to the extent of only five out of the six affinities, the element would be univalent. And again, it is obvious that by separating the atoms x x to a still greater extent, the element would successively become bivalent, trivalent, quadrivalent, pentavalent, and finally when the atoms were completely sundered, hexavalent.

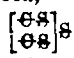
It therefore appears that the apparent quantivalence of an element affords no absolute proof of the real, or maximum, quantivalence which it would exhibit were its atoms in a thoroughly free condition. We have, in fact, no absolute proof that one atom of an element can exist entirely apart from its fellow atom, and we therefore can never be certain that self-saturation is not exerted to a greater or less extent.

This communication is not put forward with the object of offering anything entirely new upon such an important topic, but rather with the view of eliciting the opinions of others more qualified to decide upon what, in theoretical chemistry, is a matter of the greatest interest.

Laboratory, 19, Great St. Helens, E.C., May 9.

On Sesquisulphide of Carbon, by O. LOEW.

SESQUISULPHIDE of carbon,



$$\left[\begin{array}{l}\cancel{C}\cancel{S}\\ \cancel{C}\cancel{S}\end{array}\right]\cancel{S}$$

is obtained when the freshly-precipitated hydrogen com-

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[*] "The atom-fixing or atom-expelling power of the elementary bodies, or, as we have agreed to term it, their quantivalence."—Hofmann, "Modern Chem.," p. 180.

pound (to be presently described) is digested at a moderate heat with the strongest ammonia, and the filtered dark red liquor is treated with chlorine until colourless. This speedily happens if the NH_3 is in considerable excess, so that the formation of chloride of nitrogen is not to be feared. To remove every trace of free sulphur from the precipitate it is digested with sulphite of soda, washed first with hot water, then with alcohol, and now dried. An analysis gave—

		Calculated.
C . . .	19·8	20·0
S . . .	79·3	80·0

Sesquisulphide of carbon is perfectly amorphous, brown, without smell, and but slightly soluble in bisulphide of carbon. It decomposes readily above 210° C., sulphur volatilises, and a bulky carbonaceous residue remains. It seems that no new body is formed during the decomposition, and the breaking up of the body simply indicates a loose state of combination. On boiling sesquisulphide of carbon with potash or baryta, the oxalate and sulphide of the metal are formed; ammonia acts on it but slightly; dilute nitric acid oxidises it at about 100° to a peculiar acid, probably

$$\begin{bmatrix}\text{ꞒS}\\ \text{ꞒS}\end{bmatrix}\Theta,H_2\Theta.,$$

which forms a tolerably soluble salt with baryta, and with lead and silver less soluble reddish salts.

Hydro-sesquisulphide of Carbon—

$$H_2\begin{bmatrix}\text{ꞒS}\\ \text{ꞒS}\end{bmatrix}S.$$

This body is obtained chemically pure by extracting the mass obtained by the action of sodium amalgam on bisulphide of carbon with water, treating the warm solution for four or six days with sulphuretted hydrogen. The fluid thus freed from mercury is then treated with hydrochloric acid, and the mass so obtained is washed, dried, exhausted by bisulphide of carbon at 130°, filtered and evaporated. It then forms a resinous mass, which has a faint odour of garlic. When boiled with alkalies it gives oxalic acid and sulphides of carbon poorer in sulphur; at 200° it is completely decomposed.

When freshly-precipitated hydro-sesquisulphide of carbon suspended in water is treated with chlorine gas, a chlorine compound is formed as a secondary product. If its solution in bisulphide of carbon is mixed with a solution of bromine in CS_2, HBr, and bromide of sulphur are formed, and a black product separates which somewhat approaches in composition mono-sulphide of carbon; 0·202 grm. gave 0·178 CO_2 = 24·03 per cent of C. (theory requires 27·27 per cent.).

I did not succeed in preparing this body chemically pure, it being extremely difficult to separate these similar amorphous compounds one from the other. If bromine is in the smallest excess it forms also an amorphous body containing bromine, which also cannot be separated.

Fused with iodine at about 80°, hydro-sesquisulphide of carbon developes HI, and forms an uninviting magma from which nothing definite can be separated.

Ammonio-sesquisulphide of Carbon exists only in solution. When the hydrogen compound is dissolved in colourless sulphide of ammonium, the solution precipitated with HCl, and the finely divided mass digested with NH_3, a red solution of the salt is formed, which is completely decomposed by evaporation, and decomposes also if allowed to stand for some time.

Bario-sesquisulphide of Carbon.—The hydrogen compound is warmed for a short time with sulphydrate of barium filtered, and treated with CO_2 until HS is no longer evolved, and then filtered again. The solution, as well as the amorphous salt obtained by evaporation decompose on standing in the air.

Sodio-sesquisulphide of Carbon.—This, as well as *sodiosulphide of mercury*, is found in the course of the reduction of CS_2 by sodium amalgam; it is also found together with NaS when sodium in small pieces is heated in a tube with CS_2 to 140° or 150°. It is obtained purest from the barium salt, and forms on evaporation a brownish red mass which is quickly decomposed by the oxygen of the air.

When iron filings are heated with CS_2 in a tube to 220°, no action takes place, but if water is present some action takes place at 100°, and formic acid and sulphide of methylene. An iron compound, however, as well as a cobalt, nickel, lead, copper, and silver salt, can be found from a freshly prepared barium salt; the first is a black powder. The zinc salt is dark red, the copper salt brownish-black; the latter will be found among other products on digesting finely divided copper in bisulphide of carbon for six months in the sunlight.

In conclusion, the author expresses an opinion that sesquisulphide of carbon is constituted similarly to oxalic acid, into which it is directly controvertible.—*Zeischrift für Chemie, &c.*, 1866, 173.

A New Class of Radical Metallic Compounds,

by M. BERTHELOT.[*]

(Continued from page 219.)

I.—Double hyposulphite of soda and gold, with the addition of ammonia, is slowly precipitated by acetylene, with the formation of yellowish flakes. When dry, this precipitate detonates violently at the least contact with a hard body, leaving a mixture of gold and carbon. There is no doubt that this is oxide of auroacetyle.

Chromous sulphate, dissolved in a mixture of hydrochlorate of ammonia and ammonia, as M. Peligot directs, rapidly absorbs acetylene. At the same time the liquid loses its colour almost entirely; when much concentrated it gives a reddish-violet precipitate. It always becomes coloured again, but with a rose tint, which indicates the superoxidation of the chromium; a new precipitate is formed, and acetylene disengaged.

In short, there appears to be formed first an oxide of chromos-acetyle, which decomposes the water, almost immediately, by complex affinity, the chromous oxide taking the oxygen, while the acetylene combines with the hydrogen.

The total result of these reactions may be represented by the formula

$$C_4H_2 + 2Cr_2O_2 + H_2O_2 = C_4H_4 + 2Cr_2O_3.$$

I pursued the study of the reactions of acetylene with regard to various salts of metallic protoxides. . . .

II.—Allylene furnishes analogous results. I will cite some of the indications tending to prove the existence of a chloride and iodide of cupros-allyle, less stable, however, than the salts of cupros-acetyle.

Allylene reacts equally on hyposulphite of soda and ammoniacal gold, though more slowly than acetylene.

The analogy is carried out as regards chromous salts. In fact, allylene is abundantly absorbed by chromous sulphate dissolved in a mixture of ammonia and hydrochlorate of ammonia. The chromium quickly superoxidises, and propylene is disengaged:

$$C_6H_4 + 2Cr_2O_2 + H_2O_2 = C_6H_6 + 2Cr_2O_3.$$

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[*] *Comptes Rendus*, lxii., 628.

I have observed facts still more characteristic with salts of silver. These salts, dissolved in ammonia, are precipitated by allylene; by means of ammoniacal chloride of silver, I obtained a chloride of argentallyle $[C_6H_3Ag(C_6H_3Ag_2)]Cl$ † — a white precipitate, which becomes rose-coloured by exposure to light. Hydrochloric acid reproduces allylene:

$$[C_6H_3Ag(C_6H_3Ag_2)]Cl + 2HCl = 2C_6H_4 + 3AgCl.$$

Nitric acid oxidises it, producing chloride and nitrate of silver, the nitrate containing a weight of silver double that of the chloride.

I have failed to isolate any oxide of argentallyle. M. Liebermann's analyses have shown that the precipitate formed by allylene in ammoniacal nitrate of silver corresponds to the formula C_6H_3Ag—that is to say, that it differs from oxide of argentallyle

$$(C_6H_3Ag,Ag)O$$

by the elements of oxide of silver; and this is argentallylene.

Oxide of argentallyle seems, however, to exist for a few moments; in fact, the first product of the reaction of allylene on nitrate of silver is yellow; but it blanches rapidly by contact with the liquid, at the same time that it takes the composition of argentallylene. All this is easily understood by taking into consideration the similarity established between ammonia and acetylene.

Ammonia .	NH_3, C_4H_2 & C_6H_4, C_4HAg & C_6H_3Ag
Oxide of ammonium .	$(NH_3,H)O$, $(C_6HAg.Ag)O$, $(C_6H_3Ag,Ag)O$.

The oxide of argentacetyle corresponds to the oxide of ammonium, and is stable; while oxide of argentallyle, an unstable body, divides, in the manner of oxide of ammonium, into argentallylene, corresponding to ammonia, and oxide of silver, corresponding to oxide of hydrogen—

$$(NH_3H)O = NH_3 + HO;\ (C_6H_3Ag.Ag)O = C_6H_3Ag + AgO.$$

Were argentallylene really comparable to ammonia, it should form salts by reacting on metallic solutions. This is, in fact, what happens when this compound is digested with sulphate of silver dissolved in sulphate of ammonia. A sulphate of argentallyle is formed, almost insoluble, but unstable. Digested with water, it slowly decomposes, reproducing sulphate of silver and a salt which turns yellow in proportion as it becomes more and more basic. Ammonia separates it immediately into soluble sulphate of silver and argeutallylene.

Argentallylene is also attacked by chloride of silver dissolved in hydrochlorate of ammonia, and by hydrochlorate of ammonia simply. It dissolves in the latter salt, forming a liquid decomposable by boiling into allylene and pure chloride of silver—

$$C_6H_3Ag + NH_3HCl = C_6H_4 + AgCl + NH_3.‡$$

In short, the reactions of allylene and acetylene, on metallic salts, are similar up to a certain point; but the allylic compounds are more easily split up than the acetylic compounds. The difference between them is comparable to that of ammoniacal salts, and the salts derived from feebly basic hydrogenated alkalies.

III.—I will end by giving some facts relative to the action of alkaline metals on carbides of hydrogen.

Sodium, heated in a curved receiver, in presence of an excess of acetylene, attacks this carbide. With gentle heat a part of the gas is absorbed, leaving a gaseous residue amounting to about half the original volume—

$$C_4H_2 + Na = C_4HNa + H.$$

There is formed in this way a monosodic acetylide, C_4HNa, and hydrogen.

This hydrogen is not pure, however; it is mixed with small quantities of ethylene C_4H_4 and hydride of ethylene C_4H_6, which are the result of its action in a nascent state on acetylene.

At a dull red heat the reaction of sodium on acetylene is more complete. The carbide disappears, without notable change in the gaseous volume, with the formation of almost pure hydrogen and of a carbonaceous matter, containing disodic acetylide—

$$C_4H_2 + Na_2 = C_4Na_2 + H_2.$$

Water violently attacks the two sodic acetylides, reproducing acetylene.

These facts, which agree with Gay-Lussac's and Thénard's experiments on ammonia, continue the parallelism between acetylene and hydride of nitrogen, though the latter furnishes the two compounds NH_2K and NK_3.

This is, I believe, the first instance in which a carbide of hydrogen has been found attackable, regularly and directly, by metals, at a low temperature. Formene C_2H_4 and ethylene, C_4H_4, gave no similar result with sodium.

Allylene, on the contrary, was attacked by sodium gently heated; but it underwent complete decomposition, resolving itself into sodic acetylide, carbon, and hydrogen§—$C_6H_4 + Na_2 = C_4Na_2 + C_2 + 2H_2$.

The product of the reaction, treated by water, consisted of soda and acetylene free from allylene. The composition of this carbide was thus found to resemble that of the most simple homologous generator.

Potassium, gently heated in an atmosphere of acetylene, burnt with explosion, and formation of acetylide. The same compound was formed in small quantity during the reaction of potassium on ethylene, at dull red heat.‖ Commercial potassium contains traces of it.

Finally, acetylides are to be found among the complex products of the reaction of alkaline metals on carbonic oxide, and on alkaline carbonates. I have studied the reaction of a great number of metals on acetylene.

These facts indicate the existence of three series of metallic compounds derived from acetylene, some by substitution :—

$$\begin{array}{llll} C_4H_2 & & C_6H_4 & NH_3 \\ C_4HNa & C_4HAg & C_6H_3Ag & \\ C_4Na_2 & & & \end{array}$$

and corresponding to ammonia NH_3, the others by substitution and simultaneous addition,—

$$\begin{array}{ll} C_4HAg.AgCl & NH_3.HCl \\ C_4HAg.AgO & NH_3.HO \\ C_4\text{HꞒu.ꞒuO} & \end{array}$$

and corresponding to oxide and chloride of ammonium. The formation of these last agrees with the incomplete character of acetylene and the fixation of hydrogen, water, and hydracides which, according to my experiments, results.

Another striking circumstance is that acetylene reacts especially on peroxidisable salts, as if it filled a vacant place usually occupied by oxygen,—

$$\text{ꞒuO} + (O) = \text{ꞒuO}(O)$$
$$\text{ꞒuO} + (C_4\text{HꞒu}) = \text{ꞒuO}(C_4\text{HꞒu}).$$

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† Corresponding to the second acetylmetallic series

$$[C_4HAg.(C_4HAg,Ag)]O,$$

to the base $[NH_2(NH_3Pt)]O$, and finally to the ammoniacal oxide of silver $[NH_2(NH_3Ag)]O$.

‡ In the same way chloride of argentacetyle, but more slowly—$C_4HAg.Ag)Cl + NH_3HCl = C_4H_2 + 2AgCl + NH_3$.

§ Part of this nascent hydrogen acted on the allylene, changing it to propylene—$C_6H_4 + H_2 = C\ H_6$.

With gentle heat there was no reaction.

Finally, I would observe that in the order of its derivatives, acetylone furnishes a striking example of the change from the ethereal to the saline type. The first type being formed in the reaction of a hydrogenated body on acids and water

$$C_4H_2 + HCl\ ;\ C_4H_2 + 2HI\ ;\ C_4H_2 + H_2O_2\ ;$$

while the second type is formed by the reaction on metallic salts

$$C_4HAg + AgCl.C_4HCu + CuO.$$

On the Estimation of Silver Oxide as Metallic Silver, by Dr. ALEXANDER CLASSEN.*

SILVER oxide is easily reduced to the metallic state by means of cadmium. A solution of nitrate of silver is evaporated with sulphuric acid until all the nitric acid is driven off. The sulphate of silver is then dissolved in hot water, and a stick of cadmium is placed in the solution. The reduction of the silver oxide proceeds immediately, the metallic silver is easily separated from the cadmium, and collected in a mass which can be washed by decantation with hot water without loss. A previously tared porcelain crucible will serve to effect the reduction in. As the reduced silver may possibly have a little cadmium mixed with it, it is well to heat the acid liquor until no evolution of hydrogen takes place. In the clear liquid which remains not a trace of silver can be recognised. The reduced silver is now washed until the washings give no precipitate with chloride of barium, then dried, and lastly ignited, by which the greyish black of the precipitate is changed to silver white.

The author here quotes some weighings to show the accuracy of the results.

The reduction of silver compounds by means of cadmium, he states, goes on very quickly, and as cadmium is but slightly soluble in dilute acids, the same piece of metal will serve for several operations, without even losing the metallic lustre of the surface.

Freshly-precipitated chloride of silver may be reduced in the same way.

Description of the English Method of Assaying Copper by the Dry Way, by M. L. MOISSENET.*

(Continued from page 220)

SECTION II.—*Manipulations.*

The sample, which has been taken with the utmost care, arrives at the laboratory rather coarsely powdered, still wet, and wrapped in strong packing paper; the paper is opened and placed near a furnace on the cast-iron plate which covers it; the drying is rapidly done there.

The first question is to discover the kind or kinds of minerals, so as to employ the warm or raw sample.

For this purpose we throw one or two large pinches of the mineral into a flat-bottomed copper dish, and we wash it very easily by putting in water several times and giving a rotatory motion to the matters, at the same that we incline the dish so as to cause the muddy parts to run from the gangue. The small metallic fragment remains distinctly visible, and we can often discern by simple inspection the presence of foreign metals.

We weigh 400 grains of the dried mineral, a quantity upon which the assay is made.

The crucibles used in Cornwall are of three sizes:—

1. Large.
2. Large second.
3. Small second.

The small seconds have externally the internal dimensions of the large, into which they fit as into a nest; the first and third are sold the one in the other, and called nested. They are the most used.

The large serve for the roasting and the fusion for regulus, the small second for calcining the regulus and all the fusions which follow.

The large seconds are only employed in place of the former when we have to treat a very large regulus.

The crucibles are of a kind rather wrinkled, and as if fused superficially, they present the appearance of coarse stoneware pottery. Their form, moderately wide, permits us to make use of them successively for the roasting and the fusion for regulus, and gives them sufficiently great stability in the fire of a wind furnace. They are besides very resisting. They are made at Truro and Redruth.†

The wind furnace has for its principal dimensions—

		Inches.
Length from front to flue		10
Breadth		8
Depth to the bars		14
Opening of the flue	length.	8
	height.	2

A sufficiently large space is reserved underneath the fire, where the ashes accumulate without inconvenience, but opening only by a framework contracted so as not to allow too free an access of cold air.

The furnace serves either for roastings or for fusions in the latter case we cover it with two mounted bricks, very easy to manage, and allowing to only half open it when we wish to inspect the contents of the crucibles. We can conduct ten roastings at once; the crucibles are marked by a brush with colcothar mixed with water. The furnace having been recharged with coke, we put the crucibles on the top, and after a few minutes the substances beginning to get warm, we stir them by means of iron rods. Each crucible receives a rod which we leave standing there (leaning against the chimney) during the whole period of the roasting, so as to avoid the loss which would take place if we withdrew the rod. From time to time we renew the surfaces by lightly taking hold of the rod with the left hand by the upper end, whilst the right forefinger and thumb make it turn at once upon itself and round the crucible.

The duration of the warming varies essentially with the nature and the richness of the mineral; it is never less than six or seven minutes, and may reach half an hour. When from the *sandy appearance* of the matters we consider the operation finished, we withdraw the crucible, raise the iron rod with care, and expose the crucible to the air, allowing its contents to cool slowly. The roasting has succeeded when the surface has the brown red colour of oxide of iron and the bottom only is black. In this case we proceed to the fusion for regulus by simply adding the three fluxes (borax, fluor spar, and lime); if the bottom of the crucible appeared too black, we ought to complete the oxidating action by the addition of a little nitre.

Fusion for Regulus.

The different substances above indicated are taken from the box with a slightly concave ladle of 1⅜ diameter, then mixed in the crucible with a stirring knife. We ought to allow the heat of the wind furnace to fall and to recharge, so as to have a gentle fire at the commencement of the fusion for regulus. The crucibles are placed upon

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* *Journ. fur prakt. Chemie*, 4, 1866, p. 217.

† Mr. Juleff, of Redruth, is considered to make the best crucibles. Each laboratory uses 1500 dozens annually. A lid is never used for the crucible.

the coke, and supported against the walls of the furnace, which we then close with the two bricks. After about a quarter of an hour we open the front brick so as to observe the progress of the operation; it is at this stage that we throw in the sulphur and tartar into those crucibles from which a blue flame is disengaged. Some minutes later—that is to say, nearly seventeen minutes from the commencement, we add the salt and the flux destined to collect the regulus; then (twenty minutes from the beginning) we run into a metal mould, not greased.

We make, in general, several fusions at once—four, for example; we have in consequence two moulds into which we pour the contents of the crucibles in an adopted order, so as to avoid all confusion. The matters, very rapidly solidified, are detached simply by a blow, and fall in order on a metal plate fixed in front of the laboratory window. We immediately seize them with the copper tongs, put them into a basin of the same metal, and immerse them for a moment in cold water, where it is important not to leave them too long. This immersion allows us then to separate very easily the slag from the button of regulus, itself very brittle. For this purpose the fluxions are put on the metal plate, and by means of a hammer we strike with care all round the slag, which breaks off pretty cleanly. We hasten to detach from the surface of the regulus the slag which may remain adherent, using a small hand chisel, without the hammer. The slags are broken, and if we find any prills of regulus they are added to the principal button. Sometimes in these breakings, and especially in those analogous for the last fluxings, we surround the substances by an iron ring, placed on the metal plate, so as to avoid loss of splinters. In a general way, the slags of the fusion for regulus are rejected. We shall see further on how it may become necessary to flux them again when the mineral contains blende.

The aspect of the regulus is characteristic, and it is easy to arrive at a pretty close estimation of its richness, and consequently of the degree of success of the operation, by simple inspection of the regulus.

No. 1. A regulus very poor (coarse), that is to say, too much charged with iron, is bronzed and dull; the operation following would not be able to carry off the excess of iron, at least without a corresponding loss of copper. A like regulus evidently results from an imperfect warming, or from an excess of sulphur, or from an insufficiency of nitre, as the case may be.

It contains less than 40 per cent. of copper. There is nothing for it but to reject it.

No. 2. A regulus of good appearance is in general bronzed but rather shining; it appears finer. Its richness varies from 40 to 60 per cent.

No. 3. From oxides, carbonates, and from some minerals charged with impurities (SnSb) we desire to obtain a fine bluish button of a greater richness—65 to 75 per cent. We perceive, indeed, that for oxides and carbonates, to which we have only to add sulphur, and which also by their nature do not, like pyrites, contain combined iron, it is easy to obtain a richer regulus without fearing any loss of copper. As for the stanniferous and antimoniferous minerals, I shall return to them further on.

No. 4. In every case a regulus, the richness of which rises to 80 per cent., and of a very shining grey blue appearance, ought to be rejected, its richness indicating the loss of a certain quantity of copper left in the slag.

Here is, in the preceding order, the result of the analyses of four buttons whose description agrees with that which I have just given, excepting, perhaps, No. 2, whose fracture is rather reddish—

No.		Copper.	Iron.	Balance; sulphur & traces of forgn. metals.
1.	Coarse, to be rejected . .	36·00	32·90	31·10
2.	Good in general (rather too fine)	60·00	14·70	25·30
3.	Good for a carbonate, &c. .	65·60	10·50	13·90
4.	Too fine, to be rejected . .	80·16	2·10	17·74

If we compare these products with those obtained in the metallurgy of copper by the Welsh method, we find (Le Play, *Annales des Mines*):—

	Matts of the operations. II., V., IV., VIII.	Copper.	Iron.	Different metals.	Sulphur.	Total of Dif. M. & S.
II.	Coarse metal (fusion of poor minerals, raw or calcined) $3Cu_2S+Fe_2S_3+4(Fe. dif. met)S$	34·6	34·1	1·5	29·8	31·3
V.	Blue metal (fusion of the calcined coarse metal with minerals of mean richness) $0·8Cu+3Cu_2S+2(Fe. dm.)S$	57·2	18·5	1·0	23·3	24·3
	Reddish variety, *matte mince* $1·3Cu+3Cu_2S+2 (Fe. dm.)S$	61·6	15·8	0·6	22·0	22·6
IV.	White metal (fusion of the calcined coarse metal with rich minerals, carbonates, and oxides)					
	Metal—very pure type	77·4	0·7	0·9	21·0	21·9
	very blue variety . . .	64·8	9·0	3·6	22·6	26·2
	mean	73·2	6·3	—	20·5	—
	$8Cu_2S+FeS$					
VIII.	Regulus (roasting of extra white metal VII.) $0.2Cu+Cu_2S$	81·1	0·2	—	18·5	—

These numbers show the evident analogy, the identity almost, of the products of the laboratory and those of the works; we may sum up by saying that the regulus ought to be richer than coarse metal, and in the case of ordinary minerals to approach if not to attain (as in the case of sample No. 2) to the composition of blue metal.

For carbonated and oxidated minerals we arrive directly at the very bluish variety of white metal.

Finally, in no case must we arrive at a button as rich as regulus matt.

Calcining the Regulus.

The regulus is pounded fine in a bronze mortar; we avoid loss of fragments by means of a perforated cover and a cloth which surrounds the pestle. To facilitate the pulverisation, and avoid the sulphuret greasing, we add in the mortar a small piece of coke. The pounded regulus is carefully turned upon a sheet of paper, the mortar wiped out with a hare's foot, and the substance put into a small second or large second crucible. The calcining is conducted as the warming of a mineral; it generally lasts longer, for the expulsion of the sulphur is to be as complete as possible. It demands the most minute care to regulate the fire so as to avoid all agglomeration, and to stir almost continually. When the matter adheres to the rod, we withdraw the crucible for a moment; this inconvenience is chiefly produced, if we have not detached the slags sufficiently from the regulus; the calcining is then much longer, the flames remain blue a long time, and the fumes which are disengaged have an odour which is not purely that of sulphurous acid. When the fumes and the odour cease, and the matter has taken a sandy appearance, we raise the heat; then withdraw it, and allow to cool slowly in the air as for warming.

The mean duration of calcining is half an hour.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, March 16, 1866.

Sir Henry Holland, *Bart., M.D., D.C.L., F.R.S., President, in the Chair.*

Balfour Stewart, *Esq., F.R.S.*

On the Existence of a Material Medium pervading Space.

The question whether interstellar and interplanetary space is a plenum or a vacuum has for a long time engaged the attention of the scientific world.

As we can hold no communication with these distant regions, except through the light which reaches us, it is to this agent we must look to enable us to answer this question, directly or indirectly, either from its own properties and nature, or from its faculty of revealing to us the position and motion of the heavenly bodies, or from both of these together.

This twofold aspect of the problem gives rise to the following questions:—

Question first.—Does the nature of light and radiant heat induce us to believe that space is a plenum or a vacuum?

Question second.—Is there anything in the motions of the heavenly bodies that gives us any information on this point?

These two questions comprise the observational evidence on the subject. By observational, as distinguished from experimental, we mean evidence derived from a region where we may observe what is going on, but into which we cannot transport ourselves so as to make any experiments; besides this evidence, we may moreover make experiments on the surface of the earth in our laboratories, and derive from these experiments a certain amount of information bearing upon our question. We have thus altogether three sources of evidence.

First.—Evidence derived from the nature of light and heat.

Second.—Evidence derived from the motion of the heavenly bodies.

Third.—Experiments made on the surface of the earth.

Possibly also the force of gravitation which is exercised by bodies at a distance, and the connection between solar spots and terrestrial magnetism, discovered by General Sabine, imply the existence of an interplanetary medium; but it is better to confine ourselves to light and heat, which differ from other influences in this respect. We know that light and heat travel with a certain velocity, and we can suppose, as it were, a slice of light to be cut off half-way between the sun and the earth; here, then, we have a certain amount of energy neither in the sun nor in the earth, but half-way between; we cannot, however, at present make any such assertion with regard to gravity or magnetic action.

To begin with the evidence derived from the nature of light and heat. It is supposed by some (or rather perhaps it has been supposed, for the advocates of this theory are dying out) that light consists of exceedingly small particles which are projected into space by a luminous body on all sides, particles having different properties, but all of which, nevertheless, pass through interplanetary space with the same enormous velocity of 190,000 miles per second. On the other hand, it is supposed that light consists in the transmission of some sort of motion of a medium pervading all space.

The difference between these two hypotheses may be explained in a very few words. The theory of emission supposes the transit of an individual particle from the luminous body to the eye; the theory of undulation or similar theory, on the other hand, merely supposes the progressive motion of a state of displacement between the luminous body and the eye. (Illustrated by an experiment.) Thus, according to the former theory, each ray of light which passes between the sun and the earth is equivalent to the bodily transmission of a set of particles 90,000,000 of miles; while, according to the theory of undulation, the greatest amount of relative displacement of the ether whose vibrations form this ray, is probably much less than the millionth of an inch.

Now, the difference between these two modes of viewing light as concerns our subject is this:—The existence of an ethereal medium does not appear to be inseparably connected with the first theory, or that of emission. The two ideas may be held and have been held together, but they do not appear to be inseparably connected; on the other hand, if light and heat consists of the transmission of some sort of motion of a medium pervading space, we have to start at once with the hypothesis of such a medium. Hooke and Huyghens were the scientific authors of the undulatory theory of light, while Newton, on the other hand, was the great advocate of the theory of emission.

The scientific repute of Newton seems to have retarded the progress of the undulatory theory for nearly a century; but of late years it has been revived and extended in this country by Young, whose name is inseparably connected with the Royal Institution, and in France by the illustrious Fresnel. It is only by an appeal to experiment that we can decide between the claims of these two rival theories, and we have to ask ourselves which best accords with the phenomena of optics.

First of all, if we assume the hypothesis of emission, it is not easy to conceive why the luminiferous particles discharged by so many different kinds of bodies should all pass through space with precisely the same velocity. In order to escape from this difficulty, it was suggested by Arago that particles may be originally projected with different velocities, but that there is only one of these which is adapted to our organs of vision. This, however, is a very lame explanation, and the necessity for such explanations is one of the characteristics of a bad hypothesis. For if a theory be good, it is wonderful how many facts it will account for without any additional assumption, but a bad hypothesis requires to start an additional assumption for almost every new fact, until at length some one arises which cannot be won over by even this method, and so the hypothesis fails.

In the next place, it is difficult to conceive why particles, even although exceedingly small, moving with such enormous velocity, should not inflict on us terrific blows on account of their momentum; and it has been calculated that if the weight of a molecule of light amounted to but one grain, its momentum would equal that of a cannon ball 150 pounds in weight moving with a velocity of 1000 feet per second. Even although a molecule of light should be many million times smaller than this, its momentum would still be sensible; and as millions of millions must enter the eye every instant from every visible point of every visible body, we should be pounded to atoms. A good many years ago, Mr. Bennet made some experiments on this point. A slender straw was suspended horizontally by means of a spider's thread, and to one end of this lever a small piece of white paper was attached, and the whole was enclosed in an exhausted receiver of glass, while the sun's rays, concentrated by a large lens, were allowed to fall on one side of this paper; but they did not twist round the lever in the least. The advocates of the theory of emission may perhaps, however, suppose that they are entitled to make the light molecules, and hence their momentum, as small as they choose, and of course, if this be allowed, even the most delicate experiment will not be decisive. But a short explanation will show that they are not entitled to make the momentum of a ray of light as small as they choose, but that the theory of the conservation of energy which has been elaborated by Grove, Joule, Thomson, and others, and is now universally accepted, determines this momentum.

Of course one who denies the undulatory hypothesis may, at the same time, deny the conservation of energy—we have nothing to say to such an one; but we think it can be proved that one cannot at the same time hold both the theory of emission and the theory of the conservation of energy. In order to show this, let us suppose that such a man exists, believing the theory of the conservation of energy, but denying the undulatory hypothesis, and advocating in its stead the theory of emission. Now, in the first place, the amount of momentum or the blow which a body is capable of giving must be distinguished from the energy which it possesses. Thus, if we fire a rifle-bullet so as to strike an iron target (swung by a string) and lodge in it, this target or pendulum will be swung to a side on account of the momentum or blow of the ball. But as far as momentum is concerned, when a rifle is discharged, action and reaction are equal, so that the momentum of the ball is no greater than that of the recoiling rifle; and hence if the rifle were swung, attached to another pendulum, the recoil of the rifle would produce the same effect as the ball in the first pendulum. (Illustrated by an experiment with a small cannon.) But the ball does something more than swing the pendulum, it ultimately heats it; and, in fact, this amount of heating forms very much the energy of the ball.

Now, energy is known to be proportional to the momentum or blow multiplied by the velocity, and hence it is owing to its high velocity that a rifle-ball possesses so much energy. Let us now return to Bennet's experiment, in which a powerful beam of light was made to strike a piece of paper fastened to the end of a straw, delicately suspended in the centre by a spider's thread. By the theory of the conservation of energy, we know that the energy of the light and heat which strike the paper in one minute, will, just as in the case of the rifle-ball, be represented by the whole heating effect produced. Now we can roughly estimate this heating effect, and we can therefore find the amount of energy produced by these rays in one minute, and knowing the amount of energy, we can tell at once the blow multiplied by the velocity to which the energy is proportional. We therefore know the blow multiplied by the velocity of the light, but we also know the velocity; hence, dividing the first by the second, we know the blow which the light ought to produce in this arrangement, if we suppose the theory of emission to be true. By a rough calculation it may be shown that the blow ought to be sensible, but Bennet found it to be insensible, hence we argue that the theory of emission is not true.

The experiment performed by MM. Foucault and Fizeau was then described. This experiment proves that light travels slower in water than in air, and this result is also in favour of the undulatory theory, but against that of emission. Finally it was stated that a great number of beautiful and interesting optical experiments can be explained with the greatest ease by the theory of undulations. (Through the kindness of Professor Tyndall, a selection of these was exhibited.) All these various proofs are in favour of the undulatory theory of light, and we have therefore great reason to believe in its truth, and, believing in it, we are compelled also to believe in the existence of a material medium in which these undulations may take place.

We now come to discuss the second branch of our subject, or the evidence derived from the motions of the heavenly bodies, and as yet there is only one of these that has afforded us evidence of the existence of an ethereal medium

In November, 1818, M. Pons, in Marseilles, discovered a comet, which M. Encke, in Berlin, after calculating its elements, found to be identical with the comets seen in 1786, 1795, and 1805. In comparing the different observations, he immediately noticed a steady decrease in the duration of the comet's revolution. M. Encke conceived that some permanently retarding force must influence the motion of the comet; but the nature of that force would only be cleared up by continuous and very carefully conducted observations at each return. Consequently, in 1819, he called the attention of astronomers to this comet, but the whole of the subsequent observations, and the calculations founded upon them, were not discussed until forty years had elapsed. M. Encke, in his first discussion, obtained the following results:—

(*a*.) It is impossible by the laws of planetary motion to explain the motion of this comet.

(*b*.) The whole period of revolution has been shortened since the first observation in 1786 by two days and eight hours, which, in proportion to its small period of revolution (about 1210 days), is far too large an amount to ascribe it to imperfections of the observations or of the instruments.

(*c*.) The amount of decrease is at each revolution constantly the same, and so regularly observed at each return of the comet to its perihelion that not the least doubt now exists as to the fact itself.

(*d*) The mathematical consideration of the nature of the retarding force shows it to be entirely a tangential force—that is, such a force as is always exerted by a medium filling space where a body is in motion; it follows, that we are led to assume the existence of a medium filling all space, and producing effects analogous to those observed on our earth. This is, says M. Encke, not an artificial assumption, but the force is immediately suggested from the nature of its effects.

An experiment made by the speaker in conjunction with Professor Tait was then described. This experiment was carried out by means of an ingenious mechanical contrivance invented and made by Mr. Beckley, of the Kew Observatory. The object of the experiment was to produce very rapid rotation in vacuo. This was accomplished by carrying a slowly revolving iron shaft up a barometer tube; at the top of this tube there was a large receiver, which might be considered analogous to the vacuum of a barometer, with the exception that it was exhausted by an air-pump, and not by the Torricellian process. In this receiver, by means of multiplying gear connected with the shaft, an aluminium disk, 13 inches in diameter and $\frac{1}{40}$th of an inch in thickness, was made to revolve with great velocity. When it was kept for thirty seconds at the full speed of eighty-three revolutions in a second, this disk was found to become heated nearly 1° Fahr., and this heating was independent both of the density and chemical constitution of the residual air of the vacuum.

The disk was insulated from its bearings by a piece of ebonite, so that very little heat could be conveyed from the bearings to the disk; besides, an experiment made by artificially heating the spindle showed that the effect observed could not be due to heating of the disk by the bearings. This heating effect, it was believed, was not due to rotation under the earth's magnetic force, nor to vibration of the disk; but the experiment was not quite finished: in the meantime, the evidence that it could not be explained by any known cause was very considerable, so that perhaps an explanation may be sought for in a resisting medium which we cannot get rid of.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

PHOTOGRAPHICAL SECTION.

April 12, 1866.

Dr. J. P. Joule, *F.R.S., &c., Vice-President of the Section, in the Chair.*

A paper was read entitled "*Note on the First Use of Hyposulphite of Soda in Photography,*" by A. Brothers, F.R.A.S.

During an investigation into the early history of photography, I met with the statement that Daguerre used hyposulphite of soda in his process for fixing the pictures, and also that in Mr. Talbot's patent the use of that substance was included. I was under the impression that Sir John Herschel had pointed out that hyposulphite of soda would fix the photographic image, but was unable to ascertain where or when the discovery was first published. In order to determine this point, I wrote to Sir John Herschel, requesting him to inform me whether the discovery was his, and the date when it was published. To these questions I received the following reply:—

"Colingwood, October 29, 1864.

"Sir,—I think I may very fairly claim the discovery of the hyposulphites as fixing agents, as I believe I was the first to call the attention of chemists to that class of salts and their peculiar habitudes, especially in relation to the insoluble salts of silver. In my paper 'On the Hyposulphurous Acid and its Compounds,' which bears date January 8, 1819, and which appeared in Brewster and Jamieson's *Edinb. Phil. Journal*, 1819, occur these words:—

"'One of the most singular characters of the hyposulphites is the property their solutions possess of dissolving muriate of silver and retaining it in considerable quantities in permanent solution.'—P. 11.

"'*Hyposulphite of Potash.*—It dissolves muriate of silver even when very dilute, with great readiness.'—P. 19.

"'*Hyposulphite of Soda.* . . . . Muriate of silver newly precipitated dissolves in this salt when in a somewhat concentrated solution in large quantity and almost as readily as sugar in water.'—P. 19.

"'*Hyposulphite of Strontia.* . . . . Like the rest of the hyposulphites, it readily dissolves muriate of silver, and alcohol precipitates it as a sweet syrup.'—P. 21.

"'*Hyposulphite of Silver.*—Muriate of silver newly precipitated is soluble in all liquid hyposulphites, and, as before observed, in that of soda with great ease and in large quantities. This solution is not accomplished without mutual decomposition, as its intense sweetness proves—a sweetness surpassing that of honey, and diffusing itself over the whole mouth and fauces without any disagreeable or metallic flavour.'—P. 27.

"In a second paper on the same subject, which appeared in the same journal, vol. i., p. 396 *et seq.*, it is shown (*inter alia*) that the affinity of this acid for silver is such that oxide of silver readily decomposes hyposulphite of soda and likewise the soda in a caustic state, 'the only instance, I believe, yet known of the direct displacement of a fixed alkali *viâ humidâ* by a metallic oxide.'—P. 397.

"'*Hyposulphite of Ammonia and Silver.*—Its sweetness is unmixed with any other flavour, and so intense as to cause pain in the throat. . . . One grain communicates a perceptible sweetness to 30,000 grs. of water.'—P. 399.

"In a third communication, dated November, 1819,—'The habitudes of this acid with the oxide of mercury are not less singular than its relation to that of silver.'—'The red oxide is readily dissolved by . . . hyposulphite of soda, while the alkali is set at liberty in a caustic state,' &c.

"The very remarkable facts above described, I have reason to believe, attracted a good deal of attention at the time, and thenceforward the ready solubility of silver salts, usually regarded as insoluble, by the hyposulphites was familiar to every chemist. It would not, therefore, be surprising if Daguerre tried it to fix his plates—*i.e.*, to wash off the iodide coating; but I have been informed, though I cannot cite a printed authority for it, that at first he fixed with ammonia, or with a strong solution of common salt. For my own part, the use of the hyposulphites was to myself the readiest and most obvious means of procedure, and presented itself at once. My earliest experiments were made in January, 1839, and in my notebook I find:—

"'Exp. 1012.—1839, Jan. 29. Experiments tried within the last few days, since hearing of Daguerre's secret, and also that Fox Talbot has got something of the same kind.' . . . [Here follow some trials of the relative sensitiveness of the nitrate, carbonate, acetate, and muriate of silver. I should observe that at that time I did not even know what kind of pictures Daguerre had produced. This process was not revealed till August, 1839.]

"'Exp. 1013.—Daguerre's process—attempt to imitate. Requisites: 1st, very susceptible paper; 2nd, very perfect camera; 3rd, means of arresting further action. Tried hyposulphite of soda to arrest the action of light by washing away all the chloride of silver or other silvering salt; succeeds perfectly. Papers half acted on, half guarded from the light by covering with pasteboard, were withdrawn from sunshine, sponged over with hyposulphite, then washed in pure water, dried, and again exposed. The darkened half remained dark, the white half white, after any exposure, as if they had been painted with sepia.'

"'Jan. 30, 1839.—Formed image of telescope with the aplanatic lens . . . and placed in focus paper with carbonate of silver. An image was formed in white on a sepia coloured ground . . . which bore washing with hyposulphite of soda, and was then no longer alterable by light. Thus Daguerre's problem is so far solved,' &c., &c.

"'Exp. 1014.—Jan. 30. Tried transfer of print and copper plate engraved letters,' &c.

"The publication of Daguerre's process (according to Dr. Monckhoven, for I cannot refer at present to the original document) took place on August 19, 1839. My early experiments printed in the notices of the *Proceedings* of the Royal Society of March 14, 1839, in which occurs this passage in the abstract of a paper read to the Society:—

"'Confining his attention in the present notice to the employment of chloride of silver, the author inquires into the method by which the blackened traces can be preserved, which may be effected, he observes, by the application of any liquid capable of dissolving and washing off the unchanged chloride, but leaving the reduced oxide of silver untouched. These conditions are best fulfilled by the liquid hyposulphites.'

"'Twenty-three specimens of photographs made by Sir J. Herschel accompany his paper—one a sketch of his telescope at Slough, fixed from its image in a lens.'

"This is the image above mentioned as having been taken on January 30, 1839—and was, I believe, the first picture ever fixed from an optical image ever taken in this country—at least I have heard of none earlier. At the time of making these experiments, as already mentioned, I had no knowledge of M. Daguerre's process further than the mention of the existence of a process (a secret one) in a note from Admiral (then Captain) Beaufort some time about January 23, 1839. Of course I used paper, not silver, and it was not a suggestion, but a regular and uniform practice to use the hyposulphite—I never used anything else.

"I am, Sir, your obt. servt.,

"J. F. W. Herschel."

In reference to the subject of fixing the photographic image, I find the following passage in a paper read before the Royal Society on January 31, 1839, by Mr. Talbot. After referring to the improvements of Wedgwood and Davy in 1802, and the difficulties they found in making the paper sufficiently sensible to receive the impression in a camera obscura, and their inability to fix the pictures, the author states that "his experiments were begun without his being aware of this prior attempt; and that in the course of them he discovered methods of overcoming the two difficulties above related. With respect to the latter, he says that he has found it possible by a subsequent process so to fix the images or shadows formed by the solar rays that they become insensible to light . . . . and states that he has exposed some of his pictures to the sunshine for the space of an hour without injury."

In the abstract of the paper given in the *Proceedings* the method adopted for fixing the image is not stated; but in a paper read before the same Society on February 21 of the same year, it is stated that the prints were fixed in a weak solution of iodide of potassium. Ammonia had been tried, but not very successfully, but the method preferred was a strong solution of common salt. It will be seen, therefore, that up to the date of the publication of Sir John Herschel's paper hyposulphite of soda had not been used in photography excepting by himself.

ACADEMY OF SCIENCES.

May 7.

Several communications "*On Suint*" were presented. This, as our readers will know, is the perspiration of sheep condensed on the wool. It is a kind of soap, the base being potash, which MM. Maumené and Rogelet propose to separate by evaporating the washings of fleeces and incinerating the residue. An account of their methods will be found in Dr. Hofmann's "Exhibition Report." M. Eymard now proposes to separate the fatty acids, which he believes to be good for greasing ropes. The chemical composition of suint has been investigated by M. Chevreul, who now adds another communication on the subject. He has discovered in it a large number of acids and bases also—indeed, twenty-nine bodies altogether. The acids are as follows:—Carbonic, phocenic, and an undetermined volatile acid x, a crystallisable fatty principle, probably an acid; stearine, elaieric, a colourless crystallisable acid; another, orange yellow and uncrystallisable; a nitro-sulphuretted acid—these three forming together a brown liquid; a nitro-sulphuretted matter insoluble in water; sulphuric, silicic, phosphoric, and oxalic acids. And now M. Chevreul adds another, *elic acid.* This is a liquid at ordinary temperatures, and has a density a little above that of water. It is colourless, reddens litmus, insoluble, or nearly, in water, but soluble in ether and absolute alcohol. It forms a baryta salt, which is soluble in a proper proportion of water, but a dilute solution deposits a superelate. Here, says the author, is a fatty acid, affecting the form of oleic acid, but giving a soluble baryta salt, soluble in water, which, in an excess of water, behaves like the soluble stearates and margarates. MM. Maumené and Rogelet describe suint as neutral: M. Chevreul says he always finds it alkaline. The former chemists assert that no soda is present in it: M. Chevreul hints his disbelief in that statement.

M. A. Boillot made a discovery, and sent a sealed note to the Academy on the 12th of March last. It was opened at the writer's request to-day, and found to be a paper *On the General Phenomena of Combustion*, in which the author enunciates the following proposition:—*Combustion consists in the combustion of bodies with the production of heat, often accompanied by light.* He has discovered that oxygen and a jet of atmospheric air will burn in an atmosphere of hydrogen, and in a second paper gives instructions for demonstrating the fact, his method being exactly that which is always adopted for showing the well-known experiment.

MM. Naquet and Longuinine sent a note *On Bromocuminic acid*, which they form by exposing cuminic acid to the vapour of bromine. It is a body offering no particular interest.

M. Bechamp sent an analysis of the water of Vergese and the gases escaping from the source. There was nothing remarkable in either.

The MM. Halphen exhibited to the Academy *a remarkable diamond.* Naturally it is of a light-brown colour, but when strongly heated, it assumes a rose colour, which it retains for eight or ten days. It seems to retain this property indefinitely, for the experiment has been repeated five times. MM. Halphen have met before with a stone which became rose-coloured when rubbed, but the colour vanished almost immediately. The stone now exhibited, which weighs four grammes, is valued at 60,000 francs; but if the rose colour were permanent, it would be worth 150,000 or 200,000 francs!

NOTICES OF BOOKS.

Third Report of the Commissioners Appointed to Inquire into the Origin and Nature, &c., of the Cattle Plague; with an Appendix. Presented to both Houses of Parliament. London: Eyre and Spottiswoode.

This final report of the Commissioners is scientifically the most important of the documents issued by the Commission. It deals with the nature, propagation, progress, and symptoms of the disease, its general pathology and its relation to human diseases, its chemical pathology and morbid anatomy. It gives also microscopic researches on morbid discharges, details on the modes of treatment, and lastly, experiments to ascertain the best modes of preventing the spread of the contagion. Having had a share in these last investigations, we propose in future numbers to lay the results before our readers, assured that in a matter of such moment, not only as regards the spread of cattle plague, but of all zymotic diseases, the subject cannot fail to be of great interest.

Dr. Marcet's investigations on the chemical pathology will also offer some points of much interest to chemists. Dr. L. Beale's researches with the highest magnifying power yet produced failed to reveal the existence of any definitely formed substance that could with certainty be said to be the cause of cattle plague, and "chemistry," the report adds, "has as yet found no complex albumenoid matter in a state of rapid chemical change capable of communicating its own action to the albumen of the blood and the textures of the cattle." The true pathology of the disease is, it must be admitted, not clearly understood, and the results of the best considered and most rational treatment are extremely unsatisfactory. It must be admitted, the Commissioners say, that in this, as in other countries, no drug has been found which can be recommended as either an antidote or a palliative. Under these circumstances, preventive measures must occupy the most attention, and among these disinfection stands foremost. Experiments seem to show that disinfectants can do much to prevent the spread of the disease; and the Commissioners very properly observe that "a fair case has been made out for a large and systematic trial of these measures." "They must, however," it is added, "be fairly tried; they must be used with energy and perseverance—not grudgingly or insufficiently, but with the determination to keep the disinfectant in the presence of the poison everywhere and constantly, so that every particle of virus may be, without fail, subjected to its action." By such measures we have a confident belief that the spreading of the disease may be controlled, and for this reason we are anxious to give as much publicity as possible to the knowledge of what have proved the most effective agents, and the best means of ensuring success in their employment.

Journal für Praktische Chemie. No. 4. 1866.

There is little to notice in this journal, now usually twelve months behind. The first article is *On the Sulphur Compounds of Uranium*, by Dr. A. Remelé, which adds but little to the information contained in the paper by the author, published in the Chemical News for 1864 (vols. IX and X.) Some remarks on the separation and estimation of uranium by means of sulphide of ammonium we may extract.

The only original paper is by Dr. A. Classen *On the Estimation of Oxide of Silver as Metallic Silver*, which he precipitates by means of metallic cadmium. The author has suggested before the same method of reducing a copper solution, and weighing the copper in metallic form. The objections to the use of the ordinary zinc for the purpose are sufficiently obvious; the author finds, however, a stick of cadmium to answer very satisfactory. The process for silver will be found in another part of our columns.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

1046. J. M. Macrum, Hill Street, Knightsbridge, Middlesex, "Improvements in the apparatus and processes for tanning."—A communication from J. Johnson, Alleghaney, Penn., U. S. A.—Petition recorded April 13, 1866.

1098. W. Oldham, H. Penn, and C. Eades, Birmingham, "Improvements in collecting or condensing and utilising the fumes given off by furnaces used in the manufacture of copper and in other metallurgical operations, which improvements may also be applied to the collecting or condensing of fumes from other sources."

1102. R. Hamilton, St. Helen's Place, London, "An improved composition for coating or covering ships' bottoms and other surfaces subjected to the action of sea-water."—A communication from J. Beeston, Table Bay, Cape of Good Hope, and I. Spence, Cape Town, Cape of Good Hope.

1107. E. C. Nicholson, Fenchurch Street, London, "Improvements in the manufacture of blue colouring matters suitable for dyeing and printing."—April 19, 1866.

1108. G. Lunge, Ph.D., South Shields, Durham, "Improvements in the manufacture of carbonates and bicarbonates of soda and potash."—April 20, 1866.

1132. F. C. Buisson, Nantiat, France, "Treating and applying a certain vegetable plant for the purposes of the tobacco plant."—April 21, 1866.

1163. G. E. Noone, Hastings, Sussex, "Improvements in machinery and processes for deodorising and treating sewage and other refuse, and manufacturing therefrom manure and other substances for chemical and other uses."

1167. A. Borgnet, Swansea, "Improvements in furnaces, retorts, and apparatus for smelting or treating zinc and other ores."—April 25, 1866.

Notices to Proceed.

3374. E. J. Hughes, Manchester, "Improvements in the manufacture of aniline green." A communication from C. Lanth, Paris.—Petition recorded December 29, 1865.

31. W. E. Newton, Chancery Lane, "Improvements in distillation." A communication from A. Lugo, New York, U.S.A.—January 4, 1866.

202. W. Jeffries, West Bromwich, Staffordshire, "Improvements in puddling furnaces and heating furnaces, and other reverberatory furnaces used in the manufacture of iron and steel."—January 22, 1866.

383. P. A. F. Bobœuf, Rue Buffault, Paris, "Improvements in the manufacture of artificial coal tars and their solid derivatives, such as phenical soaps and salts."—February 8, 1866.

773. A. G. Lock, Roseland, Millbrook, Hants, "Improvements in the manufacture of manures."—March 25, 1866.

1058. T. Gray, Mitcham, Surrey, "Improvements in the manufacture of soap, or in the preparation of materials applicable to such manufacture, or for dressing or finishing textile fabrics."—April 14, 1866.

CORRESPONDENCE.

Continental Science.

Paris, May 12.

The journals unfortunately offer very little worth communicating in the shape of gossip. M. Jamin, perhaps our most eloquent lecturer, brought the series of lectures for the Benevolent Fund to a most brilliant close. His lecture was attended by the Empress, who, on this occasion, brought the Prince Imperial with her. The theatre of the Conservatoire was crowded in every part, and a large number were turned from the door for want of space. What the audience at the Royal Institution would have done, I can't tell; but the lecture lasted two hours, and here no one moved from his or her seat. It may have been that the presence of royalty restrained impatience, and yet I am inclined to think that no impatience could be felt in the presence of such a lecturer and in sight of such experiments. M. Jamin astonished the Parisian fashionables by showing them liquid protoxide of nitrogen and solid carbonic acid, and the effects that could be produced by them. Mentioning solid carbonic acid reminds me that a quantity was recently sent without accident from Paris to Nancy by railway. There was no reason that this should not be, if the cylinder was sufficiently strong, but it was the first time that solid carbonic acid had travelled, and some apprehensions were entertained. It is mentioned in *Les Mondes* that M. Brette has made a large number of experiments on rifled arms, to determine the deviation of the projectile under the double influence of the resistance offered by the air and the earth's movement of rotation. The end of it is that M. Brette has succeeded in producing such a modification in the grooving that the two influences are made to compensate each other, and the projectile consequently follows a normal path.

Dr. Muspratt's Chalybeate.

To the Editor of the Chemical News.

Sir,—I wonder you insert anonymous letters in your journal, which is so well and ably conducted. Who is E. A. H.? Will he remain "in humble obscurity," or can I induce him to give me his name? The water has been analysed from time to time by *first-class chemists.* Is it not most strange that the *protochloride of iron* was only discovered in it *last August?* I feel convinced *it must have been there years ago.* I again repeat, in spite of all your correspondents may say or write, "I feel proud in being the first chemist who has discovered this salt (FeCl) in a potable water."

Give me the avow'd, the erect, the *manly* foe, &c.

I am, &c., Sheridan Muspratt, M.D.,
Professor of Chemistry.

College of Chemistry, Liverpool, May 14, 1866.

[It is due to ourselves to state that purely anonymous correspondence is never inserted in the Chemical News. The letters we have printed were written by gentlemen, chemists of repute, who chose, however, only to sign initials for publication; and we saw no reason to refuse insertion to the letters on that account.—Ed. C. N.]

Pyrotechnic Experiments.

To the Editor of the Chemical News.

Sir,—On looking over a number of receipts, collected among my earlier days of chemical experimenting, I came upon a number of original receipts for coloured stars, for rockets, Roman candles, and shells, which, as they were the result of many experiments, I can confidently recommend as very brilliant in colour and good, and I venture to hope that not only amateurs, but even some professional pyrotechnists, may find the receipts serviceable, for even in professional exhibitions some of the colours are often sadly wanting in brilliancy.

The ingredients for each of these stars for rocket heads, &c., is powdered separately, and then the whole is made up into a thick paste with water, which is rolled out to the proper thickness and punched into square stars and carefully dried till quite hard.

1. Red Stars.—Dried nitrate strontia, 4; chlorate potash, 2; sulphur, 2; black sulphide antimony, 1.

2. Green Stars.—Nitrate baryta, 5; chlorate potash, 2; sulphur, 2; black SbS_3, 1.

3. Lilac Stars.—Chlorate potash, 49; sulphur, 25; chalk, 20; black CuO, 6.

4. Purple or Blue Stars.—Chlorate potash, 42; pure nitrate potash, 22; Sulphur, 22; CuO, 10.

With regard to the remaining receipts, I am not able to state whether they are original or not at this distance of time; still, as they are all well proved, I venture to send them, if they will not take up too much room in your journal:—

5. White Stars.—Saltpetre, 16; sulphur, 4; black sulphide antimony, 5.

Blasting powder at 6d per lb. reduced to powder is meant in the following receipts:—

6. Tailed Stars.—Blasting powder, 8; sulphur, 8; saltpetre, 8; coarse charcoal, 8.

Charge for 2 oz. Rockets.—Blasting powder, 20; charcoal, 6; saltpetre, 4. A moderate amount of blasting powder for the head to light and disguise the stars.

Composition for Roman Candles between the stars lying on powder at 1s. 3d. per lb. Saltpetre, 5; blast powder, 1½; sulphur, 1; sand, 1.

Spur Fire.—Saltpetre, 4½; sulphur, 2; finely powdered and mixed, and then gently rubbed with lampblack 1½; pack in cases 6 inches long and ¾ internal diameter.

So far for the receipts.

Having had occasion to speak of baryta and strontia, I may as well take this opportunity for mentioning a fact the discovery of which some years ago interested me much, and may prove interesting to such of your readers as are mineralogists, and know Clifton from its beautiful suspension bridge or otherwise. Geological books state that sulphate of baryta exists in our Clifton rocks. After much trouble in my early days, I found it in the form of red veins traversing the limestone cliffs. No other sulphate of baryta, I believe, was known in the neighbourhood. Sulphate of strontia, I believe, was not known to be found nearer than Aust-passage, until a quantity was found at Pyle-hill railway cutting, Bristol, a few years ago, and I once found some crystals at Clevedon, twelve miles distant, in the sea cliffs. But during the last few years a number of fields running directly eastwards from the Clifton Downs towards Cotham, and familiar from childhood, have been disturbed, the grass has been taken up, and numberless buildings erected. This has disclosed lying horizontally over the upturned limestone strata forming the Clifton rocks and downs, a layer of new red sandstone of pale yellow colour. This layer abounds in masses of white pulverulent sulphate of baryta and fine crystals of sulphate of strontia.

I am, &c. E. A. H.

MISCELLANEOUS.

University College.—Chemical Prizemen for 1865-66.—Gold medal, Theodore Maxwell; 1st silver medal, Alfred Shewen; 2nd silver medal, Frederick Leonard. Certificates—4th, R. T. Smith; 5th, Alexander Muirhead and W. W. Houlder, equal; 6th, Alexander Gray and Frank Salter, equal; 7th, J. R. W. Seymour; 8th, J. Hallowes; 9th, R. Parker; 10th, John Cameron Graham and G. Benczedi, equal.

The Royal Academy.—The Academy have submitted a number of resolutions to the First Commissioner of Works, including the following:—"The recommendation of Her Majesty's Commissioners, that there should be a chemist and a laboratory attached to the Academy, to submit colours and vehicles to practical tests, entirely commands the sympathy of the Royal Academy, the question of space alone preventing its immediate adoption."

Pharmaceutical Society.—The annual conversazione of the Pharmaceutical Society was given on Tuesday evening last, and was extremely well attended. The objects exhibited were, as usual, numerous and of great interest. In the course of the evening Dr. Thudichum gave a lecture in the theatre on the trichina spiralis, exhibiting specimens both of the living and dead animal by means of the oxyhydrogen light. After this, Mr. Debenham took a photograph of the audience by the aid of the magnesium light, igniting an ounce of magnesium filings at one instant. We hope the photograph will prove a success, which is promised by the success of a trial picture taken on the previous evening. In another room Mr. Samuel Highley exhibited a number of enlarged microscopic and other objects on the screen by the aid of his lantern and the lime light. The exhibition of microscopes was very extensive, comprising instruments by the best makers, Ross, Murray and Heath, How, Horne and Thornthwaite, and several others. Mr. Spencer Browning also exhibited some useful spectroscopes. Messrs. Horne and Thornthwaite also exhibited a most ingenious engine, devised by Mr. Acland, for dividing tubes, eudiometers, burettes, thermometers, &c. Mr. Ansell showed and described his diffusion instruments for detecting firedamp in mines, which we are pleased to see have attracted the attention of royalty, Tuesday's *Court Circular* informing us that Prince Alfred had, by her Majesty's desire, visited Mr. Ansell to inspect his instruments. Among the special novelties was Schultze's electrical induction machine, exhibited by Dr. Bence Jones. Of this marvellous machine we shall hope to give a full description in a short time. Another novelty was a number of joints of meat enveloped in paraffine, according to Dr. Redwood's process. Around the walls were displayed beautifully mounted specimens of ferns and seaweeds by Mr. Jardine, together with some fine pictures contributed by Mr. Vokins and others. One which attracted much attention was the portrait of Mr. Jacob Bell hastily sketched only a few days before his death by Sir E. Landseer. Professor Bentley, as usual, brought a number of rare and interesting plants, one of which was Sarracenia purpurea in flower. Among the strictly chemical and pharmaceutical objects we noticed various salts by Messrs. Morson and Son, Hopkins and Williams; metallic oxides and a platinum still by Johnson, Matthey, and Co.; nitrate of silver and pure silver by Johnson and Co.; pure ether for anæsthetical purposes by Mr. Robbins; and pancreatised fats by Mr. Schweitzer. We ought not to omit mention of a small Carre's freezing apparatus, exhibited in operation by Mr. Sheppard, showing how the kitchen fire may be used for the production of ice as well as boiling water. We doubtless overlooked many things of interest, for the number was embarrassing; and all we need say is that every visitor must have left the rooms much gratified and instructed.

Explosive Oils.—The importation of nitro-glycerine (glonoin oil) was the subject of a very interesting discussion at the Mersey Dock Board on Thursday. In the course of the conversation it came out that the very packages which blew up the *European* and destroyed the town of Aspinwall had been forwarded from Germany to Hamburg, thence to Hull, and thence by railway to Liverpool. "A small quantity was sufficient to shatter a block of iron of thirty tons, and it might have caused the utmost destruction at Liverpool." A gentleman present stated that the trade was so lucrative that "the most fraudulent means were adopted in the forwarding of these oils, and that they were described under all kinds of evasive names. Packages containing these destructive articles were frequently covered with canvas, to represent Manchester goods. He personally knew an instance in which seventy cases of glonoin oil had been shipped at London—a sufficient quantity, had it exploded, to have shaken the metropolis to its centre, and destroyed an immense amount of property." At present, it appears, the Board is only empowered to impose a fine where goods of this kind are insufficiently described. They are now going to ask Parliament to render such an act criminal, and that powers should be taken to punish local agents for foreign houses where necessary.—*Pall-Mall Gazette.*

Nitro-Glycerine Defended.—Because nitro-glycerine is capable of producing the most disastrous effects, some over-timid people cry out that its use should be forbidden by the Legislature. But in spite of this outcry we believe its enemies will be defeated; that it is capable of being made of the greatest service in industrial operations; and that as its properties become better known, danger of accident may be prevented. In the meantime the greatest precaution should be used in the storage, shipment, and employment of this formidable servant. The early uses of gun-cotton and even gunpowder were full of alarming and fatal results, and in the case of the latter, even at the present time—when it is supposed to be so well understood—whole hecatombs of lives are being sacrificed. Scarcely a day passes in the Western Mining regions without its record of from one to half a-dozen accidents from ignorance in handling powder—and ignorance is really the cause of fatality in the handling of nitro-glycerine. So with gun-cotton when first introduced. The disasters occasioned by ignorance of its qualities were terrible. Yet it is now manufactured, stored, and carried by express, with comparatively slight risk, because the means of keeping it in safe condition are known. Professor Seeley—the largest manufacturer of gun-cotton in the world—exhibited this very lucidly to the Association for the Advancement of Science and Art, at a recent meeting. Said he: "When I first commenced making gun-cotton, the neighbours, greatly alarmed, ran hither and thither to different authorities, and presently I had a visit from the insurance agent, who entered my office in a somewhat excited state with: 'Sir, is it true that you store gun-cotton here?' 'Yes,' I replied, 'I have gun-cotton here; there are about 80 lbs. in that box.' 'But, sir,' he retorted, 'do you not know that it is against the law?' 'On that point,' said I, 'we may differ; but let me show you that there is no danger.' So I took a newspaper, folded it, lighted it at the gas and advanced to the box, while the agent hastily retreated in an opposite direction. Opening the box I put in the lighted paper. Of course there was no explosion, as I knew the properties of the substance I was manufactuing, and that gun-cotton, when kept wet, will not explode. So with nitro-glycerine; if the whole body of the oil be kept below a certain temperature, it will not explode. If you light the top of a flask containing nitro-glycerine, it will burn away gradually, like naptha. If you let fall a spark into it, no explosion will take place; but put it in a close vessel, on a heated place, even though the oil be covered with water, and so soon as it reaches a temperature of 360° Fahrenheit, it will explode with the greatest violence, because the component parts will unite with such suddenness." From the Professor's remarks we also learned that the recent explosions were caused by spontaneous combustion. The oil had been so packed that it became overheated, and explosion ensued. In the New York city explosion, the nitro-glycerine was stored in large carboys and packed in saw dust. The advantages attending its use are; among others, that it can be manufactured very cheaply; ordinarily at 50c. per lb., and in large quantities probably at 25c. per lb. It can be easily transported, on account of its occupying so little a space in proportion to its weight. It can be poured like water wherever it is needed, and can be "tamped" with water. Smaller holes can be used than when blasting with gunpowder, and from the suddenness of its explosion the effect is much more decisive. It was asked at the meeting whether the nitric acid and the glycerine could not be combined at the mines, or other places, where the nitro-glycerine is to be used. To this it was answered: "Not conveniently, because three times more bulk of nitric acid has to be used in the preparation than nitro-glycerine contains when prepared." This objection, however, refers only to transportation to distant countries. In mines near the Atlantic seaboard there will be no difficulty in conveying the nitric acid separate from the glycerine. It is stated that in Sweden, Germany, and elsewhere, nitro-glycerine has already superseded other mining explosives. How silly, then, to imagine that unenlightened popular clamour will banish it from this progressive country.—*American Journal of Mining.*

Meetings of the Week.

Saturday, May 19.

Royal Institution, 3 p.m., Professor Huxley, "On Ethnology."

Tuesday, May 22.

Royal Institution, 3 p.m., Professor Ansted, "On the Application of Physical Geography and Geology to the Fine Arts."

Medical and Chirurgical Society, 53, Berners Street, 8½ p.m.

Wednesday, May 23.

Society of Arts, John Street, Adelphi, 8 p.m.

Thursday, May 24.

Royal Institution, 3 p.m., Professor Huxley, "On Ethnology."

Friday, May 25.

Royal Institution, 8 p.m., Alexander Herschel, Esq., "On the Shooting Stars of the Years 1865-6."

ANSWERS TO CORRESPONDENTS.

Vol. XII. 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., II., and VII. are out of print. All the others are kept in stock. Vol. XIII. commenced on January 5, 1866, and will be complete in 26 numbers.

⁂ 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.

⁂ We must impress on our correspondents that no letters are ever inserted in the Chemical News unless authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

J. Bourne.—By post, 4s. 7d.

A. A. H.—Received.

J. Hargreaves.—Your communication will be inserted when the engraving is made.

W. P.—We have said above that we consider the advertisement intended for a joke. If it is not, we agree with our correspondent, that it is a disgrace to the advertiser.

J. H. Thorne.—The colour is separated from the tarry matter by treatment with hot water acidulated with an acid. The crystals are obtained by careful evaporation.

Assayer.—We do not know the name of the Registrar, but you may obtain the regulations through a foreign bookseller. Dr. Hofmann is at the University of Berlin.

A Young Chemist who does not wish to be a Waiter.—We see nothing so objectionable in the advertisement as would call for its exclusion from our columns. We cannot help suspecting that it was intended for a joke; but if it were not, we do not see why our correspondent or any other reader should feel himself insulted. Surely, if it is true that assistants are occasionally expected to wait at table, the fact cannot be too widely known to young chemists.

Books Received.—"The Chemistry of Common Things," by S. Macadam, Ph.D., F.R.S.E., &c.; "On Asiatic Cholera," by F. A. Burrall, M.D., New York.

Received.—J. J. Declined with thanks C. O. Paget; "A True Lover of Chemistry;" F. Tibbs.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Crystallised Oxides of Antimony and Antimonites,[*] *by M.* A. Terreil.

In this work I propose to determine the physical and chemical properties of two dimorphic conditions of oxide of antimony, obtained in the dry way, to examine the precise conditions under which these bodies are produced, and to compare with these oxides those obtained by the wet way, and which have hitherto been considered as anhydrous oxide of antimony of the octahedral form.

It is well known that Wöhler was the first to ascertain the dimorphism of oxide of antimony, since which the natural oxide of this metal has been found under its two crystalline forms—that is to say, in prisms constituting exitèle and in octahedral constituting senarmontite.

It is also known that in the preparation of flowers of antimony small octahedra are often found among the prismatic needles; but these octahedra are always few in number, and it is not known under what conditions they are formed.

In studying the preparation of these two oxides I arrived at the following results:—

By burning antimony, or the sulphide of this metal, in contact with the air, the prismatic oxide is always produced.

Oxide of antimony of the octahedral form is produced only by the slow sublimation of prismatic oxide in non-oxidising gases, the temperature not passing a dull red.

This phenomenon of slow sublimation takes place on a large scale in the mines of Sensa, in Algeria, where the oxide of antimony is found under its two crystalline forms, but clearly separated one from the other; the exitèle and senarmontite there run in nearly parallel veins, separated by about six kilometres.

Rapidly sublimed octahedral crystals become transformed to prismatic crystals.

Oxide of antimony may easily be obtained under its two crystalline forms at the same time by causing a current of dry air to arrive extremely slowly in a porcelain tube, in which has been placed a boat containing the antimony, and then heating the part of the tube containing the metal. When the operation has lasted several hours, the heating is continued by placing some lighted charcoal towards the part where the prismatic crystals should be deposited, so as to heat the tube to redness from below.

If, after this has lasted twelve hours, the tube be broken, the part near the metal will be found quite full of prismatic crystals, the middle part will contain prismatic oxide with octahedral crystals on its crystals, often extending over a millimetre, and giving a very pretty effect; finally, the extreme part of the tube will contain octahedral crystals only.

The prismatic oxide of antimony presents stronger chemical affinities than the octahedral oxide, while the latter is most stable. In fact, hydrosulphate of ammonia immediately colours prismatic crystals red brown, and completely dissolves them, while the hydrosulphate does not alter the octahedral crystals which remain white and brilliant in the reagent, but they lose this curious property when reduced to a fine powder.

The prismatic oxide dissolves more readily in acids and alkaline solutions than the octahedral oxide.

The densities of the two oxides differ greatly—that of the prismatic oxide being equal to 3·72, that of the octahedral oxide to 5·11.

The densities of natural and artificial oxides are the same under the same forms. Having carefully examined the densities of natural oxides, I found, in fact, for very pure crystals of Algerian exitèle 3·70, and for senarmontite 5·20. I have, moreover, ascertained that natural oxides possess the same chemical properties as artificial oxides.

After this study of oxides prepared by the dry way, I began the examination of the oxide obtained in the wet way. I found that the crystallised compounds deposited in alkaline liquids containing protoxide of antimony, and which are often found in kermes, are hydrated antimonites of soda corresponding in composition to a neutral antimonite of soda with six equivalents of water, or to a terantimonite of soda with two equivalents of water; these compounds have been hitherto considered as anhydrous oxide of antimony of the octahedral form.

Analysis has given the following numbers of the centesimal composition of these antimonites:—

Neutral antimonite.	Numbers. found.	Numbers. calculated.
Protoxide of antimony .	62·83	63·05
Soda	13·47	13·47
Water	23·70	23·48
	100·00	100·00
Terantimonite.		
Protoxide of antimony .	90·40	89·88
Soda	6·35	6·40
Water	3·25	3·72
	100·00	100·00

These numbers correspond to the formulæ—

$NaO.Sb_2O_3.6HO$ (neutral antimonite),

and—

$NaO.3(Sb_2O_3).2HO$ (terantimonite).

Neutral antimonite of soda is in the form of small octahedral crystals, belonging apparently to the rectangular system. These crystals depolarise light, and often present the phenomenon of coloured rings, accompanied by black hyperbolic crosses; they are white and very brilliant, becoming opaque when changed, by the action of heat, into anhydrous antimonite. Their density is equal to 2·864.

Hydrosulphate of ammonia does not alter them.

Neutral antimonite of soda is very slightly soluble in water; a boiling solution deposits, during the process of cooling, almost the whole of the salt dissolved. The crystals deposited always tightly adhere to the sides of the vessel.

The solution of neutral antimonite of soda presents the following distinctive characteristics:—It is neutral with coloured reagents, has often an opaline appearance, it precipitates nitrate of silver white, the precipitate rapidly collects together, it is soluble in diluted nitric acid, ammonia colours it first dark brown, then dissolves it and takes away its colour; this last reaction is entirely characteristic.

The solution precipitates chloride of barium only when ammonia has been added.

Sulphuretted hydrogen and hydrosulphate of ammonia precipitate this solution only when it has been previously acidulated. Sulphuretted hydrogen, however, colours the neutral liquid light yellow, but forms no precipitate,

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[*] *Annales de Chimie et de Physique,* vii., 350.

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Acids, alkaline bases, alkaline and earthy salts, produce no turbidity in this solution.

Neutral antimonite precipitates the salts of peroxide of iron yellowish white, acetates of lead white, sulphate of copper bluish white, nitrate of protoxide of mercury white; all these precipitates are soluble in nitric acid. With bichloride of mercury and chlorides of gold and platinum no apparent reaction is produced.

Terantimonite of soda is rarely to be obtained; it is deposited very slowly in large crystals, in very concentrated alkaline liquids; it is almost insoluble in water; its density is equal to 5·05; it crystallises in the same system as neutral antimonite of soda; its crystals are altered by hydrosulphate of ammonia, which colours them red brown, and dissolves them slowly, but completely; this property distinguishes this salt from the octahedral oxide, with which it might otherwise be confounded.

I have as yet found it impossible to obtain crystallised antimonite of potash, and the few crystals, always deposited in a solution of protoxide of antimony in potash, are but crystals of antimonite of soda, potash always containing a certain quantity of this base.

The solution of oxide of antimony in potash is not immediately precipitated by salts of soda, but it sooner or later deposits crystals of antimonite of soda.

The results of these observations are:—

1. That oxide of antimony crystallised under the octahedral form is formed only by the slow sublimation of prismatic oxide in non-oxidising gases, and never by the direct oxidation of antimony or its sulphide.

2. That the densities of the two oxides differ much, one from the other, but that the densities of the natural and artificial oxides are the same for the same crystalline forms.

3. That prismatic oxide of antimony presents more fully developed chemical affinities than octahedral oxide, which is, however, more stable.

4. That the crystallised compounds deposited in alkaline liquids containing protoxide of antimony, and frequently found in kermes, are perfectly defined hydrated antimonites of soda.

TECHNICAL CHEMISTRY.

On the Application of Disinfectants in Arresting the Spread of the Cattle Plague—Report to Her Majesty's Commissioners, by William Crookes, *F.R.S.*

Part I.—*Theoretical Considerations as to the Propagation of the Cattle Plague.*

1. Previous to my receiving instructions from the Royal Commission for inquiring into the origin and nature of the cattle plague, I had devoted considerable attention to the investigation of the applicability of disinfectants to the prevention or cure of this pestilence, ever since its first appearance in England, and had tried numerous experiments both in the laboratory and also on a large scale in farmyards. I was therefore not unprepared to commence at once the practical operations which it was considered desirable to carry out.

2. As to the bare fact of the infectious* nature of the cattle plague all are agreed. That contamination of some kind is communicated from a diseased to a healthy animal is obvious to every one; but when we inquire by what agency the disease is carried, the answers are of the most conflicting kind. Something, evidently a material substance, passes from one beast to another; but what is this something? Is it a solid, a liquid, or a gas; living or dead; an animal or a vegetable germ; a poison, virus or ferment? Each of these views has found advocates, and in favour of each something may be said.

3. There are weighty reasons for deciding that the infecting matter is neither a gas nor even a volatile liquid. The almost infinite attenuation which a gas undergoes owing to its rapid diffusion into the atmosphere, would render its supposed noxious influence imperceptible a few yards from the focus of infection. Moreover, the infection is capable of being carried considerable distances in clothing or running water, and in a variety of ways incompatible with the behaviour of gases. For these reasons, and many others unnecessary to adduce here, it seems clear that the disease must be communicated by the agency of solid, non-volatile particles.

4. The specific disease-producing particles must, moreover, be organised, and possess vitality; they must partake of the nature of *virus* rather than of *poison*.† No poison yet known to chemists can approach, even in a faint degree, the tremendous energy of the active agent of infectious diseases. A poison may be organic, but it is not organised. It may kill with far greater rapidity than the virus of infection, but, unlike this virus, it cannot multiply itself in the animal economy to such an extent as to endow within a few hours every portion of its juices with the power of producing similar results. A virus, on the contrary, renders the liquids of an infected animal as virulent as the original germ. Strychnine may be regarded as the type of a poison, and vaccine matter as the type of a virus.

5. Many considerations tend to show that the virus of cattle plague is a body similar to vaccine lymph, and consists of germinal matter, or living cells, possessing physiological individuality, which, if not exposed to extremes of heat, cold, or dryness, are capable of preserving their activity for a certain time outside the living organism, of adhering to material objects, and of being carried from one place to another by currents of air; each, when introduced into the blood, requires a certain time (known as the period of incubation) during which the septic germs develope and multiply, until they have so far poisoned the blood that the ordinary symptoms of disease become manifest.

The blood poisoning thus set up may legitimately be called "fermentation;" it is a decomposition caused by the act of nutrition of the living cell, whereby it reproduces in incalculable numbers the specific septic germs which have given it birth. These gradually infest the blood and other animal liquids, and as the disease progresses are discharged from the skin, throat, glands, &c.; the breath, perspiration, and excreta of the animals forming vehicles for the distribution of the virus. By "living" cells is not meant living, in the sense in which an animal, or even a low form of infusoria, lives; but living as a

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* I have throughout this Report used the word "infectious" in preference to "contagious." The limitation to actual contact involved in the word *contagious*, and the popular opinions which the use of these words foster, that some diseases are infectious and not contagious, whilst others may be contagious though not infectious, imply a far more profound knowledge of the way in which diseases are transmitted than we yet possess. I therefore prefer the wider term infectious, as being more applicable to our present knowledge on the subject.

† The words *virus* and *poison* are generally regarded as synonymous. It would be more convenient, and would tend to promote accuracy of thought, were the distinction here made generally adopted.

seed, or as vaccine matter, even when dried, may be living, inasmuch as it still possesses reproductive vitality.

6. It is by no means certain that the multiplication of these individual cells is the immediate cause of the blood poisoning. The analogy of the action of virus on the blood to that of yeast on sugar renders it more probable that this is not the fact. In the case of the best known ferment—yeast—its cells multiply by feeding upon the sugar in the liquid; alcohol and carbonic acid being their excretions. It is therefore probable that during the multiplication of the virus cells, they, in a similar manner, impoverish and weaken the blood, by feeding upon some element in it, whilst at the same time they excrete a poison to which the symptoms of the disease may be immediately due.

7. The foregoing view differs from the prevalent notion that the virus of contagion consists of decomposing organic matter, declining from a complex towards a more simple chemical constitution, and during its degradation inducing decomposition in the neighbouring particles of matter. This chemical theory at first sight appears very plausible; but it fails to satisfy one necessary condition of the present case. It is possible to imagine that the force set free in the declension of a complex chemical molecule to a more simple form will be sufficient to raise a neighbouring molecule to a structure almost as complicated as the original; but according to this view the ferment would be constantly diminishing, whereas in reality it constantly increases in bulk. The hypothesis is therefore insufficient to explain the prodigious procreative power of the original particle. This power belongs only to the nature of an organised germ, capable of producing multiples of itself by a process of nutrition and subdivision. Thus the line of demarcation between organic poison and organised virus appears to be very clearly defined.

This necessarily brief outline of the theoretical views which have governed me in the present investigation will, it is hoped, be clearer and more intelligible after perusing the experimental proofs which follow. They have been corroborated by numerous small laboratory experiments, as well as by practical operations at different farmhouses.

8. Whether this theory thus briefly sketched be adopted or not, or whether it be regarded as a provisional scientific artifice, it certainly includes and explains a far greater number of the phenomena of pestilence than any other hitherto propounded. Moreover, it is the theory sanctioned by the most influential of those medical philosophers who have the best right to be heard on this subject, and notably by the distinguished Registrar-General, Dr. Farr, who by the adoption of the word zymotic, in his classification of diseases, has implied his adhesion to this theory.

9. Bearing upon the communicability of this disease are other questions, which hitherto have not received a satisfactory settlement. How does the virus travel? What amount of resistance to ordinary conditions of moisture and time does its vitality confer upon it? Will it propagate and multiply, outside the animal body, under favourable conditions of warmth and moisture? And can we find any chemical disinfectant or antiseptic which will readily destroy it?

The extreme communicability of the pestilence may arise either from the eminently diffusible character of the virus-cells, or from their persistent vitality, or from both conditions combined. It is proved that the *materies morbi* will adhere to clothing, and can be carried a considerable distance in it; that the breath, perspiration, and evacuations of the diseased animal are loaded with virus-cells; and that the secretions from the mouth, nose, and eyes are in a similar condition. It follows, therefore, that the sheds, in which diseased animals have stood, become impregnated with the virus, ready to settle on the clothes of every one who enters; that ponds, streams, and even wells may become contaminated through foul soakage; that a road over which diseased cattle have been driven may be poisoned along its whole distance by the evacuations and other discharges from the animals; whilst their very breath, carried by the wind, may plant the seeds of infection in all the healthy farms by which the road passes.

There is no difficulty in admitting that the infection may travel for a certain limited distance through the air, and it is even likely that it may be carried longer distances by fogs, or heavy vapours, or by the gases of putrid decomposition; but it appears in the highest degree improbable that the germs should be able to retain their vitality for any length of time in the atmosphere.

10. Sufficient data do not at present exist to decide whether the germs can propagate themselves apart from the animal. Viewing them as of the nature of a ferment, it is not impossible that they may live and multiply in other warm liquids besides the blood; but the most reasonable supposition seems to be that the presence of decaying organic matter, or the gaseous emanations from putrefying dunghills, preserves, or may even revive, the expiring vitality of germs brought by men, dogs, birds, vermin, or perhaps the wind; whilst the same causes which foster the virus-cells—dirt, overcrowding, constant re-breathing of their own and the adjacent animals' breath, an insufficient supply of fresh air, the presence of ammonia and other gases of putrefaction, together with inappropriate food—may establish a deteriorated state of body, which causes the animals to fall ready victims at the first approach of the plague.

The existence of these unfavourable conditions may account for the fact that on some farms the disease assumes a character so virulent that no remedy or preservative is of any avail against it, every head of cattle being swept off one after another, each attack being fatal within three days (15, 79, 80). In the words of a writer in the "Edinburgh Review," "a single spark of infected matter accidentally thrown into the animal economy, thus reduced, as it were, to a touchwood state, fires the mass, which burns until it is consumed."

PART II.—*On Disinfectants generally.*

11. There appears as yet but faint hope of finding a cure for the disease, and even were medical science to supply that great boon, it would be of little use unless supplemented with vigorous disinfecting measures; otherwise it would be like attempting to put out a fire fed on all sides with inflammable materials. Disinfection must, therefore, be the first consideration, and should be carried as far as possible short of endangering the health of the sound animals by the agents employed. Disinfectants and antiseptics have necessarily a powerful action on vital phenomena; and in some cases it may happen that an animal's vital powers are so diminished by the disease that it

will not have strength left to bear the remedial treatment; but even in this case less harm will be done by its use than if the animal had been allowed to die of cattle plague.

12. Disinfection, in the widest sense of the term, includes deodorisation, and means the neutralisation or destruction of all substances, arising from putrefying organic matter, or emanating from diseased animals, either injurious to health or offensive to the sense of smell.

The putrefactive products of animal and vegetable matter are found to consist of some or all of the following gases and vapours:—

Sulphuretted hydrogen,
Phosphuretted hydrogen,
Ammonia,
Phosphorus and nitrogen-bases of complex constitution,
Acetic, butyric, valerianic, &c., acids,
Carburetted hydrogen,
Hydrogen,
Carbonic oxide,
Carbonic acid,
Nitrogen,
Various organised animal and vegetable products of little or no activity, and
The special virus of infection. (The latter in an infected district.)

13. In a more restricted sense, the term "disinfectants" is used to express those agents which destroy organic or offensive matter by oxidation or analogous action; whilst under the term "antiseptics" are classed those agents which prevent chemical change by destroying the tendency to putrefy. The latter are termed, by Dr. Angus Smith, colytics, from κωλύω, I arrest.

14. Oxidising disinfectants are by far the best known and most popular, inasmuch as they appeal directly to popular prejudice, by destroying the foul odours which are the usual accompaniments of infection, whilst antiseptics have little or no action on these gases. I hope to succeed in showing that this fallacious mode of estimating the relative value of disinfectants and antiseptics, is one which does great injustice to the latter.

15. Cleanliness, ventilation, and good drainage have been spoken of as comprising all that is required to preserve cattle from the plague. This is not correct. Due attention to these points will certainly tend to preserve the animals in better health, and will render them more fitted to sustain the exhausting action of the disease; but ventilation, cleanliness, and drainage are unavailing against the importation of the germs of disease from adjacent herds. These measures are of value as they remove what might otherwise become nurseries for infection. A germ from without, falling on to a clean dry stall, is likely soon to die; but if it meet with moisture and dirt, its vitality may be fostered, and the chance of its coming in contact with a healthy animal so much the more increased (10). Cleanliness, drainage, and ventilation are admirable adjuncts to disinfection, but it is not safe to trust to them alone to ward off the plague. Ventilation, by allowing a greater number of cubic feet of air per minute to pass over the animals, may be, in fact, the means of conveying the infection to them. A moderately ventilated shed, in which antiseptics are freely employed, has been proved to be a place far safer for cattle than an open field; although when the animals have caught the disease the mortality appears to be less when they are turned out into an open field than when they are kept in sheds.

16. Dr. Angus Smith, by his exhaustive examination of disinfectants, has rendered it unnecessary for me to search amongst the numerous class of possibly useful bodies for those likely to be of practical value. His results I accept in the full conviction that they are correct; and I proceed to investigate the respective merits of the comparatively small number of agents available for disinfection.

17. At the outset it is necessary to strike off at once a whole class of valuable agents which will not meet the requirements of the case. It appears to have been satisfactorily proved that the infectious matter passes off mainly from the lungs of diseased animals, and that it attacks healthy ones through the same channels. It is suspended in the air with fogs, vapour, and gaseous products of decomposition, settling on rafters and in crevices whence mechanical purification would be unlikely to dislodge it. Partaking in this manner of the physical properties of a vapour, or of fine dust, it is clearly hopeless to attempt to combat the virus by non-volatile solid or liquid disinfectants.

18. For this reason charcoal, chloride of zinc (Sir William Burnett's disinfecting fluid), solutions of metallic salts, and other similar substances are of very limited use. Moreover, chloride of zinc (and this is probably true of the other metallic chlorides) has been proved to possess no efficacy in destroying specific infective emanations. What is wanted is a volatile and liquid disinfectant, which after first acting on the excreta, the floors, walls, and stalls of the shed, will, by its quality of gaseous diffusion, rise into the air, enter the lungs of the animals, pervade the whole building, and attack the hidden germs of infection, which otherwise would escape. In addition to this the agent must do its work with as little inconvenience as possible to the cattle and their attendants.

(To be continued.)

PHARMACY, TOXICOLOGY, &c.

*Rhigolene,** *a Petroleum Naphtha for Producing Anæsthesia by Freezing, by* HENRY J. BIGELOW, *M.D., Professor of Surgery in the Massachusetts Medical College.*

THE above name is proposed as convenient to designate a petroleum naphtha boiling at 70° F., one of the most volatile liquids obtained by the distillation of petroleum, and which has been applied to the production of cold by evaporation. It is a hydrocarbon, wholly destitute of oxygen, and is the lightest of all known liquids, having a specific gravity of 0·625. It has been shown that petroleum, vapourised and carefully condensed at different temperatures, offers a regular series of products which present more material differences than that of their degree of volatility,† and that the present product is probably a combination of some of the known products of petroleum with those volatile and gaseous ones not yet fully examined, and to which this fluid owes its great volatility. A few of these combinations are already known in trade, as benzolene, kerosene,

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* Rhigolene, from ῥῖγος, extreme cold, to which is added the euphonious termination of most of the other petroleum naphthas.

† See Researches on the Volatile Hydrocarbons, with references to authorities, by C. M. Warren. CHEMICAL NEWS, vol. xii., Dec., 1865.

kerosolene, gasolene, &c., all of them naphthas, but varying with different manufacturers. I procured, in 1861, a quantity of kerosolene[‡] of four different densities, and found the lightest of them, the boiling point of which was about 90°, to be an efficient anæsthetic by inhalation.[§] When it was learned here that Dr. Richardson, of London, had produced a useful anæsthesia by freezing through the agency of ether vapour, reducing the temperature to 6° below zero, F., it occurred to me that a very volatile product of petroleum might be more sure to congeal the tissues, besides being far less expensive than ether. Mr. Merrill having, at my request, manufactured a liquid of which the boiling point was 70° F., it proved that the mercury was easily depressed by this agent to 19° below zero, and that the skin could be with certainty frozen hard in five or ten seconds. A lower temperature might doubtless be produced, were it not for the ice which surrounds the bulb of the thermometer. This result may be approximately effected by the common and familiar "spray producer,"[‖] the concentric tubes of Dr. Richardson not being absolutely necessary to congeal the tissues with the rhigolene, as in his experiments with common ether. I have for convenience used a glass phial, through the cork of which passes a metal tube for the fluid, the air tube being outside, and bent at its extremity so as to meet the fluid tube at right angles, at some distance from the neck of the bottle. Air is not admitted to the bottle, as in Dr. Richardson's apparatus, the vapour of the rhigolene generated by the warmth of the hand applied externally being sufficient to prevent a vacuum and to insure its free delivery; 15° below zero is easily produced by this apparatus. The bottle, when not in use, should be kept tightly corked, a precaution by no means superfluous, as the liquid readily loses its more volatile parts by evaporation, leaving a denser, and consequently less efficient residue. In this, and in several more expensive forms of apparatus in metal, both with and without the concentric tubes, I have found the sizes of 72 and 78 of Stubs's steel wire gauge to work well for the air and fluid orifices respectively; and it may be added that metal points reduced to sharp edges are preferable to glass, which, by its non-conducting properties, allows the orifices to become obstructed by frozen aqueous vapour.

Freezing by rhigolene is far more sure than by ether, as suggested by Dr. Richardson, inasmuch as common ether boiling only at about 96° instead of 70°, often fails to produce an adequate degree of cold. The rhigolene is more convenient and more easily controlled than the freezing mixtures hitherto employed. Being quick in its action, inexpensive, and comparatively odourless, it will supersede general or local anæsthesia by ether or chloroform for small operations and in private houses. The opening of abscesses, the removal of small tumours, small incisions, excisions, and evulsions, and perhaps the extraction of teeth, may be thus effected with admirable ease and certainty; and for these purposes surgeons will use it, as also, perhaps, for the relief of neuralgia, chronic rheumatism, &c., and as a styptic, and for the destruction by freezing of erectile and other growths. But for large operations it is obviously less convenient than general anæsthesia, and will never supersede it. Applied to the skin, a first degree of congelation is evanescent; if protracted longer, it is followed by redness and desquamation, which may be possibly averted by the local bleeding of an incision; but if continued or used on a large scale, the dangers of frost-bite and mortification must be imminent.

It may be superfluous to add that both the liquid and the vapour of rhigolene are highly inflammable.

PHYSICAL SCIENCE.

Experimental Researches in Magnetism and Electricity —Part I.—by H. Wilde, *Esq.*

This paper is divided into two sections, the first being on some new and paradoxical phenomena in electro-magnetic induction and its relation to the principle of the conservation of physical force, the second on a new and powerful generator of dynamic electricity.

The author defines the principle of the conservation of force to be the definite quantitative relation existing between all phenomena whatsoever; and in the particular application of the principle to the advancement of physical science and the mechanical arts certain problems are pointed out which, in their solution, bring out results as surprising as they are paradoxical. Although, when rightly interpreted, the results obtained are in strict accordance with the principle of conservation, yet they are at the same time contrary to the inferences which are generally drawn from analogical reasonings, and to some of those maxims which philosophers propound for the consideration of others.

The author directs attention to some new and paradoxical phenomena arising out of Faraday's important discovery of magneto-electric induction, the close consideration of which has resulted in the discovery of a means of producing dynamic electricity in quantities unattainable by any apparatus hitherto constructed. He has found that an indefinitely small amount of magnetism or of dynamic electricity is capable of inducing an indefinitely large amount of magnetism; and again, that an indefinitely small amount of dynamic electricity or of magnetism is capable of evolving an indefinitely large amount of dynamic electricity.

The apparatus with which the experiments were made consisted of a compound hollow cylinder of brass and iron, termed by the author a magnet-cylinder, the internal diameter of which was 1⅝ inch. On this cylinder could be placed at pleasure one or more permanent horse-shoe magnets. Each of these permanent magnets weighed about 1 lb., and would sustain a weight of about 10 lbs. An armature was made to revolve rapidly in the interior of the cylinder, in close proximity to its sides, but without touching. Around this armature 163 feet of insulated copper wire was coiled, 0·03 of an inch in diameter, and the free ends of the wire were connected with a commutator fixed upon the armature axis, for the purpose of taking the alternating waves of electricity from the machine in one direction only. The direct current of electricity was then transmitted through the coils of a tangent galvanometer; and as each additional magnet was placed upon the magnet-cylinder, it was found that the quantity of electricity generated in the coils of the armature was very nearly in direct proportion to the number of magnets on the cylinder.

[‡] The kerosolene was furnished by Mr. Merrill, Superintendent of the Downer Kerosene Oil Company, South Boston.

[§] An account of these experiments may be found in the *Boston Medical and Surgical Journal*, July 11, 1861. Reference is made to them in a paper "On the most Volatile Constituents of American Petroleum, by Edmund Ronalds, Ph.D.," in the *Journal of the Chemical Society*, London. February, 1865. Mr. Ronalds there states that "the most volatile liquid obtained by collecting the first runnings from the stills employed in the process of refining petroleum has a specific gravity of 0·666." He had also received a specimen of "kerosolene" from Professor Simpson, of Edinburgh, at 0·633. It will be observed that the rhigolene has a specific gravity of 0·625.

[‖] Bergson's tube.

Experiments were then made for the purpose of ascertaining what relation existed between the sustaining power of the permanent magnets on the magnet-cylinder and that of an electro-magnet excited by the electricity derived from the armature.

When four permanent magnets capable of sustaining collectively a weight of 40 lbs. were placed upon the cylinder, and when the submagnet was placed in metallic contact with the poles of the electro-magnet, a weight of 178 lbs. was required to separate them. With a larger electro-magnet, a weight of not less than 1080 lbs. was required to overcome the attractive force of the electro-magnet, or twenty-seven times the weight which the four permanent magnets used in exciting it were collectively able to sustain. It was further found that this great difference between the power of a permanent magnet and that of an electro-magnet excited through its agency might be indefinitely increased.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

May 17.

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

The minutes of the previous meeting were read and confirmed. Messrs. J. T. Brown and J. Robinson were formally admitted Fellows of the Society, and the names of the following candidates were read:—For the first time—Professor Arthur Gamgee, M.D., Edinburgh; Mr. James H. Lightbown, Corporation Street, Manchester; Mr. Frederick Keating Stock, Darlington; and Mr. Edward I. Sparks, Corpus Christi College, Oxford. For the second time—Mr. William Arnot, Bachelor Street, Liverpool; Mr. Edward H. Davis, Harley Road, Brompton; Mr. William Field Flowers, B.A., Guy's Hospital; Mr. Charles Wilson, Bridgwater Smelting Company, St. Helens; and Mr. C. R. A. Wright, B.Sc., Runcorn, Cheshire.

Mr. Ernest T. Chapman read a paper "*On the Production of Acetic and Propionic Acids from Amylic Alcohol.*" The author finds that by the action of anhydrous phosphoric acid on nitrite of amyl he obtains a substance which splits up, when heated with potash, into ammonia and a mixture of acetic and propionic acids. The reaction would seem to be as follows:—Nitrite of amyl by the action of phosphoric acid loses two equivalents of water—

$$C_5H_{11}NO_2 = C_5H_7N + 2H_2O.$$

C_5H_7N may be regarded as the cyanide of an alcohol radical of the allyl series (C_4H_7Cy). Frankland and Kolbe have shown that the cyanides as a class, when acted upon by potash, produce the corresponding acid and ammonia. The corresponding acid in this case would be angelic acid, or an acid isomeric therewith; but angelic acid, when heated with potash, splits up into propionic acid, acetic acid, and hydrogen; the reaction is therefore quite intelligible.

A paper "*On the Oxidation of Ethylamine,*" by Professor J. A. Wanklyn and Mr. E. T. Chapman, was then read by the latter. The authors find that the base in question is only slowly attacked by chromic acid, and that the products of the reaction are aldehyde, acetic acid, water, and nitrogen; no ammonia appears to be formed in this reaction.

Mr. Chapman then read a paper "*On the Action of Acids on Naphthylamine.*" (Preliminary Notice.) Various methods of preparing azo-dinaphthyldiamine were enumerated. These methods range themselves under two heads—those depending on the action of nitrous acid, and those depending on the reduction of nitro-substitution compounds of naphthylin. The author stated that he had been unable to obtain the substance in question by the reduction of dinitronaphthylin, and proceeded to describe a new method of formation. If naphthylamine be boiled for about an hour with any of the following acids—phosphoric, acetic, oxalic, tartaric, citric, hydriodic, diluted sulphuric or nitric—a colourless solution is obtained, which in most instances yields a red precipitate on the addition of an alkali; sometimes, however, the red substance is not produced until excess of acid is added, and then more alkali. The experiment was performed at the meeting, and a white precipitate was at first obtained. This was dissolved in acid and reprecipitated, when the red compound was formed. On acid being again added, it turned violet. The author has examined this precipitate and found that it contained azodinaphthyldiamine. The nature of the reaction is not altogether manifest; $C_{10}H_9N$ has yielded $C_{20}H_{15}N_3$, from which it is evident that at least three equivalents of $C_{10}H_9N$ take part in the reaction, and that there must be another product formed which has not yet been identified. It is a remarkable fact that hydrochloric acid will not determine the formation of azodinaphthyldiamine. The author then stated that he had been unable to obtain substitution products in which more than one equivalent of hydrogen was replaced by an alcohol radical, and he therefore proposed to regard naphthylamine as a nitrile base.

Professor Church remarked that he believed Mr. Perkin had already succeeded in obtaining substitution products of the kind to which Mr. Chapman had alluded. He regretted the absence of Mr. Perkin, as he could not himself furnish the details of the experiments.

Mr. Chapman observed that, as was well known, iodide of ethyl-naphthylamine split up, when acted upon by caustic potash, into alcohol and naphthylamine, and mentioned that he had actually separated the alcohol so formed.

Professor Church then inquired whether Mr. Chapman had acted upon dinitronaphthylin with nascent hydrogen as produced by the electro-decomposition of water.

Mr. Chapman replied that he had made this experiment, but that when no other substances were present excepting pure dinitronaphthylin, alcohol, and water, no colouration was observed.

Professor Church remarked that as azodinaphthyldiamine is discolourised by nascent hydrogen, one must not expect more than a trace of it to be present in the liquid at one time.

To this Mr. Chapman replied that the objection was not valid, inasmuch as a mixture of nitro- and dinitronaphthylin yielded appreciable quantities of the base in question when treated with nascent hydrogen.

Sir Robert Kane then gave an account of "*Some Derivatives of Acetone,*" which embodied the results recently obtained in the re-examination of products described by the author in 1838. Acetone, originally regarded as an alcohol, was said to contain the hydrocarbon mesitilene (C_6H_4 old style), the formula of which underwent a process of triplication in the hands of Dr. A. W. Hofmann, and by Mr. Maule upon the discovery of the base, nitro-mesidine, in 1849. The analogy to ethylic alcohol was, however, disturbed by the results obtained in the analysis of the sulpho-mesitilates of lime, baryta, and lead, which, instead of containing two, had only one atom of sulphuric acid, thus: C_6H_5O,SO_3,CaO. The author's "oxide of mesityl" had again been examined by Fittig, and the liquid boiling at 131° C., was said to have a doubled formula, and to be, in fact, mesitic ether, $C_{12}H_{10}O_2$. With respect to this body, the speaker found that when subjected to the action of hydrochloric acid gas it absorbed about 42 per cent.; but even then only half the mesitic ether was acted upon, some acetone was regenerated, and the body $C_6H_6Cl_2$ formed. By the action of oxalic acid both gaseous and liquid products were obtained. The gas was readily absorbed by subchloride of copper, but gave no rēd precipitate like acetylene or allylene. Respecting the action of ammonia, the statements of Fittig and Stadeler were at variance, the latter asserting that a base, acetonine, $C_{18}H_{15}N_2$, was formed. The author found that where aqueous ammonia was mixed with an equal bulk of mesitic ether, the two liquids gradually coalesced, and after a few days became entirely dissolved; sulphuric or oxalic acid then added set free abundance of acetone, and formed salts containing an organic base. The analysis of these had not been attempted, but the observed results tended to confirm Stadeler's views. Sir R. Kane wrote upon the board the composition of those bodies (C=6) referred to the type of aldehyde, when the mesitic ether appears to contain allyl.

Aldehyde, $C_4H_4O_2$.
Acetone, $C_4(C_2H_3)H_3O_2$.
Mesitic ether, $C_4(C_2H_3)(C_6H_5)H_2O_2$.

Dr. **Frankland** felt great interest in the foregoing results, and considered there was yet much remaining to be investigated in the acetone series. There were two schemes under which these compounds might be viewed, in one of which both the bonds of the oxygen were united with carbon, whilst in the other, which best suited the requirements of Sir Robert Kane's illustrations, the affinities of the oxygen were divided between carbon and hydrogen. The formula of acetone according to the different systems was graphically represented on the blackboard, and Dr. Frankland wrote them as follows:—

$$\text{I.}\ \left\{\begin{matrix}CH_3\\ COMe\end{matrix}\right.$$

$$\text{II.}\ \left\{\begin{matrix}CH_3\\ C(CH_2)''(HO)\end{matrix}\right.$$

$$\text{III.}\ \left\{\begin{matrix}CMeH\\ CH(HO)\end{matrix}\right.$$

"*Some Observations on Vapour Densities*," embodying a criticism of Dalton's, Gay Lussac's, and other formulæ for the calculation of vapour densities, were offered by the Rev. Mr. Gibsone.

A paper on "*The Nitro-prussides, their Composition and Manufacture*," by Mr. E. A. Hadow, was then read by the **Secretary**. The previous researches, and particularly the analytical results, of Dr. Playfair were quoted in proof of these bodies being framed on the type of the ferridcyanides, but there was still a doubt as to which of the oxides of nitrogen entered into the composition of these magnificent red salts, and the author addressed himself to the problem of determining this point by attempting the conversion of a ferridcyanide into a nitro-prusside by the use of the several oxides of nitrogen respectively, and it was found that nitrous acid (not binoxide of nitrogen, as formerly supposed) was the agent really involved in their production, and that the composition of the nitro-prusside of sodium was thus expressed—

$$Fe_2Cy_5NO_3Na_2 + 4HO.$$

Starch was acted upon by nitric acid, and the red vapours conducted into caustic soda in order to furnish an alkaline nitrite. A specified proportion of this solution was then brought into contact with a mixture of acetic acid and ferridcyanide of potassium, and at the same time it was recommended to employ corrosive sublimate (amounting to half the weight of the latter) for the purpose of aiding in the expulsion of one molecule of metallic cyanide in the form of the more difficultly soluble mercury-salt. The products of this somewhat complex reaction were then as follows:—Nitroprusside of sodium, cyanide of mercury, acetate and chloride of potassium. These salts can be separated by crystallisation, and the pearly scales of cyanide of mercury recovered as such, or economised by conversion again into corrosive sublimate with formation of hydrocyanic acid as a secondary product. A large sample (two or three pounds weight) of beautifully crystallised nitroprusside was exhibited by Mr. Hadow at a previous meeting of the Society, and the author now remarked, in conclusion, that the characteristic violet reaction was best seen when the colourless monosulphides were brought into contact with a solution of the nitroprusside of sodium.

The **President** moved a vote of thanks to the authors of the several communications, and, at a late hour, the meeting was adjourned.

Lectures were announced for June 7, by Mr. A. Vernon Harcourt, "*On the Course of Chemical Change:*" and on June 21 (the last meeting), by Dr. Debus, "*On the Constitution of Organic Compounds.*" A paper, by Professor Wanklyn, "*On the Oxidation Products of Propione obtained from Carbonic Oxide and Sodium Ethyl,*" still remained to be read at the next meeting of the Society.

ACADEMY OF SCIENCES.

May 14.

In a letter to M. St. Clair Deville, Wöhler described *Laurite*, a new mineral from Borneo. It is a sesquisulphide of ruthenium, combined or mixed with sulphide of osmium. It is the first example, it is said, of a natural sulphide of a member of the platinum group. Laurite is found in the form of small granules or globules, having some appearance of crystallisation. In colour and brilliancy it resembles crystallised oligist. It is attacked neither by aqua regia nor by bisulphate potash at a red heat. It fuses, however, with hydrate of potash and nitre, forming a brown mass, which gives a magnificent orange-coloured solution. An analysis gave ruthenium 65·18, osmium 3·03, sulphur 31·79. The osmium was determined by difference.

M. Oppenheim presented a note "*On Isomerism in the Allylic Series.*" Chemists, the author says, often designate the iodide, bromide, and chloride of allyl by the names of ioduretted, bromuretted, and chloruretted propylene. He has, therefore, been induced to undertake researches in order to determine whether the names are really synonymous, or whether the substitution products of propylene and allylic ether afford us other examples of isomerism. He finds, in fact, that the bodies are isomeric, and not identical. In the course of his researches he discovered an easy mode of preparing chloride of allyl by mixing iodide of allyl with its volume of ordinary alcohol, and adding a slight excess of bichloride of mercury. The mixture is distilled. Chloride of allyl passes almost pure between 43° and 50°. The author finds a difference of 19° between the boiling points of chloride of allyl and chloruretted propylene. The density of the two bodies is sensibly equal, and is about 0·9307–0·9340 at zero. The latter body treated with ethylate of sodium is completely transformed into allylene; the former treated with alcoholic potash forms only allyl-ethylic ether. The hydrogen of the allylic ether is more strongly united to the carbon than is the case with the propylenic compounds; it can only be separated by effecting the complete destruction of the allylic molecule. Lastly, the substitution products of propylene combine only with difficulty with other non-saturated compounds; while, on the contrary, their isomers of the allylic series produce new compounds easily by direct addition. In conclusion, the author mentions that the reaction of bichloride of mercury on the iodides of alcoholic radicals appears to be general. He has obtained the chlorides of amyl and ethyl by its means.

M. Béchamp presented a note "*On the Use of Nitro-prusside of Sodium to ascertain whether a Water Contained an Alkaline Sulphide or not.*" Nitro-prusside of sodium gives a purple colouration with an alkaline sulphide; a dilute solution of sulphuretted hydrogen remains without colour. A water, however, which contains alkaline or earthy carbonates as well as sulphuretted hydrogen will become coloured gradually on the addition of the nitro-prusside in consequent of an evident reaction.

M. Béchamp also presented "*An Analysis of the Sulphurous Water of Fumades*," which appears to be remarkable only on account of the traces of glucina present.

NOTICES OF BOOKS.

The Chemistry of Common Things. By Stevenson Macadam, Ph.D., F.R.S.E., &c., &c. London: Nelson and Sons. 1866.

This book is one of a school series published by the Messrs. Nelson, and is intended for "the more advanced pupils in educational institutions," and also for "others who desire to obtain a general and popular knowledge of the chemical relations of the world around us."

It is, no doubt, a difficult thing to write a good general and popular elementary book on science, and we cannot help thinking that the difficulty is greatly increased when a writer sets out with the idea of bringing himself down to a level with his expected readers. Some notion of this kind we fear influenced Dr. Macadam in the composition of this book, and has in our opinion marred what would otherwise have been a very successful performance.

It must, however, in fairness be said that Dr. Macadam has produced a very interesting book, and but for the presence of many far-fetched and sometimes trivial illustrations and comparisons, one which even an advanced chemist might read with pleasure. It treats of the atmosphere and the soil, and their relations to plants and animals, the decay of plants and animals, and the circulation of matter. In the former part a short account of the principal constituents of the atmosphere is given; an account of the plant and what it feeds on and yields us, and the animal and what it feeds on follows. We have been somewhat puzzled to find an extract which shall at once do the author justice and, at the same time, justify the remarks we have made, but we take one from the section on "Grass and Flesh:"—

"When grass becomes flesh, as it does in the ox, a good deal of useless matter is got rid of, and the true food in the grass is stored up by the ox in one part or other of its carcase. That part which forms the edible portion of the animal, and which is generally called beef, has been sifted, so to speak, by the ox from the dross accompanying it in grass, and the true golden material—the portion really useful to man—is presented to us in the form in which we can, with least work to ourselves, make a proper use of it. What is stated here of the ox applies also to the sheep, goat, the deer, and, indeed, to all the animals on which we feed, and which in their turn live upon grass.

"The ox, sheep, &c., aid us in preparing our flesh by taking the crude material, grass, and so treating it that they disentangle the good from the bad, and hand over to us only that which can be useful to us. We may live upon grass, or parts of grasses, such as the seeds, but it requires a greater degree of force for us to form our flesh from such food than from an animal diet, as in the latter case a part of the work has already been done for us in the stomachs of the ox and the sheep.

"Living on a diet consisting in part of animal food is a saving to our digestive powers, and a saving of work implies a storing-up of force. Each man in a healthy condition has a stock of force, which he can expend in manual labour at the anvil or elsewhere, or in thinking, writing, or speaking. In either case the force so expended may be the direct means of procuring bread for himself or his household.

To *think* and to *work* are, in popular language, so separated from each other that at first sight they appear quite different in all their relations; but the thinking or mental powers, and the bodily or physical—in other words, the thought and the arm—draw on the same bank or stock-in-trade. They are two partners in the same concern, and the more there is squandered on the one, the less there is left for the other. And thus the smaller the force which is expended in the digestion of food—and of all work, stomach work is the hardest—then the more force or power there remains for the exercise of thought."

The above quotation will give our readers some idea of the way in which Dr. Macadam treats his subjects, and will at all events convince them that he is an agreeable writer.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

628. W. Weldon, Park Villa, Highgate, Middlesex, "Improvements in the manufacture of soda from common salt."—Petition recorded March 1, 1866.

1116. J. Leigh, Manchester, "Improvements in the purification of coal gas."—April 20, 1866.

1156. G. F. Russell, Piccadilly, and W. H. Carbines, Southwark Street, Surrey, "Improvements in the manufacture of gas."—April 24, 1866.

1171. S. Sequelin, Deptford, Kent, "Improvements in the purification, clarification, and preparation of animal and vegetable wax, tallow, oils, and other similar waxy and fatty substances."

1179. C. Hedler, Frankfort-on-the-Maine, "Improvements in the production of photographic pictures."—April 26, 1866.

1195. J. B. Thompson, Manchester, "Improvements in protecting iron ships from fouling and corrosion."—April 27, 1866.

1223. C. D. Abel, Southampton Buildings, Chancery Lane, "Improvements in the means and apparatus for reducing metallic oxides." A communication from J. Reese, Pittsburg, Penn., U.S A.—May 1, 1866.

1251. G. Feasey, Camberwell, Surrey, "An improved preparation or composition for removing and preventing incrustation in steam boilers."—May 2, 1866.

1255. C. W. Harrison, Clapham Junction, Surrey, "Improvements in obtaining copper and other metals from their ores."

1257. S. Bourne, Headstone Drive, Harrow, Middlesex, "Improvements in treating india-rubber and india-rubber compounds, and also india-rubber fabrics."—May 3, 1866.

1261. J. G. Hope, Edinburgh, N.B., "An improved composition for destroying vermin on sheep and other animals, and for preserving them therefrom."

1263. A. T. Becks, Birmingham, "Improvements in the manufacture or treatment of iron."

1271. C. de Cæsaris, Bermondsey, Surrey, "Improvements in preparing hides and skins for tanning."—May 4, 1866.

1291. H. K. York, Cardiff, "Improvements in the manufacture of iron and steel."—May 5, 1866.

Invention Protected for Six Months by the Deposit of a Complete Specification.

1366. G. A. Jasper, Massachusetts, U.S.A., "A new and useful or improved process of cleansing animal black or bone charcoal, after or before its use for the purpose of filtering a saccharine syrup."—Petition recorded May 12, 1866.

Notices to Proceed.

38. W. J. Symons, St. James's Road, Holloway, Middlesex, and N. A. T. Symons, Coburg Place, Upper Kennington Lane, Surrey, "Improvements in smiths' forges and furnaces for smelting and puddling iron, steel, and other metals."—Petition recorded January 5, 1866.

84. A. S. Brooman, Twickenham, Middlesex, "Improvements in bleaching vegetable and animal fibres and tissues."—A communication from C. R. Maréchal and C. M. T. du Motay, Metz, France.

85. A. S. Brooman, Twickenham, Middlesex, "An improved method of producing oxygen."—A communication from C. R. Maréchal and C. M. T. du Motay, Metz, France.

86. G. Chetwynd, Glenmohr Terrace, Blackheath, Kent, "Improvements in the treatment of copper and nickel ores."—A communication from Viscount C. de Secqueville, Milan, Italy.—January 10, 1866.

663. W. A. Vérel, Haugh, Stirling, Clackmannan, N.B., "An improved apparatus for distilling petroleum and the oils obtained from coal, shale, and other like substances." March 5, 1866.

CORRESPONDENCE.

The Position of the Chemist.

To the Editor of the Chemical News.

Sir,—An advertisement which appeared in your impression of Friday last has produced a feeling of profound indignation among chemists. Why so? Had it applied to medical men, lawyers, or others belonging to recognised professions, would it not have been treated as a stupid attempt at a joke? Would it have been believed, even for a moment, that any man could have proposed to members of those callings to wait at table? How, then, in the present case can that advertisement have been seriously considered, except from the feeling that it was possible for some one not to know that chemists occupied as high a social rank as the individuals composing the ranks of medicine or law, and that from the extent and variety of their necessary education, must have acquired the sensitiveness and feelings of gentlemen, even if they had not them before?

Admitting the existence of the lamentable possibility alluded to above, it remains to account for its origin and to propose a remedy. The circumstances which give rise to it are not difficult to find. The first and principal one is that chemistry is not recognised as a distinct profession. The second is that many who have no title to the name of chemists do practise as such, and from their want of knowledge and general culture, cast a slur on the whole body to which they profess to belong. Thirdly, the underbidding which forces men of good position to accept such fees as 10s. for work that, if properly performed, must take hours, almost countenances the idea that some might be actually driven to accept a nearly menial situation.

Such, Sir, might be taken as examples of the causes which give rise to the belief that the advertisement which is the subject of this long communication might be *bona fide*, and not a personality directed against some individual employer of chemists, or a gratuitous insult to the profession. (?)

Now for the remedy. Taking what has been done by medical men for our example, we find that they have procured a charter of incorporation by which they are enabled to grant certificates of efficiency, and to prevent all men not duly qualified from practising under the garb of doctors. Moreover, by some written or unwritten law they enforce an uniform scale of fees; or, at any rate, do not permit one man to take a shilling for a visit from fear some other should do the work for ninepence.

By making use of the powers which it possesses, the corporation has obtained for its members a consideration and a position which chemists, as a body, can only dream of. But why should that be a dream to chemists which is a reality to another body of men? Why cannot we also become a "body," with a standard of proficiency of our own, and with power to require the attainment of that standard by all who aspire to practise as chemists? Why cannot the Fellowship of the Chemical Society be made to mean as much as the Fellowship of the Royal College of Surgeons? Why, in short, cannot we become a real company, society, or college, and thereby acquire that share of power and influence to which we are entitled, but which we cannot hope for while remaining an unembodied class?

I am, &c.,
A True Lover of Chemistry.

[We publish this letter, not because we agree with the writer—who, it is evident, is but superficially acquainted with the medical profession—but because we have reason to believe that the advertisement at which some of our readers have taken so much offence was intended to provoke a discussion of the matter here ventilated.—Ed. C. N.]

The Black Board at Burlington House.

To the Editor of the Chemical News.

Sir,—Every one who attends the meetings of the Chemical Society must be annoyed by the board and chalk on which and with which the speakers often endeavour to inscribe formulæ. It is extremely difficult to make a mark on the board, to begin with, and when with great labour and the fracture of much chalk the mark has been made, it is hardly visible to those who sit on the back benches. The present board might, I daresay, be greatly improved by the vigorous use of some coarse sand paper. But I think the Society is rich enough to afford one of those slate-faced boards of French manufacture, but now well known in London. They are, it is true, rather expensive, but they are so easily written upon and the writing is so distinct that I am sure no Fellow of the Society who attends the meetings would object to the expense.

I am, &c. F.C.S.

London, May 17.

Sulphate of Strontian in and Around Bristol.

To the Editor of the Chemical News.

Sir,—Allow me to set your correspondent "E. A. H." right respecting the knowledge of sulphate of strontia existing in and near Bristol. As early as 1800 the late William Clayfield stated in the *Philosophical Magazine* "that sulphate of strontian was found near Bristol in such quantity that the roads were mended with it." I believe the first find of this mineral here was when St. Paul's Church was built, before or about Clayfield's time. I have specimens found more than forty years ago at Leigh, and an immense bed of it was found in front of St. Mary's Church, at Kingsdown, long before the Pyle-hill cutting was made. The specimens from this place are finely crystallised. The largest beds are at Willsbridge, about five miles from Bristol, where the top bed is nearly a yard thick, and the other, just under it, one foot thick. Here, in making a cutting, so much was excavated that at my instigation Messrs. T. E. Jones and Co., chemical manufacturers, obtained 100 tons of the material as white as loaf sugar.

I am, &c.,
William Herapath, Sen., F.C.S., &c.,
Professor of Chemistry.

Bristol, May 18, 1866.

The Transport of Liquid Carbonic Acid.

To the Editor of the Chemical News.

Sir,—In your Chemical News, No. 337, May 18, 1866, is the following communication from Paris:—"M. Jamin, &c., &c. Mentioning *solid* carbonic acid, reminds me that a quantity" (of liquid carbonic acid, I presume) "was recently sent without accident from Paris to Nancy by railway."

Now, there is nothing of novelty in conveying liquid carbonic acid to any distance. I have prepared large quantities of liquid carbonic acid during the past twenty-eight years, and I have taken it for my lectures to Manchester, Liverpool, Newcastle-on-Tyne, and other large towns. I have also safely sent it to both North and South America, and last year to Windsor, to illustrate a lecture given at the Castle before Her Majesty the Queen, by Dr. Hofmann. I am, &c.,

ROBERT ADDAMS.

59, York Terrace, Regent's Park, N.W., May 21.

MISCELLANEOUS.

Disinfection in Connection with the Cattle Plague.—Disinfection, in the sense in which the word is used here, implies the destruction of an animal poison, in whatever way it is accomplished. To find a perfect disinfectant for the cattle plague poison would be to stop the disease at once. We have naturally been very desirous of discovering a substance with such a power; but much more evidence is necessary before we can venture to affirm that success has been obtained. In the first instance we requested Dr. Angus Smith to undertake this subject, with a view of seeing what chemical agent would be best suited for the purpose. Subsequently, at his suggestion, Mr. Crookes was asked to carry on various practical trials which might test the efficacy of two agents which Dr. Angus Smith had reported to us as likely to be useful. We refer to the reports of these two gentleman for an explanation of the present doctrines of infection, and an enumeration of the different substances which may be used to destroy the poison. On examining these different agents it is soon found that the number of those which can be employed with advantage is limited. Since the poison is constantly given off in discharges flowing from diseased surfaces, and since it may be suspended like impalpable dust in the air, it becomes necessary that any disinfectant should act continuously both on the discharges and on the air. No disinfectant can be efficacious if its action is intermittent, or if it does not act on both sources of danger. It is evident indeed that the poison ought to be destroyed at the very moment of evolution or discharge. Every minute during which it remains active increases the danger. The disinfectant must therefore not only be both fixed and volatile, but so cheap and easily used as to be continually in action, and it must of course be innocuous to cattle and men. A large number of substances which can be used in many other cases as disinfectants must be put aside, as not meeting these necessary conditions. Compounds of iron, zinc, lead, manganese, arsenic, sodium, lime, or charcoal powder, and many other substances, want the volatile disinfecting power; iodine, bromine, nitrous acid, and some other bodies are too dear, or are entirely volatile, or are injurious to the cattle. On full consideration, it appears that the choice must lie between chlorine, ozone, sulphur, and the tar acids (carbolic and cresylic). Two of these bodies, viz., chlorine, in the shape of chloride of lime, and the tar acids, have the great advantage of being both liquid and aëriform; they can be at once added to discharges, and constantly diffused in the air. All these four substances—chlorine, ozone, sulphurous acid, and the tar acids—have been practically tested, either in England or on the Continent, and there is considerable evidence that they all actually do destroy the cattle plague poison. Their precise mode of action is still uncertain. Chlorine and ozone act, no doubt, as powerful oxidisers, converting animal poisons into simple and innocuous substances. Sulphurous acid probably destroys the virus by its strong antiseptic powers. The tar acids, according to the experiments of Mr. Crookes, neither interrupt nor accelerate oxidation, but they act most powerfully in arresting all kinds of fermentative and putrefactive changes, and annihilate with the greatest certainty all the lower forms of life. After a full consideration of the relative merits of the four disinfectants, and after some practical trials, Mr. Crookes arrived at the conclusion that the most powerful, and at the same time most simple, process of disinfection would be to use the tar acids as constant liquid and aëriform disinfectants, and sulphur in the form of sulphurous acid as an additional and occasional agency. In our First Report we recommended both these agents in a state of combination; the best mode of using them in a free state will be found detailed in Mr. Crookes's report, and in the instructions which we furnished to your Majesty's Government in February last, and which will be found in the Appendix. The general result of experiments on disinfection with carbolic acid and sulphur is certainly very encouraging. For the details of these experiments, which have been careful and searching, we refer to Mr. Crookes's report. It is of course most desirable that no false hopes should be raised, for we have seen but too many instances in which a rude disappointment has utterly crushed what seemed reasonable expectations. But no one can peruse the account of what has been done without seeing that a fair case has been made out for a large and systematic trial of these measures. They must, however, be fairly tried; they must be used with perseverance and energy; not grudgingly or insufficiently, as has sometimes been the case, but with the determination to keep the disinfectant in presence of the poison everywhere and constantly, so that every particle of virus may be, without fail, subjected to its action. For the reasons stated in Mr. Crookes's report, it appears that chloride of lime is inferior to the combined use of carbolic and sulphurous acids. But there is no doubt of the efficacy of this agent, and in certain circumstances, as for the washing of railway trucks, it may be employed in addition to boiling water or steam. It is very desirable that the use of carbolic acid should become general throughout the country in uninfected as well as in infected districts. There is little doubt that even were there no danger from cattle plague, the great purifying effect of this substance on the air of cattle sheds would contribute greatly to the health of the animals.—*Third Report of the Royal Commissioners on the Cattle Plague.*

Sodium Known to the Ancients.—The following remarkable statements have been made by Mr. John Calvert, C.E., in the *Mining Journal* for May 19. Are any of our readers aware of the existence of such wonderful manuscripts? To separate sodium direct from its chloride requires more knowledge of chemistry than we possess at the present day. But of this the author of these quotations was probably not aware:—"Before proceeding to describe the old woven onyx (asbestos) documents discovered by me in my voyage to New Guinea and Borneo, I will notice a few passages from the grand manuscript work of Roger Bachon (Bacon), 'Ars. Omnia,' in which he and his pupils seem to have amassed some considerable quantity of matter, and in translating the Arabic works of Lebri (chemical) and the Persian Eos (or Æos), a work describing the laws of things existing in air, also in water, and also in the earth, we are enabled to snatch at a few stray historical facts worthy of notice, which appear to suggest the origin of the science of alchemy:—'And there came from the land of Jap, a long way over the big water, a man called Syni, whose skill in the art of metals and rare things was so great, that he made metals that no man knew from rock and earth which lay in great abundance in many places; but this man Syni, finding how great the admiration for gold was in all the land, forthwith set to work to make that which was prized so greatly by all men; and after many labours and the most subtle combination of uncommon matters, he took from his earthly medley real gold, which he declared to be the work of his own will, and that he transmuted the common metals into the great; but all men saw the small piece of gold to the vast labour, and held him low in estimation until at last they sought him to kill him, as one of weak magic and power; but Syni, judging their intention, fled that place, and going up into the land of the great king, he made new fire vases and stoves, and brought forth wonders of extreme variety; and, having gathered together many slaves, he caused to be hewn from the mountain his effigy, 400 (?) high, which, when all men saw, they came from far lands, and cut from their ornaments many pieces of gold to lay at his feet.' The 'Ars. Omnia.' is a vellum manuscript, subdivided into 130 books, and is neatly written in double columns, by seven or eight different scribes, and, with the exception of a few extracts, all in pure Latin. The first forty-three books are upon the history of the earth, in which the Æos is frequently quoted; the next seven are made up from translations of the works of Hermes Trismegistus and Artesius; then a book on the great Persian King Kalid (a great chemist), and three books of translations of his works; then sixteen books on Geber, the Arabian king and chemist, and then follows a book on 'The Metal of Salt,' in which he describes how 'the burning matter of the salt has greater affinity for other substances still more foreign with which it will combine, leaving the metal of salt pure.' Also at another page he says that 'the transmutation of salt is effected by much craft and cunning, leaving a good metal the result, which is like no other metal, but the art is not known to common men.' And in the next book, entitled 'The Magic of Salt,' he says—'It is well that the vulgar understand not the good and great art of (decomposing) the destruction of salt, as if it were known to all, riches would be no longer held rare, or even respected, as with this metal much gold can be obtained, and such great virtue doth it contain, that one piece of such size that will cover the top of the small finger will work wondrous magic throughout a great mass of such worthless stuff that no man would buy for the smallest coin; yet when this and other metals well known to all men, shall lovingly and speedily unite in one common mass, then the adored of all metals becomes life, and is born unto man, and true and real gold may be taken from those common metals without loss to them in weight or virtue, so that by great craft, cunning, and magic, not enjoyed by common men, good gold, never again to be lost, is transmuted from the vilest of dross; and so men may enjoy riches without prying into other money bags, or borrowing from those who have little to lend.' The next five books are upon digging into the earth for the calx of metal, and the remainder upon the art of extracting and purifying metals and earths. I have chiefly selected these passages to prove that the alchemists, in spite of all their humbug and mistaken notions, often cheated themselves; and when they fancied they were making or transmuting gold, they were simply extracting it from ores or metals which absolutely contained it."

London (City) Corporation Gas, &c., Bill.—The select committee on the London (City) Corporation Gas, &c., Bills, and who were instructed to "inquire into the operation and results of the Metropolis Gas Act, 1860," have considered the matters referred to them, and have agreed to the following report:—

"Your committee have inquired into the working of the 23 and 24 Vict., c. 125, regulating the supply and quality of gas provided by the thirteen companies to the metropolis, and have examined witnesses from many large towns, as well as the metropolis, in various parts of the kingdom, viz., Manchester, Edinburgh, Birmingham, Walsall, Plymouth, Brighton, &c. They have found the illuminating power greater, and the quality of the gas better, than in London, and the price cheaper to the consumers. The illuminating power varied from fourteen sperm candles to thirty candles, whereas the power in London is fixed at twelve candles for common gas, and twenty for cannel gas, by the Act 23 and 24 Vict., c. 125.

"The purification of the gas in the metropolis is imperfect, and an excess of sulphur remains, which is highly injurious to pictures, leather, metals, &c. Since the passing of the Act 23 and 24 Vict., c. 125, the price of gas to consumers has been increased until recently, whilst the power of light has been less, and the quality of the article worse.

"That whereas the dividends of the gas companies in 1860 in no instance reached the amount of ten per cent. on their capital, the effect of the act was to raise the market value of their shares, and to increase the rate of dividend until, as has been shown to the satisfaction of your committee, every company in the metropolis now pays ten per cent., and many companies have, in addition, paid large sums in the form of back dividends, and have laid by reserve funds.

"Your committee is of opinion that the minimum illuminating power should be increased, and the maximum price reduced.

"That a chemical board of three members should be appointed from time to time, for the metropolis, at the expense of the gas companies, by the Secretary of State, to regulate the analysis of the purity and illuminating power of all gas supplied to consumers by the different gas companies, with power to fix the mode and places for testing the gas, such board to report to the Home Secretary.

"That every gas company should, within its own district, and at its own cost, provide and maintain, in a convenient situation, at a distance of not less than a thousand yards from the works, a testing place, and all proper materials, apparatus, machinery, and instruments for testing the illuminating power and purity of the gas by the public officer, and that such testing place should be under the control and management of the local authority. That the gas company should be at liberty to send an officer to be present at the testing by the public officer, but should not interfere in such testing.

"That each gas company may have a separate testing place in the same building, under their own control, so as to be enabled to test the same gas at the same time.

"That public officers for the purpose of testing the illuminating power and purity of gas should be appointed by the local authority—one for each district.

"That such officers should be authorised to test continuously, and report the result daily to the local authority; that every testing should be registered, and not the average only.

"That a chief gas analyst should be appointed by the local authority only to direct the operations of the testing officers; should receive daily reports, and submit and report on them weekly to the local authority.

"If any complaint be made by the company as to the testing, there should be an appeal to the chief analyst, whose decision should be final.

"The weekly report, if unchallenged, should be conclusive as to the experiments made.

"That the expenses incident to the appointment of such public officers should be paid by the local authorities.

"That the Metropolitan Board of Works be the local authority outside the City, and the Commissioners of Sewers within the City.

"That in the event of the local authority making default in appointing such officers, for the period of twelve months, the Secretary of State shall have the power to appoint officers, charging the cost of the same on the funds of the local authority.

"The power of making up former deficient dividends for six years out of surplus profits acts injuriously to the public. Your committee recommend that such power should be limited to three years.

"That the losses to companies through neglect of the directors or their officers, as instanced in the case of the Great Central Gas Company, in Wood-street, where damages were recovered amounting to 25,000*l.*, with heavy law costs, were charged on the surplus profits, instead of the shareholders' dividends, thus depriving the public of a reduction in the price of gas supplied to it, and, in fact, making the consumers answerable for the Company's default.

"Your committee think that the system of districts should be continued, and with a view to the economy of administration, and the convenience of the consumers and of the public, that every facility should be offered by Parliament for the further extension of the system of regulated monopoly, either in the way of the amalgamation of the several existing companies, or of the disposal of the interests of the several companies in the metropolis to some body or bodies representing the ratepayers of the metropolis, on such terms and conditions as may be agreed upon, and as Parliament may see fit to impose.

"Your committee having received evidence that the mode of recovering penalties against gas companies is inoperative, whether before a police magistrate or the Secretary of State, recommend that a more summary process be adopted.

"That the Metropolis Gas Act should be amended to carry out the suggestions contained in this report."

Our readers will see that the Committee adopted the suggestions made by Dr. Letheby, which we printed at page 227.

British Association of Gas Engineers.—The annual meeting of this Association, held this year at St. Martin's Hall, commences as we go to press. The proceedings were opened with an address by the President, Mr. Thomas Hawkesley, after which the financial report was read and thirty-six new members elected. Mr. Livesey then read a paper on a new mode of purifying gas. His method is confined to the removal of sulphuretted hydrogen, which he effects by scrubbing the raw gas with desulphuretted ammoniacal liquor. This desulphurisation is effected by scrubbing the liquor with air from the chimney shaft. We shall give a further account of this paper next week. The most remarkable novelty exhibited at the meeting is a self-registering photometer by Mr. Kirkham, which will be fully described in a paper by Mr. Barlow, which we shall publish. It is of course a photographic instrument, which will exclude the "personal errors of observation" incidental to all ordinary photometers.

The British Association.—At a meeting of the Nottingham Town Council on Thursday, it was unanimously resolved, on the motion of Dr. Tindal Robertson, to invite their Royal Highnesses the Prince and Princess of Wales to honour the town with their presence on the occasion of the visit of the British Association. A deputation, consisting of the Mayor, Town Clerk, and Dr. Robertson, were appointed to wait upon their Royal Highnesses.

Waynflete Professor of Chemistry.—In a congregation holden at Oxford, May 18, Sir Benjamin Collins Brodie, M.A., Balliol College, after having taken the usual oaths, was admitted as Waynflete Professor of Chemistry. At the same time, Robert B. Clifton, M.A., Wadham College, was admitted as Professor of Natural Philosophy.

Another Explosion of Nitro-Glycerine occurred at San Francisco on April 16. Fourteen people were killed, a great many injured, and property to the value of 200,000 dollars was destroyed.

Exhibition of Objects Relating to Pharmacy.—In connexion with the meeting of the Pharmaceutical Conference at Nottingham this year, it has been resolved to hold an exhibition of objects relating to pharmacy, and having a special interest for members of the drug trade. All our chemical and pharmaceutical readers will understand what these will be. Applications for space must be made to Mr. Atherton, Long Row, Nottingham, before July 1.

Photographs in Colours.— Under this title Mr. Jabez Hughes sells the materials for showing a very pretty and striking experiment, which the chemist will at once understand, while it affords great amusement to the uninitiated in the science.

Glycerine Oil.—In the House of Commons on Friday last, Mr. Graves asked the President of the Board of Trade whether it was his intention to introduce a bill for regulating the landing, moving, and shipping of glonoin or glycerine oil. Mr. Milner Gibson said his department had been in communication with the authorities of the Customs on this subject, in order to ascertain whether, under the present state of the law, precaution could not be taken to prevent accidents arising from this oil. Immediately after the holidays a bill would be introduced in reference to this question.

Something like Experiments.—Professor Doremus gave the first of a series of lectures at Brooklyn on April 17, entitled "Views of Life through the Medium of Science." Some of the experiments he performed are described as follows in the *Scientific American* :—Besides the novel experiments exhibited in these lectures, the ordinary class experiments are conducted on a scale which produces the effect of novelty. For instance, in burning potassium on water, a tank was used which extended entirely across the theatre in front of the stage, covering the whole area of the space usually occupied by the orchestra, and the middle of this tank contained several hundred pounds of ice in massive blocks; upon this water and ice half a pound or more of potassium pellets were scattered, producing most brilliant corruscations of violet and yellow sparks and flames, and filling the whole theatre with a cloud of potash. Several gallons of liquid carbonic acid were condensed, and the bar of mercury frozen by it was a yard in length and two inches in width. To exhibit the combustion of steel in the blowpipe flame, a whole saw and half of a long sword were burned, the sparks pouring forth in a shower fifteen feet in length.

Meetings of the Week.

Saturday, May 26.

Royal Institution, 3 p.m.. Professor Huxley, "On Ethnology."

Tuesday, May 29.

Royal Institution, 3 p.m., Professor Ansted, F.R.S., "On the Application of Physical Geography and Geology to the Fine Arts."

Wednesday, May 30.

Society of Arts, John Street, Adelphi, 8 p m.

Thursday, May 31.

Royal Institution, 3 p.m., Professor Huxley, "On Ethnology."

Royal Society, Burlington House, 8½ p.m.

Friday, June 1.

Royal Institution, 8 p.m., Professor Roscoe, F.R.S., "On Opalescence of the Atmosphere."

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.

F. T.—It is hydrochloric acid obtained under the circumstances, and not free chlorine.

E. K.—A short and practical account of the experiments will be acceptable.

E. W. P.—With Carre's apparatus of a proportionate size, large blocks of ice may be obtained. There is another apparatus, in which sulphurous acid is employed, by which large blocks may be made.

Errata.—Page 237, col. 1, line 22 from bottom, *for* "combustion," *read* "combination;" page 238, col. 1, line 5 from top, *for* "satisfactory" *read* "satisfactorily."

Received.—Co. P., S. H., Dr. S. Muspratt.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On a New Series of Hydrocarbons derived from Coal Tar, by C. SCHORLEMMER.

THE light oils obtained by the destructive distillation of cannel coal at a low temperature, contain, besides the hydrocarbons of the marsh gas and benzol series, other substances which are attacked by concentrated sulphuric acid. If the oil which has been repeatedly shaken with this acid be subjected to distillation, the hydrocarbons which are unacted upon volatilise first, and a black tarry liquid, equal in bulk to about half the crude oil, remains behind.* On heating this residue more strongly, a brown oil, having an unpleasant smell, comes over at about 200° C.; the temperature rises gradually up to 300° C., and at last a black pitchy mass is left in the retort. Even after repeated rectifications the oil always leaves a solid black residue behind, and it was only by continued fractional distillations over solid caustic potash and metallic sodium that I succeeded in isolating substances possessing nearly a constant boiling point and volatilising almost completely. The compounds which I thus obtained from cannel coal oil, boiling below 120° C., are hydrocarbons of the general formula $(C_nH_{2n-2})_2$, as the following analyses and determinations of the vapour densities show:—

(1) $C_{12}H_{20}$, boiling point 210° C.

(*a*) 0·262 substance gave 0·840 carbonic acid and 0·290 water.

(*b*) 0·1978 substance gave 0·635 carbonic acid and 0·2195 water.

	Calculated.		Found. *a.*	Found. *b.*
C_{12} . .	144	87·8	87·44	87·55
H_{20} . .	20	12·2	12·30	12·32
	164	100·0	99·74	99·87

	Calculated.	Found.
Vapour density .	6·68	6·98

The residue in the globe had a brown colour, the oil not being completely volatile; this accounts for the difference between the calculated and found vapour densities.

(2) $C_{14}H_{24}$, boiling point 240°.

0·107 substance gave 0·343 carbonic acid and 0·1195 water.

	Calculated.		Found.
C_{14} . . .	168	87·5	87·42
H_{42} . . .	24	12·5	12·40
	192	100·0	99·82

	Calculated.	Found. *a.*	Found. *b.*
Vapour density .	6·65	7·06	7·02

The liquid remaining in the globe had also in both cases a brown colour.

(3.) $C_{16}H_{28}$ boiling point 280° C.

0·152 substance gave 0·4885 carbonic acid and 0·174 water.

	Calculated.		Found.
C_{16} . . .	192	87·27	87·11
H_{28} . . .	28	12·73	12·72
	220	100·00	99·83

These hydrocarbons are colourless, oily, strongly refracting liquids, lighter than water, and possessing a faint peculiar smell, resembling that of the roots of *Daucus Carota* or *Pastinaca Sativa.* I have obtained them in small quantities only, and could study their reactions therefore only incompletely. They combine with bromine with a hissing noise, and if the reaction is not moderated, the liquor blackens and hydrobromic acid is evolved; but by keeping the substance well cooled, and by adding the bromine very carefully, nearly colourless, heavy, oily, sweet smelling bromine compounds are obtained, without the formation of hydrobromic acid. These are very easily decomposed by heating; charry matter separates out, and hydrobromic acid is given off even below the boiling point of water. From the hydrocarbon $C_{14}H_{24}$ alone I obtained a sufficient quantity of the bromide for analysis.

0·3715 substance gave 0·3605 bromide of silver and 0·0123 metallic silver.

Calculated for $C_{14}H_{24}Br_2$.	Found.
45·45 per cent. Br.	43·7 per cent. Br.

As it was impossible to purify the small quantity of bromide, the difference between the found and calculated quantities is easily accounted for.

Concentrated nitric acid dissolves these hydrocarbons, much heat being evolved; on diluting the acid solution with water, yellow, heavy, thick, oily nitro-compounds separate, which have a faint but peculiarly unpleasant smell. By heating these nitro-compounds with tin and hydrochloric acid, a portion is converted into a black tarry mass, and the solution contains a considerable quantity of chloride of ammonium, and a small quantity of a hydrochlorate, which can be obtained as a crystalline deliquescent mass by evaporating *in vacuo.* On concentrating the solution in the air decomposition takes place, a violet substance being formed. By adding caustic potash to the solution of the hydrochlorate, a dark oily base separates, which quickly oxidises into a black tarry mass. Platinic chloride produces at first no precipitate in the concentrated solution of the hydrochlorate, but after a few minutes a dark violet tar separates.

I could not succeed in obtaining crystallised double chlorides of tin or zinc.

If these hydrocarbons are heated with a concentrated solution of bichromate of potassium and sulphuric acid, carbonic acid is evolved, a strongly acid liquid, on which an oily layer swims, distils over, a resinous substance remaining in the retort. As I did not obtain any of the pure hydrocarbons in sufficient quantity to study their separate products of oxidation, I took all that remained, together with the intermediate distillates, and the oil boiling above 280° C., which had been previously well purified by rectification over sodium. After oxidation, the distillate was neutralised with carbonate of sodium, the oil being left undissolved. This neutral oil, which has an ethereal smell, and boils between 200° and 300° C. gave on analysis 84·9 per cent. C. and 11·8 per cent. H.; it consists, therefore, of non-oxidised hydrocarbons, containing a small quantity of an oxygen compound. The solution of the sodium salt was evaporated on the water bath, the residue distilled with diluted sulphuric acid, and the distillate rectified. It smelt strongly of acetic acid, and also slightly of butyric acid. By neutralisation with carbonate of sodium, a crop of crystals of acetate of sodium was obtained, which were converted into the crystallised silver salt.

0·1335 of this salt gave 0·861 of silver.

Calculated for $C_2H_3AgO_2$.	Found.
64·67 per cent. Ag.	64·50 per cent. Ag.

The syrupy mother liquor of the sodium salt gave with nitrate of silver a white precipitate, which on boil-

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* *Journ. Chem. Soc.*, xv., 480.

ing the liquid decomposed with effervescence and separation of metallic silver, showing the presence of formic acid; from the filtered liquid small warty crystals of a silver salt separated.

0·1314 of this salt gave 0·842 of silver, or 64·1 per cent. Ag.

The mother liquor gave on evaporation again crystals of acetate of silver.

0·2196 gave 0·1418 silver, or 64·56 per cent.

The volatile acids produced by the oxidation of the hydrocarbons are therefore carbonic acid, acetic acid, formic acid, and perhaps a trace of an acid richer in carbon.

The resinous substance left in the retort is an acid which dissolves in caustic potash, and is precipitated from this solution as a brown greasy substance, easily soluble in alcohol. The alcoholic solution, neutralised with ammonia, gave with nitrate of silver a white flocculent precipitate of a silver salt, which dried into a brown resinous mass, not fit for analysis.

As these hydrocarbons were obtained by the action of sulphuric acid on coal-tar oils boiling below 120°, and as they differ by C_2H_4, it appears to me almost certain that they are polymers of the hydrocarbons of the acetylene series, C_nH_{2n-2}, formed in the same way as diamylene is formed, by treating amylene with sulphuric acid. The products of oxidation are also in accordance with this view.

In order to test this theory, I have made some experiments with the two isomers C_6H_{10}—namely, diallyl and hexoylene. By acting with sulphuric acid on these compounds, I obtained, besides large quantities of tarry matter, polymeric modifications boiling above 200°, having a smell similar to the hydrocarbons described above, giving also similar nitro-compounds; but the quantities which I got were not large enough for a more exact examination.

The sulphuric acid which was used to purify the coal tar oils contains an organic substance in solution, which can be isolated by neutralising the acid liquid with carbonate of calcium, filtering, evaporating to dryness in the water bath, extracting the residue with alcohol, and evaporating the alcoholic solution. It forms a yellow amorphous mass, which has a faint bitter and astringent taste. A substance with exactly the same properties was obtained from the acid which was used to act upon the hydrocarbons C_6H_{10}.

I am at present engaged upon experiments to isolate the hydrocarbons C_nH_{2n-2} contained in coal tar.—*Proceedings of Royal Society.*

TECHNICAL CHEMISTRY.

On the Application of Disinfectants in Arresting the Spread of the Cattle Plague—Report to Her Majesty's Commissioners, by William Crookes, *F.R.S.*

(Continued from page 244.)

19. Some disinfectants, however suitable in other respects, are too expensive, unsafe, or injurious to health, to be used: such are bromine, iodine, peroxide of hydrogen, hyponitric acid, and hyponitrous acid.

20. The value of excessive heat as a disinfectant is very great, but it is available only in a limited number of cases. It acts in two ways. Heat, to the boiling point of water, continued for half an hour or more, acts as an antiseptic, perfectly destroying the vitality of all germs of contagion, or virus cells. In this way clothing and similar substances are conveniently disinfected. Heat, pushed to destruction in the presence of air, acts as a disinfectant, by promoting oxidation. The disinfecting value of the combustion of infected substances is too well known to require further notice.

21. Hydrochloric acid gas (evolved from salt and oil of vitriol) is most irritating to the respiratory organs, and is very inferior in its action to both sulphurous acid and chlorine. Besides, when evolved in whitewashed sheds, it unites with the lime on the walls, forming a highly deliquescent compound, chloride of calcium, which keeps them permanently damp. The employment of a dangerously corrosive body like oil of vitriol should also be avoided.

22. Oil of tar can also be removed from the list, its value entirely depending upon the small amount of the tar acids it contains (34). To the same class petroleum belongs. This body has been used with considerable success in Wallachia by M. Etienne R. Veron, who, in an interesting pamphlet, which he has taken great pains to draw up, and forward to this country (in the hope that it may prove as useful here as it has been on his estate), has given full details of the means he employed to extinguish (*étouffer*) the disease, and then keep it from his farms, in 1864.

Every animal which showed the least signs of disease was at once killed. He then caused all parts of the sheds, which could have been in contact with the animals, to be washed with petroleum, and the bodies of the cattle were afterwards rubbed over with a cloth soaked in the same material. The farm servants had orders to wash their hands, boots, &c., in a mixture of petroleum and water, and to sprinkle their clothes with the mixture, whilst a little petroleum was added to the animals' food and drink. Their excrements were frequently removed, and the floor sprinkled with petroleum. No dogs were admitted on any pretence.

For five days these precautions were rigidly observed, when they were somewhat relaxed. They were attended with complete success, and there is little doubt that, carried out as rigidly in this country, the same good results would ensue. A copy of M. Veron's pamphlet was forwarded to me, and many experiments have been made in consequence. Petroleum depends for its value upon a small quantity (1 or 2 per cent.) of either carbolic acid or a substance allied to it, and Dr. Angus Smith has shown that when this substance is removed by appropriate means the purified petroleum has no antiseptic value. This being the case, no experiments on the large scale were tried with petroleum, as they would necessarily be similar, but inferior in their results, to those of the tar acids.

23. The choice is therefore limited to the oxidising disinfectants—chlorine and ozone, and the antiseptics—sulphurous and the tar acids. These are representative bodies, and numerous trials have been made with them before coming to a conclusion as to their respective merits; the results being embodied in the following pages.

24. I am bound to admit that the conclusion to which I have been forced to come is quite opposed to my preconceived ideas on the subject. I started with a strong bias in favour of chlorine and ozone, but the irresistible force of the arguments derived from my experiments has caused me to alter my opinion.

Oxidising Disinfectants.

25. At first sight nothing appears more perfect than the action of a powerfully oxidising disinfectant, like chlorine or ozone, upon noxious vapours and septic

germs. In presence of an excess of either of these agents, all organic impurity is at once burnt up, and reduced to its simplest combinations; and could we always rely upon the presence of a sufficient amount of either of these bodies, no other purifier would be needed. But in practical work on a farm these disinfectants are always very inadequate, except perhaps for half an hour or so during the day; at other times, the oxidising agent has presented to it far more noxious material than it can by possibility conquer, and being governed in its combinations by definite laws of chemical affinity, the sulphuretted and carburetted hydrogen, the nitrogen- and phosphorus-bases, &c., would all have to be burnt up before the oxidising agent could touch the germs of infection; whilst the continued renewal of the gases of putrefaction would be perpetually shielding the infectious matter from destruction.

It is here that the great objection lies to disinfectants which act by oxidation. If we arrange in a series (as set forth in par. 12) the possible substances which may be met with in an infected shed, and gradually mix with them chlorine or oxonised air, we find that those vapours having strong and fœtid odours, and which stand at the commencement of the list, are the first to go; whilst the actual virus of the disease—the organised particles which have no odour whatever—are the last to be attacked. But in using disinfectants of this class, the only test of efficiency which a workman would employ is the sense of smell, and I have on several occasions known it happen that a deodorised shed, to all outward appearances disinfected, was still in reality saturated with infection. It so happens that the stinking gases of decomposition are of little or no danger in the atmosphere, whilst the deadly virus-cells of infectious diseases are inappreciable to the sense of smell. Mere deodorisation is therefore no protection whatever.

The following experiment tends to illustrate, if not to prove this:—Cheese mites were put into water mixed with strongly smelling cheese and sulphuretted hydrogen. Aqueous solution of chlorine was gradually dropped into the mixture from a burette. The smell of sulphuretted hydrogen was the first to go, then some smell of cheese, but it required a considerable quantity of chlorine to kill the mites. Exactly the same experiment was now repeated, only leaving out the sulphuretted hydrogen and cheese. The chlorine now had nothing to divert its energy from the cheese mites, which were consequently killed before one-fourth the quantity of chlorine used in the first instance had been added.

Again, oxidising disinfectants possess little if any continuous action. What they attack is destroyed perfectly, but what they leave has no special resistance to decomposition conferred upon it. They remove the products of decomposition, but they do not take away the power of further putrefaction.

In addition to these general faults possessed by oxidising disinfectants, the following special objections may be urged against chlorine and ozone:—

26. Chlorine.—This agent requires to be liberated in the gaseous state by a chemical process. This at the outset is an objection, for experience shows that farm labourers are not fit persons to be trusted with the performance of a chemical experiment involving the use of corrosive acids. The smell of chlorine is very irritating to the lungs of diseased or convalescent animals; and instances have come to my knowledge in which permanent injury has resulted from its employment. Moreover, the cattle dislike it much. Its action is more energetic upon the valuable constituents of the manure than upon septic germs*: it rapidly attacks ammoniacal compounds, the urea and hippuric acid, and considerably reduces the manurial value of farmyard stuff. If much ammonia is present in the shed, chloride of nitrogen is likely to be formed, the vapour of which, even in minute quantities, is painfully distressing to the eyes of cattle and their attendants. Another great objection is that gaseous chlorine, being absorbed by the whitewash, soon forms chloride of calcium (21. 28.), the deliquescence of which will make the walls of the building permanently damp, and fitted to foster the vitality of virus-cells, should they fall upon them.

27. A plan of fumigation by chlorine has recently been recommended which appears to possess another disadvantage. It is based upon the decomposition of chlorate of potash by hydrochloric acid. This reaction does not evolve pure chlorine, but a gas called euchlorine (supposed to be a mixture of chlorine and chloric oxide). The properties of this gas are different from those of chlorine, and nothing is known about its special value as a disinfectant. It is dangerously explosive, the act of transferring it from one vessel to another, or even the warmth of the hand, being sometimes sufficient to shatter the vessel to pieces with a loud report.

28. If commercial chloride of lime is used as the source of chlorine, there is the additional disadvantage that the compound into which it changes—chloride of calcium—is, as before mentioned (21. 26.), very deliquescent, and will leave the floors, walls, and especially the woodwork washed with it, permanently damp; whilst, if thrown in the solid state on the floor, it rapidly attracts moisture, and becomes unpleasantly wet. It also communicates a disagreeable odour to the hands when it is touched. It is one of the things most easily adulterated, and it would be scarcely possible to supply an ordinary consumer with a test by which he could ascertain its strength and purity.

29. Ozone.—This powerful agent attacks all kinds of organic matter with intense energy. But as in the case of chlorine, the specific substance which we most want to destroy would be nearly the last to go; and, as it would be almost impossible to generate ozone in quantity in an infected shed, its energies would in most cases be spent in doing useless work. When much ozone is present in the air it acts hurtfully on the respiratory organs.

Owing to the extremely poisonous nature of phosphorus, and its ready inflammability, danger would arise from the production of ozone by the slow combustion of this element. In the hands of ordinary farm servants serious accidents from fire would be constantly occurring.

Antiseptics.

30. Oxidising disinfectants produce their effect by actually destroying infecting substances. Antiseptics act simply by destroying their activity. The former act more energetically upon dead than living organic matter. Antiseptics attack first the opposite end of the scale, and destroy vitality; they exert little or no

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* I find it recorded in the *Medical Record* for March 15, 1866, that Dr. J. P. Loines, of New York, as the result of a series of experiments, has come to the conclusion that chlorine, in quantity sufficient to be irrespirable, has no effect upon the infecting property of the vaccine crust; and, reasoning from this analogy, he is of opinion that the same is the case with the virus of variola.

action on the foul smelling and comparatively harmless gases of decomposition, but they act with intense energy on the inodorous germs of infection which these gases may carry into the atmosphere along with them.

If, therefore, the theory with which I started be correct; if the matter which conveys infection from one animal to another be of the nature of an organised germ; if it owes its tremendous powers of destruction to the presence in it of vitality,—then antiseptics are the only agents fitted to deal with this special case; for they leave almost untouched the crowd of simply odourous gases, and seek out and destroy the one thing to be feared. When I treat of carbolic acid, ample proof of the correctness of this view will be given.

31. **Sulphur Fumigation.**—Of all disinfecting processes, this is, perhaps, the oldest. Its action was well known in the days of Homer, for we read that Ulysses employed it to remove the smell of dead bodies.† It is recorded by Ovid‡ that the shepherds of Italy yearly purified their flocks and herds with burning sulphur, and passages in other writers show that they averted disease from them by this means.

Professor Graham, Master of the Mint, says, that of gaseous disinfectants "sulphurous acid gas (obtained by burning sulphur) is preferable, on theoretical grounds, to chlorine. No agent checks so effectually the first development of animal and vegetable life. All animal odours and emanations are immediately and most effectually destroyed by it."

The value of sulphurous acid in arresting the progress of the cattle plague, has been proved beyond a doubt by the experiments of Dr. Dewar, and my own results entirely confirm his. When, however, used by itself, it can be employed only very sparingly in sheds, when cattle are in them; it is very stifling, and its powerful deoxidising action would retard the conversion of the peroxide of iron into protoxide by the act of respiration—a result equivalent to that produced by breathing an atmosphere containing less than its normal amount of oxygen, which has been shown by Dr. Angus Smith§ to be incompatible with health. For this reason I prefer to use it only as an additional precaution, relying principally upon other agents. Sulphurous acid acts in many cases through its affinity for oxygen, but it possesses also great antiseptic powers of its own, so that a slight exposure to it is sufficient to destroy the vitality of germs. The following experiment proves this:—

A mixture of sugar syrup and yeast was kept in a warm room until it became in a state of active fermentation. An aqueous solution of sulphurous acid was added, when the fermentation instantly ceased. When examined under the microscope after treatment with sulphurous acid, no apparent change was observed in the appearance of the yeast cells.

32. When sulphurous acid is produced in a whitewashed shed, it unites with the lime on the walls, forming non-deliquescent sulphite of lime, one of the valuable ingredients in McDougall's disinfecting powder; its good effect therefore does not cease as soon as the atmosphere is free from its odour.

The gaseous acid has a great affinity for water; the natural moisture always present in clothing, or on the woodwork and other parts of cowsheds most likely to retain infection, is able to absorb the gas in quantity sufficient to form a solution in contact with which virus cells cannot exist. When absorbed in this manner it is only very slowly evolved,—a fact which has been noticed by all who have been in sheds whilst undergoing this mode of purification,—the fumes of the burning sulphur being said to "hang about" the clothes for a considerable time. Articles of clothing, boots, tools, sacks, cloths, baskets, pails, ropes, and any other portable article which may require disinfection, are conveniently purified by allowing them to remain in a close shed whilst it is undergoing sulphur fumigation.

Sulphurous acid, in addition to its antiseptic qualities, is a deodoriser of considerable energy. It destroys the powerful odour of most of the offensive gases named in paragraph 12. It attacks and oxidises sulphuretted hydrogen, entirely destroying it; it neutralises the strong smell of ammonia and other alkaline bases, converting them into sulphites, but without destroying their manurial value or losing its antiseptic properties. In this respect it differs in an important manner from chlorine.

The use of sulphurous acid is open to one or two objections. When absorbed on clothing or damp woodwork, it gradually oxidises into sulphuric acid. In cowsheds this is not of much consequence, as there is always sufficient ammonia present to neutralise it; but if repeatedly formed on clothing, it will bleach the articles, and ultimately make them rotten. When neutralised with lime or ammonia, or other bases, the antiseptic value of the sulphurous acid is not impaired, but it is tied down to one spot, and prevented from acting in the atmosphere. When the sulphites thus formed are allowed to remain in contact with wet organic matter, they gradually decompose with evolution of sulphuretted hydrogen; but this decomposition is stopped at once by an additional fumigation with sulphur, and if the sheds are cleaned out every day it will never occur. Sulphites have been used with success by Professor Polli and Dr. De Ricci, both as prophylactics and as curative agents, in diseases caused by blood poisoning: in Dr. De Ricci's words, they neutralise the zymotic principle—the ferment—without being injurious to life.

33. **The Tar Acids (carbolic and cresylic acids).**—These two bodies are so commonly known under the name of acids, that I shall continue so to designate them, although by chemists they are more generally classed with the alcohols. They have great similarity, and only within the last few months have they been met with separately in commerce, having hitherto been both called carbolic acid. Creosote, (*κρέας σώζειν*, to preserve flesh), prepared from coal tar, one of the most

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† Hom. Od., xxii., 481.

Ulysses. Οἶσε θέειον, γρηῦ, κακῶν ἄκος, οἶσε δέ μοι πῦρ,
Ὄφρα θεειώσω μέγαρον . . . .
493. Ἤνεγκεν δ' ἄρα πῦρ καὶ θήϊον· αὐτὰρ Ὀδυσσεὺς
Εὖ διεθείωσεν μέγαρον καὶ δῶμα καὶ αὐλήν.

O old woman bring brimstone, the relief of evils, and bring me fire, in order that I may fumigate with brimstone the house. . . . .
And then she brought fire and brimstone, and Ulysses well fumigated with brimstone the house, and the court, and the hall.

‡ Ovid, Fast., iv., 735, &c.

Pastor, oves saturas ad prima crepuscula lustra.
Uda prius spargat, virgaque verrat humum.
Frondibus, et fixis decorentur ovilia ramis;
Et tegat ornatas longa corona fores.
Cærulei fiant vivo de sulfure fumi;
Tactaque fumanti sulfure balet ovis.

O shepherd purify the fruitful sheep at the earliest dawn; let the moist bough first sprinkle and sweep the ground. Let the sheepfolds be decorated with foliage and boughs fixed, and let a lengthy wreath ornament the doors. Let there be blue smoke of burning sulphur, and let the sheep bleat at being touched with the sulphur.

§ "Report on the Air of Mines," by R. Angus Smith, Ph.D., F.R.S., being part of the Appendix to the Report of the Royal Mines Commission, London, 1864.

powerful antiseptics known, was thought to be impure carbolic acid, until 1854, when Professor Williamson and Mr. Fairlie, in an investigation of it, discovered that it was a mixture of carbolic and cresylic acids. It was then taken for granted that Reichenbach's creosote, from wood tar, had a similar composition, until Hlasiwetz, in 1858, showed that this creosote was a different body from carbolic or cresylic acids. Finally Dr. Hugo Muller, in 1864, discovered that true creosote, and its analogue guaiacol, belonged to a different class of bodies, and consisted of methyl-oxy-phenic and methyl-oxy-cresylic acids. No experiments on the large scale have yet been tried with true creosote, as I have only been aware within the last few weeks that this compound could be obtained in quantity.

Pure carbolic acid is a white crystalline solid, melting at 34° C., and distilling at 180° C.; a trace of water or oily impurity renders it liquid, and for disinfecting purposes it is always supplied in this form, to avoid the extra expense and trouble needed for the separation of the last traces of impurity; cresylic acid is liquid, it boils at 203° C., and closely resembles carbolic acid in odour and other properties. Before the commencement of these inquiries it was thought to be of little or no value as a disinfectant, but Dr. Angus Smith has lately shown that it rivals, if it does not surpass, carbolic acid in antiseptic properties. For the present purpose of cattle plague disinfection it is immaterial which acid is used, and to avoid unnecessary repetition I shall use the term carbolic acid to express either acid, or the commercial mixture of the two acids.

34. From time immemorial carbolic acid, creosote, or bodies containing them, have been used as antiseptics. Passages in Pliny, read by the light of chemical science, show that the Egyptians used for embalming their mummies a compound made from pitch, which must have contained large quantities of creosote. Carbolic acid is the active agent in tar, which, either in its ordinary state or burnt as a fumigator, has always held high rank amongst disinfectants. Pitch and tar were the most popular medicines in use against the cattle plague when it visited this island in the last century; the animals being preserved against contagion by having their noses and jaws rubbed with tar, whilst the cowhouses were disinfected by burning pitch and tar in them (in which process a certain quantity of the vapours of carbolic acid would escape combustion). The almost universal custom of burning gum resins and odoriferous woods in connexion with religious ceremonies may have originally arisen from the disinfecting powers of the creosote in the smoke. The well-known efficacy of smoke in preserving meat is entirely due to the presence in it of this agent.

Pitch oil, oil of tar, and similar products owe their value entirely to carbolic acid (22). This body may in fact be called the active principle of tar, just as quinine is the active principle of bark, or morphia of opium, and it has the advantage of being easily prepared in any country where coal or wood can be obtained.

35. Sulphurous acid probably owes some of its antiseptic value to its affinity for oxygen, whereby the oxidation of the matter under treatment is retarded. It has been suggested that the value of carbolic acid is due to a similar property, and that it acts merely by preventing oxidation. It being important to a thorough understanding of its action that this point should be settled, the following experiments were made:—

I. Lumps of metallic sodium were cut with a sharp knife: the progress of the oxidation could be readily followed by the change of colour of the surface. The experiment was tried several times in an atmosphere strongly charged with the vapour of pure carbolic acid and of cresylic acid; comparative experiments being made at the same time in pure air. No difference in the rate or amount of oxidation could be detected.

II. A colourless solution of subchloride of copper in ammonia was prepared and divided into two parts; one being mixed with a little carbolic acid. On pouring them through the air into flat white dishes, no difference in the progress of the oxidation could be detected.

III. A mixture of pyrogallic acid and solution of potash was shaken up in a large stoppered bottle. It was then opened under water, and the amount of absorption of the atmospheric oxygen noted. The same experiment was repeated after the addition of carbolic acid to the potash solution. The same quantities were used and the agitation was continued for the same time. On again opening the bottle under water the absorption was found to be the same as before.

IV. The last experiment was repeated, substituting crystals of sulphate of iron for pyrogallic acid. The result showed equally that the presence of carbolic acid exerted no retarding influence on the oxidation.

V. Iron filings were shaken up in water with the same result.

VI. A "philosophical lamp" was made by arranging a platinum spiral over the wick of a spirit lamp, containing alcohol mixed with a little ether; on lighting, and then blowing it out, the platinum continued to glow brightly. Pieces of solid carbolic acid were then carefully placed in the cup of the brass wick holder, surrounding, but not in contact with, the wick. The heat soon melted the acid and raised its vapour round the platinum spiral, but without occasioning any alteration in the brightness of its glow.

VII. Lead pyrophorus was poured into two long and narrow jars of air, one of which had its interior moistened with liquid carbolic acid. Not the slightest appreciable difference could be detected between the rapidity of oxidation in the two jars.

VIII. Paper moistened with sulphate of manganese solution, and dried, was dipped into caustic ammonia, both with and without carbolic acid. No difference whatever could be detected in the rate of its darkening.

These experiments prove conclusively that the tar acids have no special power of retarding oxidation.

36. Other experiments were then instituted in the endeavour to understand more clearly the mode of action of carbolic acid.

IX. Some meat was hung up in the air till the odour of putrefaction was strong. It was then divided into two pieces; one was soaked for half an hour in chloride of lime solution, and was then washed and hung up again; the offensive smell had entirely gone. The other piece of meat was soaked in a solution of carbolic acid containing 1 per-cent. of the acid; it was then dried and hung up. The surface of the meat was whitened, its offensive odour was not removed, though it was masked by the carbolic acid. In two days' time the bad odour had quite gone, and was replaced by a pure but faint smell of carbolic acid. In a few weeks' time the pieces of meat were examined again. The one which had been deodorised with chloride of lime now smelt as offensively as it did at first, whilst the piece treated with carbolic acid had simply dried up, and had no offensive odour whatever. It was then hung up for another month and examined; no change had taken place.

X. A piece of fresh meat was soaked in a 1 per cent. aqueous solution of carbolic acid for one hour; it was then wrapped in paper and hung up in a sitting-room in which there was a fire almost daily; at the end of ten weeks it was examined. It had dried up to about one-fourth of its original size, but looked and smelt perfectly good and fresh, a very faint odour of carbolic acid being all that was perceptible. It was soaked for twenty-four hours in water, and then stewed with appropriate condiments and eaten; it was perfectly sweet, and scarcely distinguishable from fresh meat, except by possessing a very faint flavour of carbolic acid, not strong enough to be unpleasant.

XI. Animal membranes in the forms of gut, skin, and bladder, were perfectly preserved if immersed direct in aqueous solution containing 1 per cent. of carbolic acid; but if previously moistened with water, and then immersed in dilute carbolic acid, the preservation of the skins was not so complete.

XII. Animal size and glue, mixed, in the form of solution, with small quantities of carbolic acid, were perfectly preserved from change even in hot weather.

These are important experiments. They point out in a striking manner the difference between mere deodorisers and antiseptics. Hitherto attention has been almost entirely confined to the deodorisation of gases arising from putrescence. The effect has been combated, whilst the removal of the cause has received scarcely any attention. Chloride of lime, one of the strongest of the class of deodorisers, acts, as has been shown, only on the gases of existing putrefaction, but it has no influence over the future. Carbolic acid, on the other hand, has scarcely any action on fœtid gases; but it attacks the cause which produces them, and, at the same time, puts the organic matter in such a state that it never re-acquires its tendency to putrefy.

(To be continued.)

PHYSICAL SCIENCE.

Experimental Researches in Magnetism and Electricity —Part I.—by H. WILDE, *Esq.*

(Continued from page 246.)

Experiments were then made with electro-magnets of various sizes for the purpose of ascertaining the cause of these paradoxical results.

When the wires forming the polar terminals of the magneto-electric machine were connected for a short time with those of a very large electro-magnet, a bright spark could be obtained from the electro-helices twenty-five seconds after all connexion with the magneto-electric machine had been broken. Hence it is inferred that an electro-magnet possesses the power of accumulating and retaining a charge of electricity in a manner analogous to, but not identical with, that in which it is retained in insulated submarine cables and in the Leyden jar. It was also found that the electro-helices offered a temporary resistance to the passage of the current from the magneto-electric machine. When four magnets were placed on the cylinder, the current from the machine did not attain a permanent degree of intensity until an interval of fifteen seconds had elapsed; but when a more powerful machine was used for exciting the electro-helices, the current attained a permanent degree of intensity after an interval of four seconds had elapsed.

The general conclusion which is drawn by the author from a consideration of these experiments is, that when an electro-magnet is excited through the agency of a permanent magnet, the large amount of magnetism manifested in the electro-magnet, simultaneously with the small amount manifested in the permanent magnet, is the constant accompaniment of a correlative amount of electricity evolved from the magneto-electric machine, either all at once, in a large quantity, or by a continuous succession of small quantities—the power which the metals (but more particularly iron) possess of accumulating and retaining a temporary charge of electricity, or of magnetism, or of both together (according to the mode in which these forces are viewed by physicists), giving rise to the paradoxical phenomena which form the subject of this part of the investigation.

Having established the fact that a large amount of magnetism can be developed in an electro-magnet by means of a permanent magnet of much smaller power, it appeared reasonable to the author to suppose that a large electro-magnet excited by means of a small magneto-electric machine could, by suitable arrangements, be made instrumental in evolving a proportionately large amount of dynamic electricity.

Two magnet-cylinders were therefore made, having a bore of 2½ inches, and a length of 12½ inches, or five times the diameter of the bore.

As frequent mention is made of the different sized machines employed in these investigations, they are distinguished by the calibre or bore of the magnet-cylinders.

Each cylinder was fitted with an armature, round which was coiled an insulated strand of copper wire 67 feet in length, and 0·15 of an inch in diameter. Upon one of the magnet-cylinders sixteen permanent magnets were fixed, and to the sides of the other magnet-cylinder was bolted an electro-magnet formed of two rectangular pieces of boiler-plate enveloped with coils of insulated copper wire. The armatures of the 2½-inch magneto-electric and electro-magnetic machines were driven simultaneously at an equal velocity of 2500 revolutions per minute. When the electricity from the magneto-electric machine was transmitted through a piece of No. 20 iron wire 0·04 of an inch in diameter, a length of 3 inches of this wire was made red-hot. When the direct current from the magneto-electric machine was transmitted through the coils of the electro-magnet of the electro-magnetic machine, the electricity from the latter melted 8 inches of the same sized iron wire as was used in the preceding experiment, and a length of 24 inches was made red-hot.

When the electro-magnet of a 5-inch machine was excited by the 2½-inch magneto-electric machine, the electricity from the 5-inch electro-magnetic machine melted 15 inches of No. 15 iron wire 0·075 of an inch in diameter.

The author having found that an increase in the dimensions of the machines was accompanied by a proportionate and satisfactory increase of the magnetic and electric forces, a 10-inch electro-magnetic machine was constructed; the weight of its electro-magnet is nearly 3 tons, and the total weight of the machine is about 4½ tons. The machine is furnished with two armatures

—one for the production of "intensity" and the other for the production of "quantity" effects.

The intensity armature is coiled with an insulated conductor consisting of a bundle of thirteen No. 11 copper wires, each 0·125 of an inch in diameter. The coil is 376 feet in length, and weighs 232 lbs.

The quantity armature is enveloped with the folds of an insulated copper-plate conductor 67 feet in length, the weight of which is 344 lbs. These armatures are driven at a uniform velocity of 1500 revolutions per minute, by means of a broad leather belt of the strongest description.

When the direct current from the 1⅝-inch magneto-electric machine, having on its cylinder six permanent magnets, was transmitted through the coils of the electro-magnet of the 5-inch electro-magnetic machine, and when the direct current from the latter was simultaneously, and in like manner, transmitted through the coils of the electro-magnet of the 10-inch machine, an amount of magnetic force was developed in the large electro-magnet far exceeding anything which has hitherto been produced, accompanied by the evolution of an amount of dynamic electricity from the quantity armature so enormous as to melt pieces of cylindrical iron rod 15 inches in length and fully one-quarter of an inch in diameter. With the same arrangement, the electricity from the quantity armature also melted 15 inches of No. 11 copper wire 0·125 of an inch in diameter.

When the intensity armature was placed in the magnet cylinder, the electricity from it melted 7 feet of No. 16 iron wire 0·065 of an inch in diameter, and made a length of 21 feet of the same wire red-hot.

The illuminating power of the electricity from the intensity armature is, as might be expected, of the most splendid description. When an electric lamp, furnished with rods of gas-carbon half an inch square, was placed at the top of a lofty building, the light evolved from it was sufficient to cast the shadows from the flames of the street lamps a quarter of a mile distant upon the neighbouring walls. When viewed from that distance, the rays proceeding from the reflector have all the rich effulgence of sunshine.

A piece of the ordinary sensitised paper, such as is used for photographic printing, when exposed to the action of the light for twenty seconds, at a distance of 2 feet from the reflector, was darkened to the same degree as was a piece of the same sheet of paper when exposed for a period of one minute to the direct rays of the sun at noon on a very clear day in the month of March.

The extraordinary calorific and illuminating powers of the 10-inch machine are all the more remarkable from the fact that they have their origin in six small permanent magnets, weighing only 1 lb. each, and only capable, at most, of sustaining collectively a weight of 60 lbs.; while the electricity from the magneto-electric machine employed in exciting the electro-magnet was of itself incapable of heating to redness the shortest length of iron wire of the smallest size manufactured.

The production of so large an amount of electricity was only obtained (as might have been anticipated by the physicist) by a correspondingly large amount of mechanical force; for it was found that the large electro-magnet could be excited to such a degree that the strong leather belt was scarcely able to drive the machine.

When the electro-magnet of the 10-inch machine was excited by means of the 2½-inch magneto-electric machine alone, about two-thirds of the maximum amount of power from the 10-inch machine was obtained.

From a consideration of the combined action of the magneto-electric and electro-magnetic machines, the author points out a remarkable analogy, subsisting between the operation of the static forces of magnetism and of cohesion in modifying dynamical phenomena, which throws additional light upon the nature of the magnetic force.

On reviewing and comparing the whole of the analogous phenomena manifested in the operation of the magnetic and cohesive forces under the varied conditions to which the author invites attention, it appears to him that magnetism is a mode of the force of cohesion, or is, if the term be allowed, polar cohesion acting at sensible distances, the equivalent of magnetic force being obtained at the expense of an equivalent of ordinary cohesive force (in an axial direction) so long as the iron continues to be magnetised.

PROCEEDINGS OF SOCIETIES.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, by Dr. Percy, F.R.S.

Lecture No. V.

Ladies and Gentlemen,—This morning we will commence an interesting and special department of our subject—the study of the silicates, or the combinations of silica and bases, which form a large part of the earth's crust, the so-called igneous rocks and the secondary rocks which have been derived from weathering action, consisting essentially of silicates. In order to understand these rocks properly, it is important to study thoroughly the individual silicates.

Silica, which at the ordinary temperature is apparently a very inert and insipid body, possesses a powerful acid action, in a chemical sense, at a high temperature. If we take common sand, mix it with lime, and then expose the mixture to a good red heat for a long time, combination takes place; the silica combines with the lime, forming a silicate of lime, although to the eye there will be no appearance, if the temperature be not very high, of such a combination having been really effected. We know, however, that it has taken place, for if we take the product and act upon it by an acid which will decompose the silicate of lime generated, then we get the separation of silica in the gelatinous form—that jelly-like state which you saw in the first lecture. Now from that fact we infer with certainty that an actual combination has occurred, or otherwise there would have been no separation of silica in the state of jelly.

We have to consider two classes of silicates—those which are free from water, or anhydrous, and those which contain water, or the so-called hydrated silicates. They are both exceedingly important in a geological point of view.

We shall consider first the anhydrous silicates. These are produced by direct igneous action, or, in plain English, directly by the action of fire. Of this class I have just now given you an example in the case of silicate of lime, of which there is here a specimen.

In the first place, combination may take place without any apparent change in the physical qualities of the product—without any *apparent* change, as you may see from this specimen of silicate of lime, containing an excess of lime, and produced in the manner I described two or three minutes ago. If we expose a mixture of silica and lime in the right proportions to a much higher temperature than this has had, then we can succeed in fusing it, and we obtain occasionally a well-crystallised product, of which you have here a sample. It is very distinctly crystallised, you observe, and is identical in composition and in physical characters with the well-known mineral called wollastonite, or tabular spar. Here is a specimen produced simply by heating a mixture of lime and silica in the right proportions to a very high temperature in a platinum crucible. Please to bear in mind, nevertheless, that by the long-continued action of a much lower temperature—far below that which would suffice to cause fusion—we still get a combination between the silica and the lime. Hence the old statement, so generally believed in in former times, about bodies not acting unless dissolved, is entirely contradicted by the facts I have brought to your notice.

There is a silicate which is largely produced in commerce on this principle of heating at a comparatively low temperature. I allude to the silicate of the oxide of cobalt. This silicate is made simply by heating in mixture protoxide of cobalt and silica for a long time to a temperature considerably below that which would fuse the product when formed. There is some so generated—an earthy, stone-like matter, presenting no trace of fusion, forming a red compound, and not a blue one. This silicate of cobalt forms the basis of the so-called fine pigment, smalts, which used to be very extensively used in colouring paper, and is still used extensively for other purposes.

I will say a few words with respect to the physical properties of these silicates, a very important branch of our subject. They are all solid and hard, and generally brittle, but varying greatly in this respect, some being excessively tough, and others just as brittle, breaking sometimes with a stone-like fracture, sometimes with a conchoidal fracture like a piece of glass, and presenting almost every possible tint of colour, according to the matters which they contain. We have blue silicates, red silicates, yellow silicates, and all kinds of coloured silicates. Here, for example, is a blue silicate. It is a silicate of cobalt essentially with alumina and other things. It has a fine blue colour. Then there is the red colour. Take, for example, the silicate of some oxide of copper. Of this you have a specimen in this stained bottle. Here is another specimen having a red colour. This is a very curious speecimen in other respects, because when viewed by transmitted light the colour is green or bluish green. We might go on multiplying examples, but it would be useless on the present occasion. Suffice it to say we have every tint. Here, for example, is a silicate of the protoxide of copper, very easily made. Here is a silicate which is prepared artificially by double decomposition. The various coloured glasses we see owe their colour entirely to silicates of metallic oxides.

There is one kind of glass on which I must specially dwell on the present occasion. It has a dark black colour, and is opaque, resembling very much in external characters certain kinds of obsidian which we frequently meet with in volcanic regions, obsidian being nothing more than a natural black glass. The colour of this particular silicate—this particular black glass—appears to be due, at all events in certain cases, to the action of sulphur existing as a sulphide. There is a very excellent illustration of such a glass in the museum above. It came out of the French department of our first exhibition in the year 1851. I had it on the authority of Professor Dumas, one of the first authorities we can well have, that the colour of this glass was due entirely to sulphur in some combination. If so, it was a remarkable and interesting point, and possibly the same colouring agent may have acted an important part in nature in some of these obsidians. I do not pretend to assert that the black glass we meet with usually is black on account of the presence of sulphur or sulphides, because we know very well there are other causes, such as the silicate of protoxide of iron or of manganese, which are sufficient to account for the colouration; but what I do say is that there are glasses which do not contain a sufficient amount of these oxides to account for the black colour, and that the colour may in such instances be attributable to sulphur. All the common glass we meet with in commerce is nothing more than silicates. Silica, when combined with soda, for example, forms silicate of soda, which is a glassy product. We may get a silicate of potash and soda and lime, or silicate of soda and lead. Common flint glass is a double silicate of potash and oxide of lead. Here are specimens of these compounds.

Now, glass is either perfectly transparent or opaque—either perfectly colourless or coloured. When it has the property of ordinary glass it breaks with a conchoidal fracture, that is to say, a shell-like fracture.

There is a point of great importance to bear in mind, especially in connection with the subject we are now considering, illustrative of the bearing of chemistry upon geology. I allude to the so-called "devitrification" of glass, by which I mean the conversion of a glassy mass into a perfectly crystalline product. All true glass, the glass we deal with commonly, is perfectly non-crystalline. It is in that peculiar state to which the term vitreous is usually applied, exactly analogous to that state to which the term "colloidal" has been given by Mr. Graham—the very opposite of crystalline. If we take a piece of glass, and expose it to certain conditions of temperature, we can succeed in converting the whole of it into a crystalline mass. The condition is either slow after fusion—that is, slow solidification, or long-continued heat after solidification. I will present you with examples of this. Here is a piece of common crown window-glass, which was accidentally left to cool slowly. It still retains its vitreous character in the central portion, as you see, but the rest of the mass consists of a white more or less opaque mass, and if we examine it we shall find that it is made up entirely of aggregations of small crystals. Sometimes we have in large masses of glass of this kind delicate little star-like aggregations. Here is a very beautiful specimen of this. It is a mass of glass which owes its colour chiefly to oxide of iron, and I observe in the lower portion delicate little star-like masses, which are nothing more than glass in its crystalline state. The crystals have gone on spreading until they cover a very large area. They are very fine under the microscope, especially in polarised light. Here is some bottle glass which has been slowly cooled. You see it contains greyish strata, which consists of nothing more than little stratified spherical aggregations of crystals. They present a radiated structure, and occur in one continuous line, thus giving the appearance of a stratum. This kind of crystallised glass illustrates very well a particular kind of obsidian occurring in nature—the Lipari obsidian. In fact, placed side by side, you might almost mistake one for the other. Here is another specimen of glass devitrified and converted into one mass of crystals. Here is another specimen, which is nothing more than a mass of crystals; yet so dense is this mass of crystals that at first sight you would mistake it for a perfectly amorphous or stone-like mass. The section of this, under the microscope, is an exceedingly beautiful object. Here are other specimens of common crown window-glass which have thus been accidentally crystallised. The specimens I have shown you have been crystallised by slow solidification after fusion. Here is a specimen crystallised by long-continued heat after solidification. This white mass which I hold in my hand is nothing more than common window-glass which has been treated in that way. In the German method of making sheet-glass the glass is blown into long cylinders, the cylinders are split down with a diamond and then put into a flatting kiln and allowed to melt into a flat sheet. Sometimes during the process the cylinders crack and the pieces are put aside, and thus accumulate in the kilns to some extent. This was a piece of glass which was so put aside and which has been brought to this state by the continued heat. Those little lines are nothing more than strata of distinctly crystallised glass. This crystallised glass is termed "Reaumur's porcelain," because the fact was first fully explained by that admirable chemist and especially admirable mineralogist, old Reaumur. If we take a piece of common wine-bottle glass, like I did many years ago, and expose it to a good red heat for many hours, it undergoes first a change by which it becomes bluish, or more or less opaque. If I had continued the operation in this case long enough I should have converted this mass wholly into an aggregation of crystals. Here is a very interesting specimen in which you will see a piece of bottle-glass converted into more or less globular masses of crystallised glass; and what is worth noting in this case is the difference of colour between the perfectly crystallised portion and that which has remained vitreous. This difference of colour is due apparently to a difference of molecular aggregation. It is a very singular point, and one of considerable interest. There are several other specimens here to which I might call attention if time permitted. One of the rarest kinds of glass to obtain crystallised is flint-glass. It is much more easy to obtain crown or bottle-glass in that state than flint-glass, that is, a glass consisting of silicate of potash and lead.

Now, nature presents us with exactly analogous phenomena to those which I have been describing to you. We may see, for example, that certain trap rocks, volcanic rocks, retain perfectly their vitreous character. We can trace the conversion of those rocks occasionally into perfectly crystalline masses. Sometimes we get a rock exhibiting partly a crystallised or devitrified character and partly the character of perfect vitrification. Of this there are specimens in the museum above. In the devitrification of vitreous silicates which have a definite chemical constitution, the change is one of arrangement only; there is no difference of composition. Both the vitreous and the crystallised silicate have the same composition. But in other cases, when the silicate is not definite, if we examine the composition of the portion which is crystallised, as well as the composition of that which has remained in the vitreous form, we shall find a difference in the composition of the two samples. This has been clearly demonstrated by actual experiment, especially by one French observer of the name of Terreil.

(To be continued.)

BRITISH ASSOCIATION OF GAS ENGINEERS.

The annual meeting of this Association commenced at St. Martin's Hall on May 22. The proceedings were opened with an address by the President, Mr. T. Hawkesley, who briefly reviewed the history of the Association—now three years old—and congratulated the members on the continual accession of new members. At the present meeting 37 applications for admission were made, and the number of members would thus be raised to 137. The president then referred to the objects of the Society. These, he said, were strictly scientific. The members met to discuss the best methods of making and distributing gas, and the proceedings were of as much importance to the gas-consuming public as to the companies. Mr. Hawkesley then mentioned a number of matters which deserved the attention of the Association. The Commission on the Metropolis Gas Act has just reported that it was possible to supply the article of better quality and cheaper, and it would be for the Association to ascertain means to carry out the suggestions of the Legislature. Various other topics suggested themselves, among others the modes of purification, and the sanitary question which arose on the use of lime and the removal of foul lime in large towns. The speaker here expressed an opinion that oxide of iron must continue to be used in large cities unless the Legislature permits freer power in respect of purification; and until this is the case, it is likely that the purification will remain imperfect. He then referred to the experiments made under his superintendence at Nottingham. In the course of these he had found that the use of lime alone will reduce the sulphur in gas to 12 grains in 100 feet; a subsequent washing with ammoniacal liquor will further reduce the quantity to 8 grains, and if pure water be used for the washings the amount may be reduced to 2 grains. There is this disadvantage, however, in the use of pure water; it takes out the illuminating power of a gas, so that an 18-candle gas is brought down to 3 or 4 candles. Between such extremes, however, a proper mean must lie, and he suggested to managers the advantage of making experiments on the subject. Great differences of opinion, it was stated, still exist as to the amount of sulphur compounds in gas, some contending for the presence of at least 40 grains of sulphur in 100 feet, while others only admit 20 grains. Mr. Hawkesley next directed attention to the means of ascertaining the illuminating power and obtaining the maximum amount of light from gas. On this subject it was confessed that great ignorance existed, and the ordinary method of determining the illuminating power was denounced as senseless and unworthy in the present state of science. We need not follow the President in this part of his address, as the subject was fully treated of by Dr. Letheby in the lecture delivered in the evening.

ACADEMY OF SCIENCES.

May 21.

No chemical communication was made at the last sitting of the Academy. M. Dumas, in presenting the collected works of Stas "On the Atomic Weights of Simple Bodies," pronounced a well-merited eulogy of the labours of the great Belgian chemist. The volume now published by M. Stas contains some new determinations, which we shall in time lay before our readers.

NOTICES OF BOOKS.

Elements of Qualitative Chemical Analysis. By W. H. Spencer, B.A., Fellow of the Cambridge Philosophical Society. London and Cambridge: Macmillan and Co. 1866.

We cannot help regarding this handsome looking volume as a mistake. It unquestionably forms a very good manual of qualitative analysis, which we should be loth to soil by laying on a laboratory table. A student who begins with it, and goes conscientiously through it, will certainly find himself at the end well up in analysis. But the arrangement of the information, which forms the original feature of the work, to our mind anything but facilitates its acquisition. Everything is arranged in tables, on much the same plan as was adopted by the late Dr. Normandy on a more extended scale. Now, convenient as this plan may be for reference, when once understood, it is not easy to read up the information. Let any one, in fact, try to get up the reactions of any group of the metals from these tables, and then read the description of the same in, say Bowman's "Practical Chemistry," the last elementary book on analysis we noticed, and we do not doubt that he will agree with us that the latter is more easy. Our limits do not allow of extended criticism, so we must content ourselves with pointing out that the work has one special feature, which will strongly recommend it to many. The results of all reactions are given in the form of equations, and the author has adopted the new notation, and constructed all formulæ upon it. The work is therefore specially adapted for classes taught on the new system, but will at the same time serve very well for a student who has been taught on the old and is anxious to get up the new.

Bulletin de la Société Chimique de Paris. April, 1866.

The proceedings of the two last meetings of the Chemical Society of Paris are nearly destitute of novelty, almost all the papers having been communicated to the Academy. At the meeting in April Dr. Phipson made a communication "*On the Fall of Temperature Produced by the Admixture of Certain Metals,*" in which he asserted that when a mixture is made of 207 parts of lead, 118 of tin, 284 of bismuth, and 1617 of mercury, the temperature of the air being +17° C., the thermometer suddenly falls to −10° C. When these precise proportions are not taken, the production of cold is so considerable that the moisture of the air condenses on the sides of the vessel. As the mercury can be recovered by distillation, Dr. Phipson suggests that this mode of producing cold may find useful applications. Lead does not seem to be essential, but the presence of bismuth is important.

We are, as usual, indebted to the *Bulletin* for a number of miscellaneous paragraphs.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

130. J. Hooker, Walton-on-Thames, Surrey, "Improvements in the manufacture of ammoniacal and ammoniated soap."—Petition recorded January 15, 1866.

922. J. Davis, Southsea, Hants, "Improvements in obtaining caustic alkalies to be used as disinfectants and decarbonisers, and the means by which the same are to be applied, as also for applying the gases liberated in the process to the conversion of iron into steel, and for the manufacture of manures."—March 31, 1866.

1173. W. Edmond and A. Gurlt, Swansea, "Improvements in furnaces and apparatus for separating heated gases, fumes, or vapours from each other, and from solid or liquid bodies."

1174. A. Paraf, Manchester, "Improvemements in printing and dyeing textile fabrics and yarns."

1176. A. Paraf, Manchester, "Improvements in printing and finishing all materials where ultramarine colours are used."—April 26, 1866.

1209. W. P. Piggott, Argyll Square, Regent Street, Middlesex, "Improvements in preventing corrosion and fouling of iron ships."—April 28, 1866.

1233. G. C. Dennis, Arras (Pas-de-Calais), France, "An improved apparatus for purifying the lighting gas resulting from the distillation of coal."—May 1, 1866.

1242. W. Cormack, Commercial Road, Middlesex, "Improvements in deodorising, revivifying, and calcining animal and vegetable charcoal, and in the apparatus employed therein."

Notices to Proceed.

88. J. W. Gray, St. Dunstan's Hill, London, "Improvements in the manufacture of rice-starch."—Petition recorded January 10, 1866.

121. B. Todd, Newcastle-on-Tyne, "Improvements in the manufacture of arsenic."—January 13, 1866.

240. T. Spencer, Euston Square, Middlesex, "Improvements in the preparation of soils, to promote general vegetation, and prevent insalubrious or unhealthy exhalations from manures placed thereon."—January 24, 1866.

356. T. Spencer, Euston Square, Middlesex, "Improvements in the mode of, and apparatus for, filtering water and other fluids."—February 5, 1866.

642. V. Larnandès, Rue de Clichy, Paris, "A new or improved chemical mixture to be used as a disinfecting and preserving fluid for the cure of disease among cattle and for other purposes."—March 3, 1866.

1841. J. J. Bodmer, Newport, Monmouthshire, "Improvements in the treatment of slag or cinder from blast furnaces, copper smelting and other furnaces, and in apparatus employed therein, which improvements are also applicable to certain processes in the manufacture of iron and steel."—April 12, 1866.

1046. J. M. Macrum, Knightsbridge, Middlesex, "Improvements in the apparatus and processes for tanning."—A communication from J. Johnston, Alleghany, Penn, U.S.A., April 13, 1866.

1107. E. C. Nicholson, Fenchurch Street, London, "Improvements in the manufacture of blue colouring matters suitable for dying and printing."—April 19, 1866.

1156. G. F. Russell, Piccadilly, Middlesex, and W. H. Carbines, Southwark Street, Surrey, "Improvements in the manufacture of gas."—April 24, 1866.

1267. A. Borgnet, Swansea, "Improvements in furnaces, retorts, and apparatus for smelting or treating zinc and other ores."—April 24, 1866.

1223. C. D. Abel, Southampton Buildings, Chancery Lane "Improvements in the means and apparatus for reducing metallic oxides."—A communication from J. Reese, Pittsburg. Penn., U.S.A., May 1, 1866.

CORRESPONDENCE.

Molecule-Forming Power, Chemism, Atomic Quantivalence, and Chemical Value in Exchange.

To the Editor of the Chemical News.

Sir,—In the course of collaboration with my esteemed friend, Dr. Hofmann, in the production of his lately published "Introduction to Modern Chemistry" (quoted last week in an ingenious paper by your correspondent, Mr. John A. R. Newlands), I was struck with the barbarous character of the term "*atomicity*," at that time employed to express certain numerical relations of the elements, and I proposed the substitution of the term "quantivalence" as much better fitted for the purpose. Dr. Hofmann fully concurred in this view, which was accordingly embodied in the following passage:—

"We are in want of a good appellation to denote this atom-fixing power of the elements. The vague and rather barbarous expression, *atomicity*, has drifted into use for this purpose, and the elements have been called *mon*-atomic, *di*-atomic, *tri*-atomic, and *tetra*tomic, accordingly as their respective molecule-forming minimum weights are capable of saturating one, two, three, or four standard atoms." [The standard atom, or unit of atom-fixing power, is the atom of hydrogen.] "These expressions are faulty, because they are open to misinterpretation, as if intended to denote the atomic structure of the respective elementary molecules themseves—a sort of confusion the possibility of which should always be sedulously avoided in scientific nomenclature. We shall escape this evil by substituing the expression *quantivalence* for atomicity, and designating the elements *uni*-valent, *bi*-valent, *tri*-valent, and *quadri*-valent, according to their respective atom-fixing values.

"As to their molecule-forming values, these may be indifferently termed their atom-weights, or their combining numbers, which, it will be remembered, correspond, for the volatile elements, with a few exceptions only, to their respective gas-volume weights, or specific gravities relatively to hydrogen.

"However denoted, the two sorts of chemical value remain in themselves most clearly distinguished; and the importance of keeping this distinction in mind cannot be overrated. By the difference of their quantivalent powers the four elements under review [viz., Cl, O, N, and

C] are impressed, each with a strongly marked character of its own; and we shall presently see that each of the four stands at the head of a group of congeners, endowed with like atomic quantivalence; so that we have here the first germ of a natural classification of chemical elements, based on experiment and conformable with truth."

In another passage, the most compendious means of expressing these two sorts of chemical value are referred to in the following terms:—

"From these considerations it is clear that we might allow to each element *two* representative or equivalent numbers: one expressing its minimum weight relatively to the formation of a molecule, the other its minimum weight relatively to the fixation of an atom; and we might distinguish these as its *major* and *minor* equivalent weights, or by some other distinctive designations.

"It would, however, be obviously inconvenient thus to have in use two sets of minima weights or equivalents. Such a duplicate system would incumber the memory, and greatly impair the succinctness of our symbolic shorthand. In order to avoid these evils, it is desirable to include, for each element, the two separate weights in a single concise expression.

"For this purpose it suffices to attach to each of the molecule-forming minimum weights" [*i. e.*, the ordinary equivalent or combining numbers] "*a co-efficient of atom-fixing power*—that is to say, a sign expressing how many standard atoms its said weight is adequate to satisfy, or, for still greater brevity, as the signs Cl, O, N, and C, are already associated in our memory with their respective molecule-forming weights (35·5, 16, 14, and 12), we may attach the co-efficients directly to these symbols, writing them respectively—

Cl^{I}, O^{II}, N^{III}, and C^{IV}."

After some remarks on the general coincidence of the *atom-fixing* and the *volume-condensing* powers of the elements, and on the occasional exceptions to that law (exceptions which I am disposed to think only apparent, and likely hereafter to disappear on a closer study of the abnormal vapour densities), my illustrious colleague allowed me to introduce, for the further elucidation of the subject, an analogical conception which I believe to be just; that, namely, of "*specific chemical value in exchange*." This analogy, drawn from economical science, is referred to in the following terms:—

"The unequal *molecule-forming* powers of the elementary bodies, represented by the different weights of their atoms, and their unequal *atom-fixing* powers, represented by their dissimilar co-efficients of quantivalence, show us that each of these bodies possesses what may be termed its *specific chemical value in exchange*.

"Thus, with respect to the power of forming a molecule, we know that twelve parts by weight of carbon are 'worth' as much for this purpose as fourteen parts of nitrogen, sixteen of oxygen, and no less than 35·5 of chlorine.

"So, again, with reference to the power of fixing a standard atom, the elements comprised in each of the four groups were of chlorine, oxygen, nitrogen, and carbon are the respective types, possess for this purpose *chemical value in exchange*, varying by gradations, as we have just seen, from 1 for the first group, through 2 and 3 for the second and third, up to 4 for the last.

"In other words, and to borrow a financial mode of expression, *one* atom of any element in group 4 (the quadrivalent group), is *exchangeable at par*, for *four* atoms of any element in group 1 (the univalent group), and for two atoms of any element in group 2 (bivalent group). So also, as to the reciprocal exchangeability at par of the atoms of elements compressed respectively in the trivalent and quadrivalent groups; the simplest way to represent this equation, without resorting to fractional expressions, is to describe *three* atoms of any of the quadrivalent elements as 'worth,' for atom-fixing purposes, *four* atoms of either of the trivalent bodies.

"From the conception of 'value in exchange,' we readily gather that the atomic relations which we designate *quantivalence* imply not only atom-fixing, but also atom-*displacing* power; so that in learning how many standard units of quantivalence any given elementary atom can attract and retain within a compound molecule, we learn also how many it can remove therefrom when it is employed as a decomposing agent under conditions enabling it to eliminate, partly or wholly, one or more of the constituents thereof."

My motive for referring to these matters in connexion with Mr. Newlands' paper, published in your last impression, is that, while I am, of course, pleased to see that gentleman adopting the term *quantivalence*, I would venture (in the absence of Dr. Hofmann, who, I am quite sure, would concur in the suggestion) to deprecate his continuing the series of expressions *uni*-valent, *tri*-valent, and *quadri*-valent, by expressions with prefixes derived from the Greek, such as *penta*-valent and *hexa*-valent. He properly uses the term "*multi*-valent," not "*poly*-valent," and by parity of reasoning will see the propriety of substituting *quinqui*-valent and *sexa*-valent for his abovementioned Greek and Latin composites.

With regard to the hypothetical "constancy of quantivalence," or universally complete quantivalential saturation of compound molecules, advanced by Mr. Newlands, I am unwilling to offer any opinion, fearing to be drawn into a controversy for which I have at present no leisure; yet, having referred to his paper, I am equally unwilling to observe a silence which might be interpreted as a tacit concurrence in a view which seems to me more ingenious than sound. Were *all* compound bodies by virtue of the universal and complete "self-saturation" which Mr. Newlands assumes, in the state of perfect quantivalential equilibrium he supposes, they would all, I conceive, be equally neutral, and, in quantivalential respects, equally indifferent; resembling a race deprived of sex. The lowest carbide of hydrogen, for instance, would, according to such a theory, show no greater aptitude than the highest to take up additional atoms of carbon—a supposition we know to be incorrect. Nor, on the other hand, is it the fact that compounds of the class which I have ventured to term *equiquantic*—that is to say, compounds whose molecules are constituted of atoms in such numbers, and of such quantivalential co-efficients, as to display a perfect quantivalential equipoise, are necessarily, on that account, the most stable, the least prone to modification, by inception of additional atoms. The central compound of the nitroxygen series, for example, is nitrous acid, represented (in the new notation) by $N^{\text{III}}_{2}{\cdot}O^{\text{II}}_{3}$, in which the units of quantivalence are balanced, 6 to 6. Yet nitrous acid does not, on this account, the less readily take up more oxygen, becoming nitric acid ($N^{\text{III}}_{2}{\cdot}O^{\text{II}}_{5}$); nor, again, is the most hypo-oxygenic compound of the series ($N^{\text{III}}_{2}{\cdot}O$) by any means its least stable member. That similar atoms may combine to form diatomic molecules, such as ClCl, HH, &c., is doubtless true, as Ampére long ago pointed out; and there are cogent reasons for admitting such a diatomic condition to be the real construction of the free elementary molecules. But to assume for the molecules of all bodies, elementary and compound, under all these varying conditions, an absolute identity of quantivalential equipoise seems to me an expansion of hypothesis beyond coincidence with the facts under consideration; and beyond that susceptibility of experimental proof or disproof which is the touchstone of sound philosophical hypothesis. The facts, indeed, compel us to draw a strong distinction, as I have elsewhere ventured to observe, between *numerical* and *potential* equiquanticity, either of which may be absent in a compound, and yet the other exist. Above all, care should be taken not to confound the *atom-compensating* power of the several elements with the *specific intensity* of their chemical activity. A trivalent body, which fixes or displaces three standard atoms, may yet be far outdone in chemical energy by a univalent body, fixing or freeing only one. This sort of energy is, indeed, in its nature so distinct as to require a separate name, and I know of none more appropriate than *chemism*. Employing this term to signify the varying activity, or chemical *tension*, of elements and compounds under the varying conditions of their existence and operation; employing, again, the respective *combining numbers* of bodies to express their ponderal relations to each other; and reserving, lastly, their *co-efficients of quantivalence* to denote their respective atom-compensating values, we may, I think, hope to avoid confusing philosophical conceptions essentially distinct, and to obtain a view, clearer perhaps than heretofore, of those three well-distinguished properties of matter. That our knowledge of these properties is exact or complete I am very far indeed from affirming; they are subjects upon which, at the present juncture of chemical history, too much philosophical meditation, too much experimental research, can scarcely be bestowed; and, therefore, thanks are due, I think, to your able correspondent, Mr. Newlands, for directing attention to the subject. Upon problems so deeply interesting, and at the same time as yet so obscure, opinions and criticisms should be very modestly interchanged, for every day is pouring in fresh facts to complicate, even while they assist, our inquiries. In this ever-extending field of research we are all, of necessity, students alike, and (as Dr. Hofmann well observes) "we must all be content, whether teachers or taught, humbly to labour and learn, side by side, in the school of the great Teacher—NATURE."

I am, &c., F. O. WARD.

6, Hertford Street, May Fair, London.

Continental Science.

PARIS, May 20.

IT is always pleasant to record acts of generosity. I believe it is usual for all professional men to represent the members of their own professions as the most liberal and benevolent of all men. Attorneys, I have no doubt, do so; but I have no opportunities of seeing their journals. The medical prints never omit to extol the generosity of their profession; so I am only following the usual course when I make known the contributions of our chemists to the funds of the Benevolent Society of the Friends of Science. At the recent annual meeting of the Society, the Secretary announced that MM. Dumas, Dubrunfaut, Friedel, F. Leblanc Pasteur, H. St. Clair Deville, and Wurtz, had made a collected gift of 10,000 francs to the Society. Besides contributing to this collection, M. Wurtz has presented 1000 francs from the prize of 20,000 allotted to him by the Academy. M. Wurtz happily does not need money, and is of a very generous disposition.

The death of Rose caused a vacancy in the number of corresponding members of the Chemical Section of the Academy. To fill it a number of candidates have been proposed, every one of whom deserves to be elected, and I should think the Academicians will be puzzled to make a choice. It seems, however, that the choice will probably fall on Marignac, of Geneva, the other names submitted being Kolbe, Stas, Strecker, Frankland, Williamson, Zinin, and Schrötter. At the public meeting of the Academy, M. Dumas, in presenting the recently published work of Stas, highly lauded the labours of this chemist in the determination of atomic weights, and one would have thought his selection certain. The report of M. Chevreul, however, placed M. Marignac "in the first line," the rest being equal. The election of M. Marignac follows with as much certainty as the election of a candidate selected by the Council of the Royal Academy, which may or may not be the best plan that could be adopted. I am neither a member of the Academy nor a F.R.S., and I strongly object to be dictated to.

The greatest novelty I find is one coming from Italy, and is a method of fixing photographic prints with chloride of sodium. It is the invention of Signor Roncalli, who takes his prints from the frame, and places them in a 5 per cent. solution of chloride of sodium, leaves them there some time in the cold, and then gradually heats the bath, finally boiling for about ten minutes; after which the print is completely fixed!

MISCELLANEOUS.

Metropolitan Board of Works.—At the meeting of the Board, held on May 25, Mr. Newton moved, "That the Report of the Select Committee of the House of Commons on the Metropolitan Gas Act, 1860, be referred to a Special Committee of the Board for consideration and report." The mover seemed to suggest that the Board should buy up or arrange with all the existing gas companies and supply the metropolis with gas from two large works, one at Barking Creek and the other at Crossness. The scheme looks grand, but as at least ten millions would be required to carry it out, the realisation will probably be deferred.

Another Explosion at San Francisco.—As we go to press, news arrives of another fearful explosion, supposed to be of nitro-glycerine, on April 16. The number of persons killed and the amount of damage done appears to have been greater than in any previous casualty of the kind. We may here state that a bill to regulate the storage and transport of nitro-glycerine will be introduced into the House of Commons immediately. It is intended to put nitro-glycerine under the same restrictions as fulminating mercury and similar compounds.

Crystallised Chromic Acid.—Rammelsberg has analysed ordinary crystals of chromic acid, and decided that it is a true anhydride. The crystals of course contained sulphuric acid.—*Poggendorff's Annalen*, No. 3, 1866, p. 492.

Meetings of the Week.

Saturday, June 2.

Royal Institution, 3 p.m., Professor Huxley, "On Ethnology."

Monday, June 4.

Royal Institution, at 2 p.m., General Monthly Meeting.

Tuesday, June 5.

Royal Institution, 3 p.m., Professor Ansted, F.R.S., "On the Application of Physical Geography and Geology to the Fine Arts."

Thursday, June 7.

Royal Institution, 3 p.m., Professor Huxley, "On Ethnology."

Chemical Society, Burlington House, 8 p.m., a Lecture "On the Course of Chemical Action," by A. Vernon Harcourt, Esq.

Friday, June 8.

Royal Institution, 8 p.m., Professor Frankland, "On the Source of Muscular Power."

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. S.—It is a matter on which at present we do not feel called upon to express an opinion, but our pages are open for its discussion.

J. J.—Your communication is not suited for our columns.

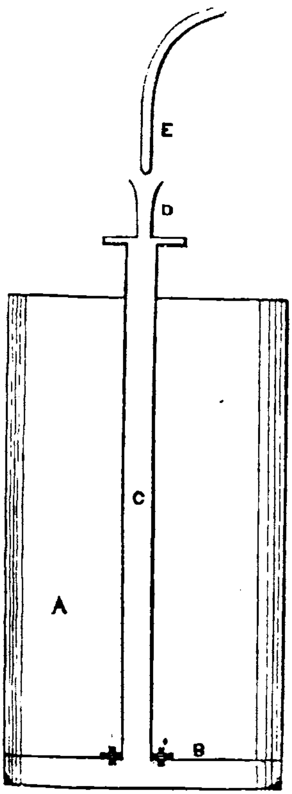
Received.—X. B.; A Young Chemist; H. A. H.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Oxidation of Crude Soda Liquors,
by JAS. HARGREAVES.

THE solution obtained from crude soda or "black ash" usually contains a small proportion of sulphide of sodium, of which it is desirable to be rid, especially when it is to be used in the manufacture of solid caustic soda. The usual mode of getting rid of this sulphide is by converting it into sulphate by oxidation with atmospheric air, nitrate of soda, bleaching powder, &c. To oxidise with atmospheric air has hitherto required the use of complicated and extensive apparatus; while nitrate of soda and bleaching powder make expensive additions to the cost of manufacturing solid caustic soda.

To reduce the cost of apparatus for effecting the oxidation of these crude liquors by atmospheric air, I invented the apparatus of which the following is a sketch,—A, the oxidising vessel; B, false bottom perforated with small holes; C, a pipe for conducting air to the bottom of the vessel; D, a short contracted "throat pipe" curved outward at the top; E, a jet connected to a boiler with steam at 40 lbs. per square inch pressure.



Scale, ¼ inch per foot.

The vessel is filled to about five feet deep with the crude solution and steam turned through the jet. The steam with its acquired momentum rushes through the "throat pipe," mixing with and carrying air along with it. The air rises through the solution, causing an intense commotion and exposing a very large surface of the fluid to its oxidising action, while the steam serves to warm the solution, and thus accelerate the oxidation of the sulphide.

This apparatus filled to about five feet deep will, with steam at 40 lb. per square inch, oxidise that quantity of crude soda liquor or the caustic "red liquor" in about four and a-half hours. The apparatus was introduced by me about sixteen months ago, and is now getting into general use among the alkali manufacturers of South Lancashire and North Cheshire, while the more costly apparatus is being discontinued. In some cases, the old apparatus has been sold for old metal, and brought more than the entire cost of this oxidiser when new to effect the same amount of work, while the cost and labour of working it is considerably less. In places where large quantities of solid caustic soda are made, and it has been in constant work, it has by the saving of nitrate of soda effected yielded a profit equal to its whole cost by a fortnight's use.

By slight modifications, upon which I need not here dilate, and which will readily occur to the mind of any alkali manufacturer, the apparatus may be adapted to the manufacture of soda crystals, soda ash, &c., by much cheaper methods than those at present in use.

When a proper quantity of the solution is run into the oxidiser, the jet of steam with the air with which it mixes itself is injected through the "throat pipe" into the vessel; the injection is continued till a test sample ceases to give a black or brown precipitate with acetate of lead, which will be in from three to five hours, the time varying with the amount of sulphide in the solution, pressure of steam, and state of the atmosphere. If it is intended to extract the caustic soda already in the solution without further causticising with lime it is concentrated till the carbonate, sulphate, and chloride of sodium are insoluble in the strong caustic solution, which is allowed to stand and cool that the foreign impurities may subside; it is then still further concentrated till it contains from 60 to 70 per cent. of soda in the state of hydrate.

If the action of this apparatus is arrested, or any other in which air is used as the oxidising agent, as soon as indications of the presence of NaS have ceased, a quantity of nitrate of soda is still required to fit the caustic soda for the market, owing to the oxidation having only gone so far as to convert the sulphide into hyposulphite or sulphite. Under the high temperature at which the concentration of the caustic soda is completed, the reactions

$$2NaOS_2O_2 = NaOSO_3 + NaS \text{ and } 4NaOSO_2 = 3NaOSO_3 + NaS$$

take place, and an addition of nitrate of soda is required to complete the oxidation, but not more than one-fourth the quantity that would be necessary, were it not previously oxidised with atmospheric air; but if the action is continued for some time after, so as to convert the hyposulphite and sulphite into sulphate, the quantity of nitrate of soda required is almost *nil.*

Appleton in Widnes, Lancashire, May 14.

Description of the English Method of Assaying Copper by the Dry Way, by M. L. MOISSENET[*]—*Translated by M.* W. W. PROCTOR.

(Continued from page 233)

Coarse Copper.

The fluxes above indicated are taken from the box No. 1, except the dry salt, which forms part of a second box called the refining flux. The ladle for this box No. 2 is a little larger than for the first; it has a diameter of ·044 m. At the beginning of the operation the furnace is well filled and lighted; the same fire ought to suffice for all the following fusions, which it is very important to conduct with great rapidity. After a moment, and if there is any frothing, we throw in some dry salt, which calms the ebullition. At the end of ten minutes, the fusion appearing complete, we throw in a pinch of white flux. A little after we withdraw successively each of the crucibles, pouring them carefully and by a single turn into each of the principal cavities of the metal mould. These moulds ought, this time only, to be greased with a cloth impregnated with suet. The crucibles are immediately put back again into the fire.

We detach the fluxion as previously, seize each one successively with the copper tongs, and plunge it

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[*] *Annales des Mines*, vol. xiii., p. 183, 1858.

for an instant into a basin full of water. The rest is effected as for the regulus, only the slags are preserved on the metal plate, and in the order in which we have detached them. The button of copper obtained appears more or less black; I have already indicated the influence of the tartar in excess.

Washings.

We place the button and the fluxes in a large copper shovel, lengthened and narrowed at the end, called a scoop, and we pour them into the crucible, which is already at a red heat. As the fusion is made in five or six minutes, it would be inconvenient to prolong it on account of the loss occasioned by the carrying off of copper with the vapours of common salt. The tapping is made with care by pouring first into one of the large cavities, then as soon as the metal has fallen there we finish by pouring in the slag into one of the small lateral cavities. This last slag, probably rich in copper, is less fluid, and would adhere to the button, which would be difficult to cleanse. The two buttons being detached from the mould, we immerse the small one first, then finish as in the preceding operation.

Testing and Refining.

The crucible has again been put back into the furnace—after the tapping; the button tried by the hammer is put into the crucible by means of the tongs. At the end of about three or four minutes it attains the colour of the vessel, the eye manifests itself, and we rapidly throw in the fluxes put into the scoop beforehand.

The tapping is made as for the washing, with the small button of slag kept apart.

In general we arrive at a button regarded as pure, clean copper; if not, as I have said, we proceed to an extra washing by adding exceptionally in the scoop the last slag obtained.

Prill.

The crucible this time has been left out of the furnace; we put into it all the slags, collected for this purpose from the metal plate into the scoop, and upon which we have put the reducing reagents. The fusion lasts a quarter of an hour; we pour all at once into the large cavity; before the cooling, by means of a transverse blow, we get rid of the upper beds which are still liquid, and composed principally of common salt. Then we operate as above. We collect the prill, which again undergoes, if necessary, a washing.

SECTION III.—*Some Minerals and Substances of a Special Nature—Influence of Foreign Metals.*

Stanniferous Minerals.—Most often we only perceive the presence of tin in a copper mineral when testing with the hammer, which reveals the nature of the bronze; when we proceed to the refining of such a stanniferous button it is impossible to obtain the characteristic eye; that is to say, the surface of the metal becomes quite clear, and we scarcely open the furnace when it again becomes obscure. We free it from tin by two or three extra washings. If we suspect tin from the known produce of the mineral, or the inspection of the sample in the basin, we endeavour to obtain a fine regulus, which is accomplished in the case of a warm sample by prolonging the calcining, and for the raw sample by putting in more nitre or less sulphur. It is clear that tin can only enter the regulus by virtue of the excess of sulphur necessary to the formation of the coppery matt, and that by restraining this excess of sulphur we diminish the chance of tin entering the button. The fine regulus ought to contain 70 to 75 per cent. of copper, as for the carbonated copper minerals.

Antimonial Minerals.—Antimony is also detected in the testing; the metal being rendered very brittle. We then add one or two grammes (15 to 30 grains) of lead in the refining operation. There forms an alloy of lead and antimony heavier than copper, which is poured into the small cavity of the mould. When we suspect antimony, we act as for tin—that is to say, we produce a fine regulus, a most careful roasting expelling the antimony; then we have to make two washings, and in the second to add the metallic lead.

We cause, then, three influences to act with a view of expelling the antimony:—

1. Slow oxidation at a low temperature, disengaging volatile oxide of antimony.
2. Repeated chloridations, from whence a formation of volatile chlorides.
3. Affinity of the lead and mechanical separation of the alloy.

Zinciferous Minerals.—One of the metals which is most troublesome is zinc. We recognise it by the appearance of the regulus and by its colour, which is that of blende. Once out of ten the regulus collects sufficiently to be able to detach it; in this case we pound it, add to it the slags, and borax 1 ladle, nitre ½ ladle. We fuse anew and obtain a good regulus, for the nitre has caused the zinc to pass into the slag in the state of oxide.

Most often the zinciferous regulus does not collect, and there is nothing for it but to begin anew by making a very prolonged warming, at least half an hour—for example, mineral of South Crenver—this is evidently what we would have done at first had we been aware of the presence of the zinc.

Plombiferous Minerals.—Lead is not injurious, for it does not alloy with copper. The warming is also prolonged. Lead passes into the regulus, which facilitates the collection of the matter. In the last operation the lead easily passes into the slag; it also in case of need carries off antimony. Thus the copper obtained from lead minerals is most malleable.

Special Cupriferous Products.

Regulus of Chill.—These are treated as those which we obtain by the fusion for regulus. Their richness, which rises to nearly 60 per cent., requires us to add much tartar in the fusion for coarse copper.

Slags of Copper.—To obtain regulus we add to the slag sulphur, tartar, and nitre; this last maintaining metals other than copper in the state of oxide in the slag.

Old Copper.—For turnings, waste of workshops, &c., yielding 97 to 98 per cent. by the assay and containing, in fact, not much foreign matter except a little mixed dust or dirt, we take care first to glaze the crucible by fusing in it a little borax and nitre; then we treat the matters by a simple washing, the slags of which we work for prill. This last is often very considerable.

SECTION IV.—*Summary Considerations—Comparison of the Results with the Analysis by the Wet Way.*

After this detailed account of the numerous operations which the metal undergoes before attaining the state of button and prill, it would, I think, be superfluous to insist upon the practical difficulty of the English method.

Nevertheless, in experienced hands, and in the case of daily practice it is still a rapid method, allowing us to treat almost uniformly the different varieties of copper mineral, and at the least to remedy during the operation itself the impurities which show themselves.

As to the metallurgic accuracy, here is a small table showing comparatively the produce by the dry way (determined by a Cornish assayer) and that which I have obtained by the most precise methods of the wet way. It comprehends six samples, whose richness varies within sufficiently great limits.

Nature of the sample and produce.	Dry way. D.	Wet way. W.	Difference W—D.
Regulus of Chili	$56\frac{1}{4}=56\cdot250$	58·40	2·150
Green carbonate copper of Castile	$9\frac{3}{4}=9\cdot750$	11·52	1·770
Variegated copper, Huel Damsel	$10\frac{1}{2}=10\cdot500$	11·30	0·800
Pyrites, West Wheal Seton ..	$8\frac{3}{8}=8\cdot375$	8·40	0·025
" United Mines	$8=8\cdot000$	10·38	2·380
" Devon Great Consols ..	$4\frac{5}{8}=4\cdot625$	5·60	0·975
			8·100
Mean difference ..	$\frac{\Sigma(W-D)}{6}$ ..		1·350°/.

By adding the result given by the last five minerals, we find

$$\Sigma D = 41\cdot25,\ \Sigma(W-D) = 5\cdot95,\ \Sigma W = 47\cdot20, \text{ and } \frac{\Sigma W}{5} = 9\cdot44.$$

By taking the ratio

$$\frac{\Sigma(W-D)}{\Sigma D} = 14\cdot42,$$

we see that we must add to the richness indicated by the Cornish assay about $\frac{1}{7}$th of that result, and by taking the ratio

$$\frac{\Sigma(W-D)}{\Sigma W} = 12\cdot60$$

that the loss is $\frac{1}{8}$th of the copper if we consider a mineral of 9 or 10 per cent.

Without wishing to draw a conclusion altogether general from so small a number of analyses, I nevertheless think they suffice to show that the English method occasions losses, always sensible and sometimes considerable. I think I may assert that upon the whole of the Cornish minerals whose mean richness varies from 6 to 7 per cent., the loss by the assay is not less than 10 per cent. of the contained copper, and that for certain pyrites of 3 to 4 per cent. it attains 30 and 40 per cent. of the metal.

The principal causes of these losses are,—(1st) The quantity more or less great of copper left in the slag of the regulus; (2nd) and especially the carrying away of copper by the vapours of common salt in the fusion for coarse copper, the washing or washings, the refining and the treatment of the slag for prill.

In consequence I think they ought to bear principally on the oxidated minerals for which we make a rich regulus, and still more on the impure minerals, which besides a rich regulus have undergone several washings. Thus the minerals of Algeria, grey copper, assayed some years ago at the School of Mines, have given a produce *much* higher than that indicated by the Cornish assayers.

Conclusions.

In conclusion, the English method, as applied by the buyers and in their laboratories, certainly answers to all their wants; but indicating results always lower than the real result, it would appear to be exercised to the detriment of the sellers.

The counter assays which are frequently made on account of mining companies and miners *tributors* can only be a proof of the good faith and of the truth of the figures announced by the buyer.

But we must not lose sight of the fact that the industrial methods of assay have for their object only to fix a basis of buying, and for this purpose it is not necessary that they should give a rigorously exact result; it is even logical that the loss in the assay should be proportioned to the loss in the treatment according to the greater or less impurity of the material.

Thus even if the Cornish companies should come to state in their products a richness of 1 or 2 per cent. greater, there would not result from this in reality any increase of *value* for their minerals, or, if we like, any advance of the buying price. This price is from other reasons far superior to those of copper minerals in foreign markets, and especially to that which is paid for American minerals at the works at Boston.

On the Cumol of Coal Tar, by MM. BEILSTEIN *and* KŒGLER.

THE cumol, boiling at 166°, extracted from coal tar always contains other hydrocarbons, which may be got rid of by combining the cumol with sulphuric acid, and submitting the cumol-sulphuric acid to distillation. The best characterised salt of this acid is that baryta

$$\text{Ɵ}_9H_{11}BaS\text{Ɵ}_3 + \tfrac{1}{2}H_2\text{Ɵ},$$

which only loses its water when heated to 150°C.

Cumol gives a well crystallised bromated compound $\text{Ɵ}_9H_{11}Br$, by which property it is easily distinguished from its isomers.

Oxidised by means of bichromate of potash and sulphuric acid, cumol gives neither benzoic nor terephthalic acid.

Cumol appears to be the last term of the homologues of benzole in coal tar, the higher products consisting simply of naphthaline.—*Zeit. für Chem.*, vi., p. 277. *Bull. de la Soc. Chim.*, April, 283.

Preparation of the Radical of Benzoic Acid, by G. BRIEGEL.

THE radical benzoyle may be isolated by the reaction of sodium on chloride of benzoyle. For this purpose the chloride is first mixed with anhydrous ether and sodium amalgam is added to the mixture. A small amount of heat is disengaged at the commencement of the reaction, but to complete it, the heat of a water bath is necessary. After twenty-four hours the etherial solution is filtered, then shaken with water to decompose the residual chloride of benzoyle. The greater part of the ether is now allowed to evaporate, and the remaining solution is set aside in a stoppered bottle. After some days a quantity of small crystals are deposited. These are collected on a filter, washed with cold ether, and then re-crystallised from boiling ether. The crystals have now the composition of benzoyle:—

$$\left.\begin{matrix}C_{14}H_5O_2\\C_{14}H_5O_2\end{matrix}\right\}$$

They are small, colourless prisms which fuse at 146° C. They sublime unchanged; they are but slightly soluble in alcohol and ether.

By these properties the new body is distinguished from Laurent's *benzyle*, the fusing point of which lies between 90° and 92°, and which is very soluble in alcohol and ether. The latter body dissolves in alcoholic potash, and from the solution acids separate benzylic acid.

Benzoyle, on the contrary, under the action of alcoholic potash appears to split up into benzoic acid and benzylic alcohol.—*Annalen der Chem. und Pharm.*, v. 135, p. 171.—*Bulletin de la Soc. Chim.*, April, 1866, p. 278.

TECHNICAL CHEMISTRY.

On the Application of Disinfectants in Arresting the Spread of the Cattle Plague—Report to Her Majesty's Commissioners, by WILLIAM CROOKES, *F.R.S.*

(Continued from page 258.)

37. It became now a matter of considerable interest to ascertain in what way carbolic acid acted in arresting decomposition, and the following experiments were made, with the object of clearing up this point:—

XIII. Albumen was mixed with four times its bulk of water, and a one per cent. solution of pure carbolic acid was added to it. No change took place for the first few minutes, but after a little time a white cloudiness was formed, which gradually collected together into a coagulum. On separating this, and exposing it freely to the air, it entirely resisted putrefactive decomposition. The solution strained from the coagulum still contained carbolic acid and uncoagulated albumen.

XIV. The same experiment was repeated with pure cresylic acid. This acid has still less affinity for albumen, the mixed solutions remaining clear for nearly half-an-hour.

It is evident, therefore, that the tar acids do not owe their special action to their coagulating powers on albumen, for the last two experiments show, contrary to the generally received opinion, that their affinity for this body is but slight.

XV. A few drops of carbolic acid, added to half a pint of sugar syrup and yeast in full action, immediately put a stop to the fermentation.

XVI. Fresh brewer's yeast was washed with a solution of one per cent. of carbolic acid, and then with water. Its power of inducing fermentation in a solution of sugar was entirely destroyed, although no perceptible change in the appearance of the yeast cells could be detected under the microscope. This experiment was repeated several times, and always with the same result, although when the yeast was simply washed in water it readily induced fermentation.

The odour of carbolic acid adhered most pertinaciously to the yeast, and by no ordinary amount of washing and exposure to the air could it be removed.

XVII. Strychnine was added to a mixture of yeast and sugar solution in full fermentation. No visible effect was produced, the evolution of carbonic acid continuing as brisk as before.

The above experiments, some of which were performed by my friend Mr. Spiller, prove conclusively that carbolic acid has a special action on the fermentation induced by organised matter; it not only arrests it instantly when in progress, but it prevents the development of future fermentation.

38. The action of the tar acids was now examined on certain chemical bodies, which are supposed to act by fermentation, in order to see if they were influenced in the same manner.

XVIII. A solution of diastase (infusion of malt) was mixed with thick starch paste, and a one per cent. solution of carbolic acid. On gently heating for a short time, the starch was converted into dextrine, as completely as if no carbolic acid had been present.

XIX. Amygdalin was mixed with synaptase (emulsion of sweet almonds) in the presence of carbolic acid. The formation of the essential oil took place with apparently the same readiness as if carbolic acid had been absent.*

The foregoing results show that carbolic acid has no action on purely chemical ferments. These consist of definite nitrogenous compounds acting simply by chemical affinity, and therefore ought not to be classed with true ferments, which are living bodies. It therefore appears that carbolic acid acts by attacking vitality in some mysterious way, and where an effect is merely due to so-called catalytic force, it exerts no interfering action.

39. The action of carbolic acid on vitality was then tested in other ways:—

XX. Cheese mites were immersed in water, where they lived for several hours. A few drops of a solution of carbolic acid containing 1 per cent. added to the liquid, killed them instantly.

XXI. An aqueous solution of carbolic acid was added to water in which a small fish was swimming. It proved fatal in a few minutes.

XXII. A very minute quantity of a weak solution of carbolic acid was added, under the microscope, to water containing various infusoria, such as bacteria, vibrios, spirilla, amœbæa, monads, euglenæa, paramecia, rotifera, and vorticellæ. The acid proved instantly fatal, arresting the movements of the animalcules at once.

These animalcules are the almost invariable accompaniments of putrefactive fermentation. The above experiment has been tried with putrid blood, sour paste, and decayed cheese, and in every instance the destruction of vitality and the arrest of putrefaction have been simultaneous.

XXII. Caterpillars, beetles, crickets, fleas, moths, and gnats were covered with a glass, the inside of which was smeared with carbolic acid. The vapour proved quickly fatal. It allays the pain caused by the stings of bees, wasps, hornets, and gnats, if applied pure, or in strong solution, to the wounded part.

I find it recorded by Dr. Lemaire and other observers that carbolic acid vapour will also kill flies, ants and their eggs, lice, bugs, tics, acari, mosquitoes, aphides, butterflies, earwigs, wood-lice, cockchafers, centipedes, and other insects of this size; its vapour, however, does not appear to be strong enough to act injuriously on animals larger than mice. When such animals are killed with it, their bodies dry up in the air, and resist putrefaction for some time.

40. From the intense aversion shown by all insects to the odour of carbolic acid, it is probable that the plentiful use of this agent would effectually preserve cattle from those terrible scourges met with in certain parts of Africa, the zimb and tsetse fly. The effects following the bite of the latter have been described to me as being almost identical with the symptoms of cattle plague.

M. Lucien Biard, in speaking of the invasions of the large ants of Mexico, says that when one of their battalions threatens his house, he sprinkles a little carbolic acid in front of it. The army immediately makes a detour to avoid the obstacle.

When an animal is killed by the injection of a saturated aqueous solution of carbolic acid into its veins, circulation is instantly arrested, the blood is not coagulated, and no alteration, either in the shape or the appearance of the globules, is detected under the

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* These last two experiments are confirmatory of a statement in Dr. Lemaire's work "Sur l'Acide Phénique."

microscope. The only apparent change consists in the immobility of the globules.

41. In the *Annales de Chemie et de Physique* for October last, there is a letter from M. Béchamp to M. Dumas, in which it is said that creosote appears to be the agent which most strongly opposes the development of organic ferments, but that it does not interfere with the living ferments or animacules when they are once developed. This assertion is in direct opposition to all my experiments, about the accuracy of which I have no doubt whatever, having submitted them to repeated tests. The powerful action which carbolic acid exerts on the phenomena of life is the most remarkable property which it possesses. It may be looked upon as the test proper for distinguishing vital from purely physical phenomena, and in most cases its action is characterised by the certainty and definiteness of a chemical re-agent. In the presence of carbolic acid the development of embryotic life is impossible, and before its powerful influence all minute forms of animal life must inevitably perish.

42. It may be considered as definitely proved that the vapour of carbolic acid, in the atmosphere, exerts a special selective power on all minute organisms possessing life. If the contagious matter of cattle plague is possessed of organic vitality, as must be now admitted, it will be destroyed, beyond the possibility of revival, when brought into contact with the vapour. French experimentalists have repeatedly tested the influence of carbolic acid on vaccine lymph. They have employed lymph both pure and mixed with a trace of carbolic acid. The vaccination with pure lymph was followed by the usual results, but in no single instance was any effect produced by the lymph containing carbolic acid.

43. The following experiment tends to show a similarity between the action of vaccine virus and that of the cattle plague:—

XXIV. The air from a close, highly infected shed (57.), containing animals in the last stage of the disease, was drawn through glass tubes containing tufts of cotton wool, in the expectation that some of the virus cells, supposed to be floating about in the atmosphere, would be arrested by the wool.

The suction was continued for ten minutes. One piece of the infected wool was then exposed for half an hour to the vapour of carbolic acid. Two apparently healthy calves were selected, and an incision being made beneath the skin, these pieces of wool were respectively inserted in each. The animal thus inoculated with the infected wool, which had been exposed to carbolic acid, remained perfectly well, but the other animal took the disease, and died in a few days.

I place this upon record, although I do not attach much importance to it, as the experiment was made at a farm where the plague was raging; and it is quite possible that the calf which died did not take the disease from the wool. Unfortunately, time would not permit me to verify this experiment so as to place its results beyond doubt. It is likewise desirable to inoculate with the virus itself, collected from the eyes, &c., of diseased animals, mixed with different quantities of carbolic acid. There can be little doubt that the issue would prove satisfactory.

44. I first employed carbolic acid on a large scale early in December last. Considerable experience suggested to me the best way of proceeding, and I consider that the results have proved that my views were correct. A detailed account of the various experiments is given in the next part.

I had two objects in view; firstly, to apply the energetic disinfecting powers of sulphurous acid for the purpose of purifying the cattle sheds two or three times a week; and secondly, to trust to carbolic acid as a permanent means of protecting the animals from extraneous infection. Sulphur fumigation and carbolic acid agree very well together, and somewhat assist each other's action; whereas oxidising disinfectants, used either with carbolic acid or sulphurous acid, are inoperative; the energies which should be directed to the destruction of infection being exhausted in neutralising each other. When dealing with such an overwhelming amount of putrefying and putrescible organic matter as is met with in a farmyard, it is of paramount importance to economise as much as possible the disinfectant. I have already shown that chlorine and ozone are very wasteful agents. As it is our chief aim to destroy the activity of cattle plague virus, (the destruction of ordinary farmyard odours being of secondary importance,) even sulphurous acid is open to objection on the score of waste; but carbolic acid goes direct to the root of the evil, and acts solely where it is most required, without touching the innocuous dunghill stenches. Owing to the power possessed by carbolic acid of arresting and preventing decomposition, it checks the evolution of these offensive odours, and, by retaining the nitrogenous compounds in the manure, it greatly increases its value. At the same time it stops the development in the manure of minute animal organisms, and it has been observed that flies never congregate about dunghills where carbolic acid has been habitually used (100.), whilst the liquid manure which oozes from them is without smell. In stables and cowsheds this property is of very great importance, both as regards the comfort and health of the animals, especially during the hot summer months.

45. Another advantage of carbolic acid, over almost all other disinfecting agents, consists in the fact that its vapour is never injurious or unpleasant to cattle. Indeed, they seem to like it; they lick the woodwork of their stalls, after it has been sprinkled with the undiluted acid (69.), and will readily drink water in which the acid has been dissolved. If applied to their mouths in its undiluted state, I am told that it will produce temporary blistering; but such blisters are entirely free from danger, and heal very rapidly. From its action on the human skin, if carelessly used, I have no doubt that inconvenience to the cattle might arise; but although carbolic acid has been used freely by me, and by many farm servants under my directions, in the treatment of several hundred animals, I have not had a single instance of this action brought under my personal notice.

If undiluted carbolic acid is allowed to remain on the hands, it will act as a mild caustic. This inconvenience is, however, very slight, and may be avoided with ordinary care. I have had my hands repeatedly covered with carbolic acid during the last four months, without experiencing any painful effect. Ample warning of the approach of blistering is given by a preliminary smarting, and if this is attended to, and the acid rubbed or washed off, no further annoyance is felt. Sweet oil rubbed over will remove the last traces of the acid.

46. Finding that medical and scientific writers were unanimous in the opinion that small internal doses of

carbolic acid were attended with no injurious effect, I have recommended the addition of small quantities both to the food and water given to the whole of the stock, sick or healthy, on the farm. This has a two-fold action. The water given to cattle is seldom very pure, and carbolic acid will neutralise any virus of infection which may happen to have found its way into it. Moreover, after drinking aqueous carbolic acid, the breath smells of it for some hours. Now, it is very probable that the germs of infection enter the animal system through the mouth (17.), and by thus loading the breath with the antidote, it is reasonable to suppose that these germs would be destroyed before they had an opportunity of doing harm. The vapour of the acid, diffused through the air, will kill large insects; it is reasonable, therefore, to suppose that it will much more readily destroy microscopic germs when brought into contact with its vapour during respiration. Besides, it is not unlikely that after the system has become habituated to repeated doses of carbolic acid, it will acquire additional power of resisting the first attack of disease.

Since this investigation was undertaken, I have made a collection of cases, illustrating the good effect of carbolic acid in arresting the spread of the cattle plague in various parts of England and the Continent. I will not, however, enter into particulars, but confine myself to those cases which have come under my own immediate knowledge.[†] I have not yet met with a single instance in which the plague has spread on a farm where this acid has been freely used.

On the Adulterations of Carbolic Acid, and their Detection.

47. The official recommendations (50.) have naturally brought into the market many substitutions for carbolic acid, in which the valuable agent is diluted with cheap inert bodies, whilst the price charged, in some cases, is higher than that of the genuine article. Specimens of two such substitutions, called cresyline and carboline, were forwarded to the Royal Cattle Plague Commission for approval, "as being more certain disinfectants than most of the carbolic acids now being sold to the public, many of which contain but a very small percentage of that acid." It was stated that the preparations contained over 60 per cent. of carbolic acid, and were miscible with water. As it was possible from these and other reputed advantages that the preparations might be of considerable value, they were forwarded to me for examination. Cresyline consists of alkaline water, and tar oils boiling above 370° C., therefore containing little or no carbolic or crysilic acid. Carboline is a dilute solution of caustic soda, containing 4·1 per cent. of carbolic acid. The price of these preparations is higher than that ordinarily charged for good commercial carbolic and cresylic acids.

Other creosote samples from different makers were found to contain respectively 4·5, 2·6, 5·9, and 4·2 per cent. of carbolic acid, the rest being tar oils. In other instances, articles have been sold as commercially pure carbolic acid which were found to contain from 30 to 50 per cent. Frequently a very foetid sulphur compound is allowed to remain. This should be avoided, as although the antiseptic powers of the liquid are great, the offensive odour which it diffuses round the neighbourhood is excessively nauseous.

48. It is by no means difficult to detect the adulterations referred to above. Commercial carbolic acid is soluble in from 20 to 70 parts of water, or in twice its bulk of a solution of caustic soda, while oil of tar is nearly insoluble; but if the amount of carbolic acid be increased some remains undissolved.

To apply the tests:—1. Put a teaspoonful of the carbolic acid in a bottle, pour on it half a pint of warm water, and shake the bottle at intervals for half an hour, when the amount of oily residue will show the impurity. Or, dissolve one part of caustic soda in ten parts of warm water, and shake it up with five parts of the carbolic acid. As before the residue will indicate the amount of impurity.

These tests will show whether tar oils have been used as adulterants; but to ascertain whether the liquid consists of a mere solution of carbolic acid in water or alkali, or whether it contains sulpho-carbolic or sulpho-cresylic acids, another test must be used, based upon the solubility of these, and the insolubility of carbolic acid, in a small quantity of water. In this case proceed as follows:—2. Put a wine-glassful of the liquid to be tested in a bottle, and pour on it half a pint of warm water. If the greater part dissolves, it is an adulterated article. Test the liquid in the bottle with litmus paper; if strongly acid it will show the probable presence of sulpho-acids, whilst if alkaline it will show that caustic soda has been probably used as a solvent.

These tests are not given as having any pretensions to scientific accuracy, but as affording persons who are desirous of using carbolic acid, and are willing to pay a fair price, a rough and ready means of seeing if they are being imposed upon.

If greater accuracy in the tests are required, recourse should also be had to distillation with a thermometer—carbolic acid boils at 184° C., cresylic at 203° C., whilst xylic acid (96.), which may possibly be present, and has great antiseptic value, boils at 220° C. Reichenbach's pure creosote (33.) boils at 219° C.

PART III.—*Disinfecting Experiments on the Farm.*

49. For all practical purposes infection may be considered as radiating from a focus, and following the same law as other radiant forces. At the centre, which may be a diseased animal, an infected shed, or farm, the danger is at its maximum, and it decreases in intensity inversely as the square of the distance from the focus increases. A certain amount of resisting power is unquestionably conferred on an animal by carbolic acid, and it is important to know how near cattle so protected can approach an infected centre and still remain safe. The simplest experiment, and the one most likely to succeed, is to endeavour to protect a healthy farm from the march of the closely investing plague (51. 52. 66. 67.). Here the resisting power is at its maximum, whilst the intensity of the infection is at its minimum. Next, in order of severity, is the test of stopping the plague when it has invaded a farm (58. 60. 68. 72.). A yet severer test is the attempt to prevent the communication of the plague to a healthy animal when kept by itself in an infected shed, or to protect a healthy animal placed by the side of a diseased one (54. 59.

[†] It may, however, be of interest to state that carbolic acid was the principal substance used in the Jardin d'Acclimatation, in the Bois de Boulogne, to prevent the spread of the disease amongst the animals in that establishment. According to the *Journal of the Society of Arts* for April 13, 1866, more than twenty pounds of this acid were used daily, in washing the walls and mangers, and in sprinkling the floors of the stables and enclosures, and it is to its constant use that the arrest of the malady is generally attributed.

65.). Lastly, in order of severity, is the attempt to counteract inoculation, and to destroy the virus when it is actually present in the system of the animal (77. to 96.). Viewed in one light, this latter experiment belongs to medical science, a subject which is out of my province, but, in another light, it is merely the last link in the chain of experiments on disinfection, and as such clearly within the domain of a chemist.

It was to test the value of disinfection, under the various circumstances here referred to, that I was authorised to proceed to infected districts and carry out practical operations at farmhouses.

Plan of Disinfection Recommended.

50. I have not thought it necessary to give any detailed recommendations concerning the best method of utilising the valuable antiseptic properties of carbolic and sulphurous acid, since the official recommendations for disinfection, issued by the Royal Commission on February 23, are very explicit on that point. With a few alterations, suggested by wider experience, they will agree perfectly with my plan of proceeding.

Experiments at Mrs. Carmichael's Farm.

51. This farm is situated about three miles from Thirsk, in Yorkshire. In November last I first heard that the disease had attacked several farms in the neighbourhood. I at once sent down a supply of carbolic acid, with minute instructions for its employment. Hearing shortly afterwards that the disease was rapidly spreading round the farm, I went down to Thirsk, personally to instruct the farm servants in properly carrying out my plan. I found the disease was making terrible ravages on adjoining farms; the death wave had rolled across the country up to these herds, and judging from the virulence the disease had already manifested, there could be little doubt that Mrs. Carmichael's farm would speedily be attacked. I found twenty-five heads of cattle on the farm, all in perfect health. The cow sheds were well cleaned out, whitewashed with lime and carbolic acid, fumigated with sulphur, and thoroughly sprinkled over the floors, walls, and rafters with carbolic acid. The manure in the fold yard was watered with a 1 per cent. solution of carbolic acid, and the open sheds were also well sprinkled with the undiluted acid. The horns, legs, feet, tails, &c., of the cattle were painted over with the aqueous solution, by means of a brush, every night and morning, the clothes of the men were also sprinkled with the liquid, and they were told occasionally to dip their hands in it. Pieces of carpet, matting, sacks, &c., were hung up in the sheds, and were kept wetted with carbolic acid.‡ Instructions were left for the whitewashing to be done every fortnight, the fumigation with sulphur twice a week, and the other operations daily.

On visiting this farm a second time, I found that my instructions had been carefully carried out, and although nearly every other farm in the neighbourhood was severely visited with the disease, this was unattacked. This exemption is the more remarkable, as on an adjourning farm, held by a near relative, many cattle died; and during the whole of the time there was frequent communication between the two families.

Up to the date of this report, Mrs. Carmichael's farm has kept free from the plague, and is now, I believe, the only one that has escaped for some miles round. Owing partly to the vigorous carrying out of the late Act, and partly to there being fewer animals for the disease to attack, the plague is now leaving the neighbourhood.

Experiments at Sir G. Wombwell's Farms, Newburgh, near Thirsk.

52. On February 17 I superintended the thorough disinfection of Sir G. Wombwell's Home farm, and left full written instructions with his bailiff. This farm and one about a mile off, belonging to Mr. Easton, were the only farms in that neighbourhood free from the disease. On the same day I superintended the disinfection of Mr. Easton's farm. My instructions have been carefully carried out, and notwithstanding the ravages of the disease all round, it has kept off these two farms.

Experiments at Mr. Daniel's.

53. This is a very large farm at Oulston, ten miles from Thirsk. When I first arrived there I found the disease raging violently; out of a herd of sixty-six on February 1, forty-five only remained by the middle of the month, and fresh cases of illness were being reported daily. Owing to the extent, and very inconvenient arrangement of the premises, I felt that it would not be a fair trial to attempt to stop the plague on this farm, as the buildings were already saturated with infection, and all the details required for an accurate experiment could not be properly carried out. Permission was asked, and freely given, to try certain other experiments here.

54. A shed was selected some distance from any other building, which had been used as a hospital for the cattle as they fell sick; several had died in it, and it then contained a diseased animal almost moribund; no system of disinfection had been adopted, and the stench was very bad. The sick beast having been removed and tethered to an outside wall, the litter was cleared away, and the floor washed with a two per cent. solution of carbolic acid. The walls, roof, and rafters were then whitewashed with freshly burnt lime, a pint of carbolic acid being added to each pailful of whitewash. The floor, after cleaning, was thoroughly sprinkled with undiluted carbolic acid, and the woodwork and inside of the door rubbed with a cloth dipped in the same. The ventilating holes were then stopped up with hay, and the door being kept shut, one pound of stick sulphur was burnt on a shovelful of red-hot cinders placed in the middle of the floor. After two hours, on opening the place, it was found full of a thick white vapour, which disappeared in the course of half an hour. In the meantime, Mr. Hain, the veterinary surgeon, of Thirsk (to whom I am under many obligations for valuable advice and assistance in the course of these experiments), had procured a healthy two-year old bullock from a farm about two miles distant from any infection. The diseased animal, formerly occupying the shed, was then tied to a stake at the end of the shed, whilst the healthy animal was fastened up near the door. Directions were left to continue treating the sick beast as hitherto, and to give the healthy one fresh hay and water, mixed with one ounce of carbolic acid per diem. The shed was to be well sprinkled daily with carbolic acid, all over the floor and walls, as high as could conveniently be reached, and to be fumigated with sulphur once a week, and whitewashed every fortnight, as long as the experiment lasted. The farm was visited every

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‡ For some of these practical hints I am indebted to my friend, Professor A. H. Church, who was, I believe, the first to publicly recommend the employment of carbolic acid as a preventive against the cattle plague.

day for a week, and on leaving I gave full written instructions to Mr. Daniel, who promised to attend personally to the experiment. Mr. Hain also promised to ride over two or three times a week, and report progress.

55. In a few days it became evident that the experiment would be much more severe than had been intended. The size of the shed, fifteen feet by nine feet, was insufficient to prevent the animals touching occasionally; the hind quarters of the healthy beast were soiled with the liquid alvine discharges from the diseased one, and on one occasion the former was seen to lick a part so smeared. Actual inoculation, therefore, might be considered to have taken place, and the question now became, how great a power of resisting the infection would the carbolic atmosphere, which the animal was breathing day and night, confer upon it. Absolute immunity was scarcely to be hoped for, and all that now remained was to see how long the means employed would enable the animal to withstand the disease.

56. The animals were put together on February 15. On the 21st the diseased one died in the shed; its body was removed, and replaced the next day by another sick animal. For a month the experiment progressed satisfactorily, when the healthy animal showed signs of illness, but in a very mild form, and in a few days recovered.

This experiment although not so satisfactory as if the animal had entirely resisted infection, is, so far as it goes, very striking and valuable. Allowing nine days for the period of incubation, it shows that the antiseptic powers of sulphurous and carbolic acids ensured absolute immunity for nearly three weeks, and finally, when the animal did succumb to this very severe test, deprived the disease of its malignant character. The relative position of the animals in the shed was unfortunate. The healthy animal being close to the door, the man who looked after the diseased animal and brought it food was obliged to pass close to it daily. Also the filth and droppings from the diseased animals had to be passed out daily close to the healthy one, and the dead bodies were likewise dragged out in the same way. Actual contact between the healthy animal and infected matter must therefore have repeatedly taken place. Considering the crucial severity of this trial, it is a very encouraging fact to have warded off an attack for so long a time.

57. On February 15 I selected, at the same farm, another small shed containing three animals in the last stage of the disease, and in which several had previously died in rapid succession. The place had not been cleaned out for some time, and was pervaded by the characteristic stench of the disease. In this shed I spent the greater part of the day, collecting specimens for future examination.

a. Several tubes of air from different parts of the shed, and from the nostrils of a dying cow, were collected and sealed up before the blowpipe.

b. Tufts of cotton wool having been pressed into glass tubes, air from the cow's nostrils and from different parts of the shed were sucked through them severally for ten minutes.

c. A very clean flask was filled with ice, a clean cup suspended beneath it, and the whole hung up to a beam in the centre of the shed, just out of reach of the animals. The moisture, condensing on the outside of the flask, dropped into the cup, and was preserved in a clean stoppered bottle. It took thirty-six hours to collect a quarter of an ounce of liquid.

d. The air of the shed was likewise examined by shaking it, in a bottle of known capacity, with a standard solution of permanganate of potash; but as no two determinations were obtained at all near to each other, nothing was shown by these experiments, except that air taken from close to the animals' mouths was more charged with organic matter than that taken from other parts of the shed.

The tubes of air, cotton wool, and condensed vapour were forwarded to Dr. Angus Smith, who kindly undertook their examination.§

Mr. Bainbridge's Farm.

58. This farm is likewise at Oulston, close to Mr. Daniel's, where the disease was spreading with the greatest virulence. It had broken out here a few days before I arrived. The original stock consisted of forty-one fine healthy beasts. The farm buildings were kept beautifully clean, no pains or expense had been spared to keep the herd in good health, and Mr. Bainbridge was willing to adopt any means likely to save his stock. In the four days between the first outbreak and my visit, three animals had died, one was ill, and another suspected. Disinfection was immediately commenced by whitewashing and sprinkling with carbonic acid, and burning sulphur, substantially in the way recommended in the official recommendations. In effecting this, I was ably seconded by Mr. Bainbridge and his very intelligent foreman, Mr. Hardcastle, both being unremitting in their endeavours to carry out the experiment in a satisfactory manner.

Some little delay occurring in procuring a sufficient supply of carbolic acid, the whole of the buildings could not be thoroughly done until nearly a week later. Then, after the animals already diseased had died, the plague left the farm, and, up to the present date, no further attack has taken place.

59. The hospital shed, to which Mr. Bainbridge's cattle had been removed when they exhibited signs of illness, and in which three had died, being in a field a quarter of a mile away from any other building, was well adapted for experimental purposes. Permission being freely given to make what use I liked of it, I had it thoroughly cleaned, and disinfected with carbolic acid, whitewash, and sulphur, in the manner already described (54.). A two-year-old bullock, from a farm a mile distant from any disease, was put into one of the stalls, and in the adjoining stall a diseased heifer was tied, in such a manner that actual contact was impossible. When, a few days after, this died, there being no other case to substitute for it, the healthy beast was kept by itself. Sprinkling with carbolic acid, sulphur fumigation, and whitewashing were strictly carried out, and for nine days the experimental bullock remained healthy. It then showed signs of disease, and died on the thirteenth day.

(To be continued.)

Salicine.—Dr. Phipson has asserted that salicine in alcoholic solution will combine with some acids—benzoic, for instance. O. Schmidt has endeavoured to obtain populine by this means, but in vain. Salicine, he states, treated with benzoic acid and water in sealed tubes gives a yellow resinoid body (saliretine?) and a solution which gives a blue colour with perchloride of iron (saligenine?). —*Bull. de la Soc. Chim.*, April, 1866, p. 287.

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§ See Dr. Angus Smith's Report, Part II.

PHARMACY, TOXICOLOGY, &c.

On a Density Test for Unguentum Hydrargyri, by Gustavus Pile.*

The relative density of mercurial ointment, or its specific gravity, although not usually alluded to, may furnish valuable information, and, as it is a means often resorted to in detecting adulterations in other preparations I determined to apply that test also in the examination of this ointment, especially as the most usual cause of inferiority is occasioned by an insufficient quantity of mercury being employed.

To prove the delicacy of the test, I made experiments with ointments of two different strengths; the one containing 50 grains of mercury in 100 grains of the preparation; the other containing 49 grains of mercury in 100 of the preparation. The specific gravity of each was taken, which, in the first instance, was 1·700, and in the second 1·683, showing a difference of ·017, where the difference of the mercury is but one grain in a hundred.

From actual trials with ointments made of various proportions of mercury and grease, the following table was formed:—

1	part mercury	to	10	parts grease	=	sp. gr.	·981
2	,,	,,	10	,,	=	,,	1·065
3	,,	,,	10	,,	=	,,	1·147
4	,,	,,	10	,,	=	,,	1·229
5	,,	,,	10	,,	=	,,	1·311
6	,,	,,	10	,,	=	,,	1·393
7	,,	,,	10	,,	=	,,	1·471
8	,,	,,	10	,,	=	,,	1·548
9	,,	,,	10	,,	=	,,	1·625
10	,,	,,	10	,,	=	,,	1·700

In taking the specific gravity of the ointment, the following precautions are necessary:—

It should be carefully introduced into a 1000 grain bottle, so that the neck may not be soiled; about 100 grains will answer. After being warmed gently so as to melt the ointment, it is set aside to cool, by which it becomes solid and free from air. The exact amount of the ointment is then ascertained, the bottle being previously tared. After filling the bottle with water at 60° F., the weight of the contents is observed and the specific gravity calculated in the usual manner. As an example, suppose the ointment introduced is 80·5 grains, and, after filling the bottle with water, the total weight is 1028·5 grains. The water alone would then weigh $1028{\cdot}5 - 80{\cdot}5 = 948$ grains; consequently the difference between this number and 1000 is the amount of water displaced, which is 52 grains; and the specific gravity is found by dividing the weight of the water into the weight of the ointment. $80{\cdot}5 \div 52 = 1{\cdot}548$ is the specific gravity, and by reference to the table, we see it would contain 8 parts of mercury to 10 parts of grease.

I may here remark that even in an ointment properly made, a slight discrepancy from the table may occur from using different proportions of lard and suet; but the variations from this cause are but slight.

Easy Preparation of a Weak Solution of Peroxide of Hydrogen.—Schönbein states that a weak solution of peroxide of hydrogen may be prepared by shaking violently for a few seconds amalgamated granulated zinc with a little distilled water contained in a large bottle. Oxide of zinc and peroxide of hydrogen are formed, but no zinc or mercury is dissolved.

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* Abridged from *Amer. Jour. of Pharm.*, May, 1865, p. 202.

PROCEEDINGS OF SOCIETIES.

ACADEMY OF SCIENCES.

May 28.

M. Fizeau continued his memoir "*On the Expansion of (Crystalline) Solid Bodies by Heat,*" repeating in this part the account of his methods of observation, to which any one entering upon the same study must needs refer. The memoir, which is very long, is not susceptible of abridgment.

M. Ch. St. Claire Deville contributed an important memoir for meteorologists "*On the Periodical Variations of Temperature in the Months of February, May, August, and November,*" which is accompanied by diagrams of curves showing the variations of temperatures on certain days, founded upon observations made in Paris for 60 years, in London for 50 years, and in Berlin for 110 years. The observations and calculations show that the maximum of temperature always occurs on or about the same day in the months mentioned. The memoir, we repeat, is one of the most important contributions ever made to the science of meteorology.

M. Henri St. Claire Deville contributed a memoir "*On Vapour Densities,*" in which he described an experiment giving ocular proof of the dissociation of the vapour of perchloride of phosphorus at a high temperature. Cahours has shown that the vapour density of pentachloride of phosphorus undergoes a regular decrease as the temperature rises, from 182° when it equals 5·076 to 300° and above when it is equal to 3·61. The most probable explanation of this fact offered is, that above the boiling point the perchloride dissociates into chlorine and protochloride. The following experiment seems to settle the question of the dissociation. The author heated in an oil bath two colourless glass tubes, one containing a mixture of equal volumes of chlorine and air, the other perchloride of phosphorus. The ends of the tubes, projecting a short distance from the bath, were flattened, so that the colour of the contents might be observed and compared, a very minute opening being made so that the expanded gases might escape. According to all analogy the vapour of perchloride of phosphorus should be colourless, and if at a certain moment it became yellowish green, the natural inference would be that it contained free chlorine; and at the temperature at which the two tubes possessed a yellow colour of equal intensity, it might be inferred that the decomposition of the perchloride was complete. Qualitatively this experiment succeeded admirably. The colour of the chlorine was seen to be developed as the temperature rose, and no doubt of the dissociation remained; but the author is as yet unable to obtain exact numerical results of the extent. M. Deville describes another experiment. When iodide of mercury is heated in a small flask or retort, it changes colour, fuses, volatises, giving a colourless vapour, and then condenses into a brown liquid. If the heating be continued, violet vapours are developed at the sides of the vessel which disappear in the middle—that is, the coldest part, where the iodine recombines with the mercury. At the same temperature, he states that a mixture of iodine and air in equal volumes shows a much more intense colouration than the heated vapour of iodide of mercury, showing that this body is only dissociated, and not decomposed. This last experiment the author recommends as a lecture demonstration, since the air having no action on iodide of mercury, the conclusion is free from all objection. The author seems to admit that pentachloride of phosphorus may be taken to represent four volumes of vapour, and he concludes by remarking that iodide of mercury represents four volumes; that water, carbonic acid, ammonia, &c., may represent two or four at will; that all these bodies are subject to the law of successive decomposition or dissociation; and consequently this phenomenon cannot be used as an argument against a condensation of eight volumes.

M. Wurtz also made a communication "*On Anomalous Vapour Densities.*" Deville, it should have been said above, believes in variable co-efficients of expansion for certain, if not all, bodies. M. Wurtz accounts for all anomalies by supposing dissociation to take place. Even in the case of sulphur, he supposes that the group S_6, which occupies two volumes at 500°, may at 1000° split up into three groups of S_2, each of which will occupy two volumes. M. Wurtz goes on to give additional illustrations of the fact of dissociation in the case of the hydrobromate and hydriodate of amylene. In the course of the experiments mentioned the author brought together the vapour of amylene and hydrobromic acid at different temperatures, and proved that at a temperature but little above the boiling point of the hydrobromate the combination was complete, while at 100° or 110° above the boiling point only a partial union of the gases took place.

NOTICES OF BOOKS.

Proceedings of the Chemical Department of the Highland and Agricultural Society of Scotland for 1865. By Thomas Anderson, M.D., F.R.S.E., Chemist to the Society. Aberdeen: King and Co. 1866.

This little book contains three excellent papers. The first is an account of field experiments on the action of uric acid and gelatine as manures. Liebig has expressed a doubt about the decomposition of uric acid in the soil, and has excluded the nitrogen in that form among the valuable constituents of Peruvian guano. Since about half the nitrogen in Peruvian guano exists in the form of uric acid, it became highly important to settle experimentally the manurial value of the acid. This Dr. Anderson has done. We must refer the reader to the book for a full account of the experiments, and quote only general results. First with oats, the author remarks:—"Wherever nitrogenous manures are applied the effect is extremely marked, the produce being greatly increased, and that nearly to the same extent in all cases. They cannot, however, be described as quite equal, for glue stands lowest, then comes uric acid; Peruvian guano slightly exceeds it, and sulphate of ammonia gives a still higher increase, but the difference between the highest and lowest only amounts to 10 per cent." Again: "The conclusions to be drawn from the experiments are very obvious. They completely bear out those of last season, and prove incontestably that uric acid acts as a manure, and is scarcely, if at all, inferior to the ready-formed ammonia."

Dr. Anderson has also experimented with incinerated Peruvian guano, and draws some important practical conclusions from the result. "The entire absence of manurial effect from the application of the mineral constituents of Peruvian guano, as applied to cereals, is particularly worthy of notice. For some years back Peruvian guano has been largely used as a top dressing for cereals, and particularly for oats, in spring, and is by many persons believed to be the most economical way of using that manure; but if, as these experiments lead us to conclude, it acts by virtue of its mineral constituents alone, its mineral matters are so much valuable matter, which is either lost or fails to make any return until a later period. Now, in buying a ton of Peruvian guano at 13*l.*, the farmer pays 10*l.* 10s. for the ammonia which it contains and 2*l.* 10s. for its mineral matters; and if the latter is to produce no immediate effect, it would in all probability be better for him to expend his money on sulphate of ammonia, because he can obtain for 10*l.* 10s. a quantity of that salt sufficient to yield the same quantity of ammonia as a ton of guano."

The next paper, on the composition of the bean plant at various stages of its growth, is also valuable. Our space obliges us to give only the practical conclusions drawn by the author. The experiments teach, he says, that as the greater part of the constituents of the bean crop are drawn from the soil within the space of two months, it must be of the greatest moment to use manures capable of yielding up their valuable matters within a short period. If they are of a kind which do not become available till late in the season, they are practically lost so far as the crop to which they are applied is concerned.

The last paper is on the adulteration of oil cake—a subject just now of great interest to agricultural chemists and farmers. This paper, however, is more adapted for the farmer than the chemist.

The Causes and Treatment of Imperfect Digestion. By Arthur Leared, M.D. Oxon, &c., &c. Fourth Edition. London: Churchill and Sons. 1866.

We may direct attention to this new edition of a very useful book. The appendix now added contains some novel and interesting information on the causes of heartburn and the treatment of flatulence by charcoal.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

1248. W. De la Rue, Bunhill Row, London, "Improvements in the manufacture of steel and iron."—Petition recorded May 2, 1866.

1274. J. G. Hope, Edinburgh, N.B., "An improved composition for destroying vermin on sheep and other animals, and for preserving them therefrom."

1278. W. Young, Straiton, Mid Lothian, and P. Brash, Leith, Mid Lothian, "Improvements in the distillation of coal, shale, and other bituminous substances, to obtain oily matters therefrom, also in the redistillation of the products thereby obtained."—May 4, 1866.

1324. S. A. Bell, Stratford, Essex, "Improvements in the manufacture of tapers and of friction matches, and in the means of igniting friction matches."—May 8, 1866.

1341. J. H. A. Bleckmand, Solingen, Prussia, "An improved explosive compound."—A communication from W. Fehleisen and E. Fehleisen, Cilli, Styria, Austria.

1349. D. Nicoll, Kilburn, Middlesex, "Improvements in the means of, and apparatus for, preserving animal and vegetable substances from decomposition or decay, and for the conveyance and transport of the same."—May 10, 1866.

1381. W. De la Rue, Bunhill Row, and H. Miller, Gower Street, Middlesex, "Improvements in treating the residues of pyrites, usually called burned ores."—May 15, 1866.

1158. A. A. L. P. Cochrane, Westminster, "An improvement in apparatus for heating and evaporating liquids and fluids."

1160. J. W. Burton, Leeds, "Improved means and apparatus for the treatment of animal fibrous substances and fabrics of mixed vegetable and animal substances, and of utilising the waste products therefrom."—April 25, 1866.

1214. A. Bernard, Paris, "A process for decolourising albumen extracted from the red blood of animals."—April 30, 1866.

1340. R. Holliday, Huddersfield, "Improvements in obtaining green colouring matters of various shades for dyeing and printing."—A communication from H. Minhorst, and F. W. Chultes, Crefield, Prussia.—May 10, 1866.

1365. A. P. Price, Lincoln's Inn Fields, Middlesex, Improvements in the means of effecting the combustion of fuel, and in apparatus employed therein."—A communication from I. Bührer and C. Hannel, Munich, Bavaria.—May 12, 1866.

NOTICES TO PROCEED.

130. I. Hooker, Walton-on-Thames, Surrey, "Improvements in the manufacture of ammoniacal and ammoniated soap."—Petition recorded January 15, 1866.

169. W. Hibbert, Manchester, "Improvements in the combination of chemical matters, and mechanical apparatus applied therewith for the prevention or cure of contagious and other diseases to which human beings and animals are subject."—January 18, 1866.

189. W. E. Gedge, Southampton Buildings, Chancery Lane, "Improved preparations of the plant known as coca, to permit its incorporation with confectionery of all kinds, syrups and liqueurs, and its use for dyeing."—A communication from F. Bouttelas-Desmoulins, Passage des Petites Ecuries, Paris.—January 20, 1866.

225. G. J. Bensen, Christian Street, St. George's-in-the-East, "Improvements in the manufacture of beetroot sugar."—January 23, 1866.

1233. G. C. Denis, Arras (Pas de Calais), France, "An improved apparatus for purifying the lighting gas resulting from the distilling of coal."—May 1, 1866.

1366. G. A. Jasper, Massachusetts, U.S.A., "A new and useful or improved process for cleansing animal black or bone charcoal, after or before its use, for the purpose of filtering a saccharine syrup."—May 12, 1866.

CORRESPONDENCE.

Continental Science.

PARIS, June 2.

As I anticipated, the Academy elected M. Marignac corresponding member of the Chemical Section. There were forty-two voters, and of these forty voted for M. Marignac, Professor Williamson and M. Stas each obtaining one vote. A good many, I dare say, will share the astonishment I feel that the name of Dr. Phipson, whose contributions to the Proceedings of the Academy are so numerous and remarkable, was not so much as mentioned for the vacancy. It was no doubt fortunate for M. Marignac that it was so. A chemist, it seems, like a prophet, may be without honour in his own country; and it would seem, too, that the former may be held of small account elsewhere.

Quite recently, the Doctor has furnished *Cosmos* with some illustrations of "the state of chemical criticism in England," partly drawn, it must be admitted, from your own pages. You stated that bromo-cuminic acid was a body of no particular interest. Whether M. Naquet, who has produced it, agrees with you is, I dare say, doubtful. He is a far-seeing chemist, but I question, however, whether he has not overlooked the important consequences of his discovery foreseen by Dr. Phipson, and if he has not he must be intensely disgusted with the man who has snatched away the thought from his brain, and so by anticipation made the discovery his own. And such a discovery, too,—the transformation of bromo-cuminic acid into quinine! You have only, says the Doctor, "to replace the bromine of this bromated acid by nitrogen, and the *constitution* of the new body is not so far off that of quinine"! No, truly; as your readers may see, M. Naquet standing for both formulæ:—

$$\underbrace{\Theta_{10}H_{11}Br\Theta_2}_{\text{Bromo-cuminic acid.}} \qquad \underbrace{\text{Ȼ}_{20}H_{24}N_2\Theta_2}_{\text{Quinine.}}$$

There is clearly no difficulty in the matter; and why should a man of genius perplex his o'er-taxed brain with such abstruse and profitless questions as the determination of silicium in cast-iron when immortality and fortune may be acquired with ease by effecting the simple changes pointed out? Certainly, the first Englishman who transforms bromo-cuminic acid into quinine may write F.R.S. after his name within a twelvemonth!

Sulphate of Strontia around Bristol.

To the Editor of the CHEMICAL NEWS.

SIR,—I am much obliged to Mr. Herapath for his interesting information. I had, indeed, no idea sulphate of strontia had been so long known to be abundant about Bristol, more especially as Aust Cliff had been pointed out by some one as the source, and Nicol's Mineralogy completely confirms the opinion in naming various localities; Aust Ferry is alone given for Bristol.

Bischof, in his Chemical Geology, published by the Cavendish Society, is quite unaware of celestine as an abundant mineral, except in North America. In vol. i., p. 451 (foot note), it is spoken of as rarer than sulphate of baryta, so that the knowledge of these abundant deposits around Bristol has failed to spread abroad.

Mr. Sander's very excellent and wonderfully exact geological map of the neighbourhood nine miles round Bristol, which I have just had an opportunity of studying, shows the connexion between all these deposits of sulphate of strontia perfectly. He has clearly marked out the new red sands extending from the Downs to Kingsdown, Montpelier, and Lower Eastan, thus including the churches named and in N.N.E. direction to the extent of the map, evidently on to Aust Passage, and which clearly explains why sulphate of strontia is found throughout all this extent, the new red I had observed at Clifton, being being the very margin or commencement of the formation. Years ago the thin horizontal layer of yellow stone had not been unobserved, but was set down as calcareous. Even after finding the strontia I knew not its nature until an acid showed its wholly siliceous character, and that it was the border of the new red sandstone formation. Mr. Sander's map again shows the new red beginning again at Leigh-court, extending through Pill, Portbury, &c., to the margin of the map, and then in a direction evidently towards Clevedon and its cliffs.

The conclusion to be drawn from these facts is, that an appeal to Mr. Sander's map will show at a glance all the places nine miles round Bristol where sulphate of strontia may be hopefully looked for.

I am, &c., E. A. H.

Wednesday, May 30.

MISCELLANEOUS.

Rendering Nitro-Glycerine Non-Explosive.—It appears that practically there is no greater difficulty in rendering nitro-glycerine non-explosive and explosive at pleasure than there is in accomplishing the same feat with gunpowder, although the means employed are, of course, dissimilar. The recent accidents with the new explosive agents have induced Mr. Nobel to turn his attention seriously to the subject, and he is now enabled to state that by mixing the nitro-glycerine with methylic alcohol (a cheap spirit, popularly known as spirit of wood) the nitro-glycerine is rendered unexplosive, either by percussion or heat. When required for use water is added, which absorbs the spirit, and the oil sinks to the bottom of the vessel, whence it is drawn by a syphon, and its explosive nature thereupon found to be restored. Experiments for testing the value of this discovery have already been made in America, and given highly satisfactory results. We look upon the subject as one of the greatest importance to miners, and shall be glad if the new discovery enables us to transport nitro-glycerine, at least as safely as blasting-powder, while we believe it has already been proved much more efficacious.—*Mining Journal.*

Mineral Ether.—Under this name a very pure and useful article has been introduced into commerce. It is free from all disagreeable smell, volatilises perfectly, leaving no odour and removes grease stains most effectively.

London Corporation Gas Bills.—In the House of Commons on June 1, Mr. T. J. Miller asked the Secretary of State for the Home Department whether it was his intention to bring in a Bill during the present or the next Session founded upon the Report of the Select Committee of the London Corporation Gas, &c., Bills. Sir G. Grey said the Report had been published, and was not accompanied with the evidence. It contained important suggestions, but it appeared that there had been considerable difference of opinion in the Committee; it would, therefore, be premature for him to say that he was prepared to propose an amendment of the law, though he had no reason to believe there was any ground for not following the recommendations of the Committee, but it would be impossible to prepare a Bill on the subject this Session.

Preparation of Zinc White.—M. Germain roasts zinc ores, or old zinc from any sources so as to form oxides. The oxides are then treated with a hot solution of sal-ammoniac which dissolves oxide of zinc, leaving behind oxides of other metals. If the solution is coloured a little carbonate of soda is added, which gives a slight precipitate and the liquid is decolourised. It is then filtered and allowed to cool, whereupon the oxide of zinc deposits mixed with a double salt of ammonia and zinc, which is but slightly soluble in cold water. The deposit is washed, and then treated with boiling water, which decomposes the double salt giving a dense, heavy precipitate of oxide of zinc. This oxide washed and dried covers, the author says, as well as the oxide made in the dry way. *Bull. de la Soc. Chim.*, April, 1866, p. 312.

Proportion of Oil in Various Seeds, &c.—Munch exhausted the materials with ether, and gives the following as the percentages of oil in the various substances:—

	Per cent.		Per cent.
Sweet almonds	55·4	Croton seed	43·4
Bitter, ditto	52·0	Castor, ditto	46·0
Poppy seed	49·4	Laurel berries	31·8
Hemp seed	35·5	Mace	25·5
Cacao	47·4	Walnuts	64·8
Linseed	29·6	Hazel nuts	59·4
Mustard	31·8	Cotton seed	18·4
		Eggs	27·8

—*Zeitsch. für Chem.*, 1866, 191; *Neues Jahrb. Pharm.*, 25, 8.

Composition and Quality of the Metropolitan Waters in May, 1866.—The following are the Returns of the Metropolitan Association of Medical Officers of Health:—

Names of Water Companies.	Total solid matter per gallon.	Loss by ignition.*	Oxydisable organic matter.†	Hardness.	
				Before boiling.	After boiling.
Thames Water Companies.	Grains.	Grns.	Grains.	Degs.	Degs.
Grand Junction	19·10	1·04	0·31	14·0	3·5
West Middlesex	18·39	0·80	0·29	14·0	3·5
Southwark & Vauxhall	19·06	1·04	0·39	14·5	3·5
Chelsea	18·87	0·81	0·27	14·0	3·5
Lambeth	18·99	0·99	0·32	14·0	3·5
Other Companies.					
Kent	28·32	1·13	0·05	18·5	7·5
New River	17·84	0·68	0·22	14·0	4·5
East London	21·68	0·79	0·38	14·5	4·0

* The loss by ignition represents a variety of volatile matters, as well as organic matter, as ammoniacal salts, moisture, and the volatile constituents of nitrates and nitrites.

† The oxydisable organic matter is determined by a standard solution of permanganate of potash—the available oxygen of which is to the organic matter as 1 : 8; and the results are controlled by the examination of the colour of the water when seen through a glass tube two feet in length and two inches in diameter.

H. Letheby, M.B., &c.

Santonine is said by Kossmann to be a glucoside. Dr. Schmidt has boiled it for a long time with sulphuric acid, and has been unable to prove the production of glucose. Unless the water is replaced as it evaporates, the acid as it becomes concentrated browns the santonine and gives rise to a resinous product, which, however, when treated with water, and crystallised from alcohol, gives colourless santonine again. Schmidt believes that the resinous body is santonine deprived of water by the sulphuric acid.—*Bull. de la Soc. Chim.*, April, 1866, p. 286.

Adulteration of Opium.—Landerer states that opium is adulterated in Asia Minor (Turkey opium) with crushed raisins and salep. The former is detected by ascertaining the presence of grape sugar with Barreswil's or other cupro-potassic solution; the latter will be recognised by tincture of iodine showing the reaction of starch.

Crystallisation of Urea on the Surface of the Skin.—Dr. Hirschsprung states that in some acute renal affections, and a short time before death, an exudation and crystallisation of urea takes place on the head, neck, and thorax.

Manufacture of Nitrate of Potash without Artificial Heat.—M. Coudurie takes equal equivalents of nitrate of soda and chloride of potassium, and dissolves them in as little water as possible. The solution is exposed to the rays of the sun in a large vessel. Evaporation goes on, and the solubility of the nitrate increases as the temperature rises, while the chloride of sodium, the solubility of which is not altered, deposits alone. In the evening the liquor is run off into a lower vessel, and the temperature falling 7 or 8 degrees in the night, the nitrate of potash is deposited, and any chloride of sodium remains in solution. The next day the same process is repeated with the mother liquor, to which a fresh quantity of nitrate of soda and chloride of potassium is added.—*Bulletin de la Soc. Chim. de Paris*, April, 1866.

Meetings of the Week.

Saturday, June 9.

Royal Institution, 3 p.m., Professor Huxley, "On Ethnology."

Tuesday, June 12.

Medical and Chirurgical Society, 53, Berners Street, 8½ p.m.
Photographic Society, King's College, 8 p.m.

Wednesday, June 13.

Microscopical Society, King's College, 8 p.m.

Thursday, June 14.

Royal Society, Burlington House, 8½ p.m.

Friday, June 15.

Royal Institution, 8 p.m., Professor Tyndall, F.R.S., "Experiments on the Vibrations of Strings."

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. XII. 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., II., and VII. are out of print. All the others are kept in stock. Vol. XIII. commenced on January 5, 1866, and will be complete in 26 numbers.

A. B.—Dr. Hofmann's Report can no longer be obtained in English. A French translation can be had a the office.

Books Received.—"Nouvelles Recherches sur les Lois des Proportions Chimiques, sur les Poids Atomiques et leurs Rapports Mutuels," par J. S. Stas.—"Right Foods for Infants and Children," by the late T. Herbert Barker, M.D., &c.

Received, with Thanks.—J. S. Stas, R. C., E. K., R. Barclay.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

*On the Origin of Carbides and Combustible Minerals,** *by M.* BERTHELOT.

THERE is, in most instances, no difference of opinion as to the origin of combustible minerals—that is, when they are evidently derived from transformed organic matters. But is this the case under all circumstances? The carbides, petroleums, and bitumens, disengaged from the crust of the earth, often in great abundance, incessantly and from depths apparently lower than the stratified earth, do they always and necessarily result from the decomposition of a pre-existing organic substance? Is this the same with the carbides so frequently observed during eruptions and in volcanic emanations, and to which M. Ch. Sainte Claire Deville has latterly called attention? Finally, should the same origin be assigned to the carbonaceous matters and carbides of hydrogen contained in certain meteorites, which seem to have an origin foreign to our planet? These are questions about which several distinguished geologists are still undecided. Without pretending to decide so difficult a point, it seems to me interesting to find how the natural carbides of hydrogen may be formed synthetically—that is to say, by purely mineral reactions of the same kind as geologists have observed to take place between the substances contained in the interior of the globe, and those constituting its crust.

We will admit, according to M. Daubrée's recent hypothesis, that the interior of the earth contains free alkaline metals; this single hypothesis, added to the experiments I recently published, almost necessarily leads to the explanation of the formation of carbides of hydrogen.

In fact, carbonic acid, everywhere infiltrated through the terrestrial crust, must come in contact with alkaline metals at a high temperature, and form acetylides in the same manner as in my experiments. These same acetylides may also result from the contact of earthy carbonates with alkaline metals even below dull red heat.

Now, these alkaline acetylides once formed will undergo the action of aqueous vapour; free acetylene would hence result were the products immediately submitted to the action of heat, and of hydrogen† and other bodies which might be present. But by reason of these diverse conditions acetylene will not be produced, as my recent experiments show. In its place are obtained, either the products of its condensation, which resemble bitumens and tars, or the products of the reaction of hydrogen on these already condensed bodies—that is to say, carbides more hydrogenated. There is scope for almost unlimited diversity in these reactions, according to the temperature of the bodies present.

The formation, in a purely mineral way, of all natural carbides may easily be conceived, and the formation would moreover be continuous, as the reactions causing it renew themselves incessantly.

The generation of carbonaceous matters and of the carbides contained in meteorites may be explained in the same way, provided it be admitted that these meteorites originally belonged to the planetary masses.

These hypotheses might be further developed, but I prefer to keep within the limits authorised by my experiments, and merely state geological possibilities.

TECHNICAL CHEMISTRY.

On the Application of Disinfectants in Arresting the Spread of the Cattle Plague—Report to Her Majesty's Commissioners, by WILLIAM CROOKES, *F.R.S.*

(Continued from page 272.)

Miss Barroby's Farm, Dishforth.

60. The experiments here have been conducted with greater accuracy than was possible at other places, and the results consequently are more striking. On February 20 I accompanied Dr. Ryott, of Thirsk, to this farm, where the disease had broken out amongst a valuable herd of pedigree short horns. The animals appeared to be tended as carefully as if they had been hunters. The buildings were scrupulously clean, the only fault being their close proximity, which rendered a proper separation of the diseased from the healthy impossible. The only available part of the premises, where the graves could be dug, was also too near the houses, and many of the carcases had to be dragged close by the doors where healthy beasts were confined. A very valuable large red bull, owing to the position of his house, was especially in danger. To attend to the sick beasts, certain men had been told off, and were even provided with a special sleeping apartment in the house, and no communication whatever was permitted them with the other farm servants.

I took some carbolic acid with me, and at once instructed the farm servants in its use, and directed the preparation of whitewash and fumigation with sulphur. Not having sufficient acid to disinfect the whole of the premises, a large supply was ordered, and attention was chiefly directed to the houses containing the healthy stock, more especially to that of the large red bull.

61. The virulence of the disease may be judged of by the following tabular statement:—

Total number of beasts, 32.
January 24.—A severe case: recovered.
February 2.—One animal attacked: died on the 3rd.
7th.—One animal attacked: died on the 11th.
13th.—Six ill.
15th.—Nine ill.
20th.—Visited Dishforth.
23rd.—Five ill. Seven dead.
25th.—Four killed by order of inspector. Three ill. Two new cases.
26th.—Two killed.
27th.—The whole of the premises were thoroughly disinfected with carbolic acid and sulphur according to written instructions.

62. From this date the disease suddenly stopped. Two young bulls and two cows, ill before the disinfecting operations had commenced, were subsequently killed by order of the inspector; but no fresh case occurred, although the disease continued to attack neighbouring farms as severely as before.

63. Dr. Ryott, who spared no trouble to have these experiments properly carried out, and to whom I am greatly indebted for his kindness in superintending them during my absence, has kept me constantly informed of the results. At the date of this report, all the animals are looking remarkably well and healthy; not one fresh attack having take place since February 27, when disinfection was effectually commenced.

The convalescent cows are now intermixed with those which have escaped the disease, and of the latter, two about to calve are tied up in the house

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* *Comptes Rendus*, vol. lxii., p. 949.

† Produced at the same moment by the reaction of the water on the metals.

where three animals had died, some also are kept in houses from which diseased animals were removed.

The large red bull, which now occupies a shed wherein were formerly a diseased cow and heifer, is thriving, although both the sick animals had to pass the open end of his shed on their removal from the other houses, and the dead were conveyed by the same road to their burial. All this time the disease keeps in the village, fresh outbreaks are reported frequently, and on some farms nearly every head of cattle is swept off.

Dr. Ryott having examined the milk, and found it free from taint, two of the convalescent cows are now supplying the family daily with milk, cream, and butter.

The man who was principally employed with the diseased animals is now attending to the lambing of the ewes; as yet they are all well, and show no signs of illness.

64. Dr. Ryott writes, under date March 27, "There can be no doubt of the value of the plan of disinfection, after what I have observed in such a severely plague-smitten place as Dishforth, not only in the protection of cattle, but also of sheep—as ewes at lambing time would be most susceptible. But the plan of disinfection may be brought into disrepute by being either improperly or insufficiently applied. For instance, hearing that a farmer in whom I took some interest had got the disease amongst his cattle, I called on him, and found several ill, and some already dead. I recommended the plan of disinfection as a protection to the healthy animals in another fold, and as a beginning gave him a gallon of carbolic acid. A week after I visited him, and found that several animals had been killed, and others were ill, waiting the executioner. He said he had tried everything, but particularly the treatment of Mr. Worms, and had used the disinfectant plan. On inquiry I found that not more than *half a pint* of the carbolic acid had been used, out of the gallon I gave him; and yet he said he had tried the plan, and had given out that it had failed."

65. An opportunity was afforded at this farm of trying a somewhat important experiment. A shed in which two cows had died was disinfected (54.), and a short-horn cow—a prize beast—which had calved about a week, and had just shown signs of disease, was shut up in it. As the yield of milk had not stopped, a healthy calf was put in the same house, and allowed to suck the diseased cow during the whole time she lived; the only precaution taken being to keep the atmosphere of the house strongly smelling of carbolic acid. This experiment was unfortunately cut short by the inspector insisting on the slaughter of the cow, although she had then almost recovered from the disease. This happened during my absence, notwithstanding the energetic remonstrances of Dr. Ryott, who explained that it would interrupt a valuable experiment, and that I was empowered to reserve infected animals for such purposes. Since the cow was killed (March 3) the calf has remained well and lively in the same house, and has been fed with milk from another cow which was recovering from the disease. It is much to be regretted that this experiment was not allowed to be properly carried out, but, incomplete though it be, it is of great value, especially when viewed in conjunction with the other operations on the same farm.

Mr. Spence's, Smedley, near Manchester.

66. I arrived here in December last, and instructed the attendants in the management of the disinfecting plan with carbolic acid and sulphur. It has been regularly carried out ever since. In January last the disease first appeared in the immediate neighbourhood, and carried off about a dozen cattle from a farm, the sheds of which were not more than 500 yards from Mr. Spence's cows. A short time after, thirty beasts, 750 yards off on another side, were attacked, and the whole were swept off in rapid succession. A month ago the disease appeared amongst twenty-two in another direction, not more than fifty yards off, and the whole of these also died. Mr. Spence's cattle still keep well, and as the disease is leaving the neighbourhood, there is every probability that they will remain healthy.

Mr. Thornton's Farm.

67. This is situated at Clayton Bridge, near Manchester. The stock consists of ten milch cows, and the shed containing them has been regularly disinfected with carbolic acid since Christmas. No case of illness has occurred, although on the adjoining farms the disease has been rather severe for some months.

Mr. Lowe's, Smethwick Hall, Brereton, Cheshire.

68. This farm is in the centre of one of the most affected localities in England. The stock consists of seventy-three animals; forty-five milch cows, kept in houses which have been regularly disinfected since December last; and fifteen two-year-old heifers, and thirteen yearling calves, kept in fields and open sheds. To these latter, no disinfectant whatever has been used, owing to the impossibility of applying it satisfactorily to animals in the open air.

69. The disease prevailed very severely all round, but no case occurred at Mr. Lowe's farm until February, when one of the forty-five milch cows showed signs of illness. Immediate investigation was made, and it was found that one of the cowmen, on the previous day, had attended a post-mortem examination of some diseased beasts, and having come directly to Mr. Lowe's houses, afterwards had milked some of the cows. The man was of course discharged instantly. The succeeding day, February 20, the first cow that the man had milked, on the day of the post-mortem, refused her food, and all the symptoms of the plague rapidly appeared. Two others in the same house were afterwards attacked, one of which recovered almost immediately; the other was killed as a matter of precaution. A fourth case then occurred in another shed. On inquiry, I found that the first, third, and fourth cows were those which had been milked by the discharged man. The second case, occurring in the same shed with the first and third, was evidently either developed from them, or was a case of infection brought from the calves mentioned below (70.). These four cases are all that have occurred amongst the forty-five milch cows in the disinfected sheds. Up to the present date the rest are perfectly well. Their health, indeed, seems to be improved by the carbolic acid. The cows are very fond of it, and lick it from the woodwork or walls whenever they have an opportunity.

70. Previous to his discharge, and on the morning of that day, the same man was employed in preparing food for, and feeding, the unprotected fifteen heifers and thirteen calves. A few days after the disease

developed itself amongst them, and in a fortnight they were all dead.

71. A crucial experiment has, therefore, been tried at this farm on the grandest scale. It was, indeed, supplied by accident, but it is none the less satisfactory and decisive. Although it far surpasses in magnitude any trial which an experimentalist dare institute, it fulfils every condition which could be demanded by the most rigid investigator. A farm is chosen in the very hotbed of cattle plague. The cattle on it are divided into two lots, forty-five being placed in disinfected houses, and twenty-eight in undisinfected open sheds. The disease is brought into each lot, on the same day, by direct inoculation of the virus. Of the disinfected animals, only those actually inoculated fall a prey, whilst of those which are not protected by disinfection the whole are rapidly swept off.

It is scarcely possible to say anything which will add to the satisfactory nature of these results; but I may mention that of the ten farms immediately surrounding Mr. Lowe's seven have lost the whole of their stock (amounting to 215), whilst on the remaining three the plague is gradually spreading through the herds.

[Accident has carried this grand experiment a step further, with the most striking results. A few weeks ago the remainder of Mr. Lowe's forty-five disinfected animals were turned out to grass, and at the same time were removed from the protecting influence of the carbolic acid. Within a few days the plague attacked and killed the whole of them. The complete proof of the value of carbolic disinfection which has been afforded at this farm is cheaply purchased at the loss of all Mr. Lowe's stock.—W. C., May 11, 1866.]

Mr. Tollemache's Farms, Cheshire.

72. On February 28 I visited Peckforton Castle, at the courteous invitation of J. Tollemache, Esq., M.P. for South Cheshire. Owing to the long continued severity of the disease in this part of the county, the only available farm, on which I could try the value of the disinfection plan, was the Home farm at the foot of the Castle Hill. I attribute the immunity which this farm has hitherto enjoyed to the protection afforded by the height and well-wooded character of the rock guarding it one side, and also to the care and strict isolation to which the cattle are subjected. About ten milch cows are kept in one house, and an equal number of cattle in a field and in open sheds. At the time of my arrival, Mr. Tollemache considered that his herds were in imminent danger, the disease existing all round, and rapidly advancing towards his farm in three directions; a row of small cottages, each having one cow, formed a train connecting a diseased farm, about half a mile off, with the Home farm. Adjoining Mr. Tollemache's farm, and forming in fact part of the same establishment, are some cattle belonging to Mr. Smith, the sheds of which are within fifty yards of Mr. Tollemache's sheds. Attention was first directed to the house containing Mr. Tollemache's best milch cows, which was thoroughly cleaned, whitewashed, fumigated with sulphur, and freely sprinkled with carbolic acid. Sacking soaked in the acid was hung up in different parts of the shed, and the water supplied to the cattle was likewise impregnated with it.

73. Beyond sprinkling carbolic acid about the sheds, no disinfection was attempted with the other cattle, it being considered difficult to guard them from infection, so long as they lay out in fields and open sheds (68.).

The small cottages were then visited. Their cow-houses were whitewashed, sulphured, and treated with carbolic acid in the usual way. A sufficient supply of the acid was left at each cottage, with full instructions for its use. Nothing was done to the cow-houses of Mr. Smith, who professed little faith in disinfection.

74. The disease still advanced steadily towards the Home farm, and on March 12 one of Mr. Smith's cows was attacked; she was not removed, but kept in the same house with the healthy ones. Then, for the first time, carbolic acid was used in the shed, but in very sparing and insufficient quantities. The disease spread, and at the present date five have died and three recovered.

75. Up to March 26 the whole of Mr. Tollemache's cattle remained in health. On that day, however, a young bull, lying in the open yard (one of the lot which had not been disinfected), was thought to show symptoms of disease; it was put into a shed by itself, and on the 28th it died of the plague. No other case of disease has since occurred amongst the cattle lying in the partially disinfected, open sheds, and as a month has elapsed since this bull died, the period of incubation has long passed, and it is certain that no germs of plague from that source are lurking in the systems of the remaining animals.

On April 7 one of the milch cows was taken ill in the disinfected shed; however, she recovered in a few days, and is now amongst the other cows, and gives as much milk as before. This case is easily accounted for, as since March 12 the milch cows have been exposed to several cases of disease within fifty yards on one side of them at Mr. Smith's (72.), whilst at the latter end of March a bull actually died of the plague within a few yards of their shed. Notwithstanding the care which doubtless was taken to avoid communicating infection from the sick to the healthy animals, the virus may easily have been carried to one of the milch cows whilst they were being driven across the yard to water, as was done once or twice a-day.

76. Even the wonderful disinfecting powers of carbolic acid are probably put to too severe a test, when it is expected to preserve cattle from taking the disease brought to them in so direct a manner as was the case on this farm; but it may be considered as almost proved (56. 69. 75.), that when the plague does enter a shed which for some time past has been properly disinfected with carbolic acid and sulphur fumigation it loses much of its virulence, and is deprived of its infectious character.

All the cows at the small cottages which have been disinfected since the beginning of March remain healthy, although they are now quite surrounded with the disease, and are even more exposed to the danger of infection than are those at the Home farm.

PART IV.—*Experiments on the Injection of Antiseptics into the Blood of Diseased Animals.*

77. Although perhaps there is no actual cure as yet known for the cattle plague, any more than for small-pox and similar diseases, yet on theoretical grounds it appeared not improbable that good might be done by injecting various antiseptics into the blood (49.). If the disease depend on a change in the blood, analogous to fermentation (8.), induced by the presence of certain virus-cells, it appeared likely that such anti-

septics as sulphite and bisulphite of soda, or carbolic acid and its homologues, might stop this action, if they were introduced in adequate quantity, without acting injuriously on the health of the animal. Professor Polli, Dr. De Ricci, Dr. M'Dowall, Dr. Waters, and others, have advantageously used sulphites and bisulphites as prophylactics in zymotic diseases. Viewing the matter solely from a chemical point of view, it appeared feasible that, as I had successfully attacked the floating germs of the disease by atmospheric disinfectants, so I might neutralise the virus in the blood by the introduction into it of appropriate antiseptics. The experiments have been tried upon too limited a number of animals to be worth much. I, however, put all these trials on record, as the results may prove of some service to others who may be enabled to continue them.

78. The first experiments were performed on March 2 at Mr. Findlow's, Wardle Hall, Cheshire, on two heifers in calf, just taken ill. The temperature of the animals per rectum was, No. 1 106°·2 Fahr., No. 2 106°·1 Fahr. The jugular vein having been opened with a fleam by Mr. Dunn, veterinary surgeon, (to whose assistance in these experiments I am much indebted), the flow was stopped by pressing the finger on the distal part of the vein, whilst I inserted the nozzle of an injection syringe (specially made for this purpose) into the vein, pointing towards the heart. The liquid injected consisted of half an ounce of sulphite of soda dissolved in three ounces of water. The temperature of the liquid and syringe was as near as possible 100° Fah., and the act of injection was performed very slowly; particular care being taken to avoid injecting air into the vein. The vein was then fastened up by the surgeon. Two or three men were necessary to hold the animals, as they struggled somewhat, but as soon as the operation was over they seemed as well as before, and suffered no inconvenience from it. The next day the animals were certainly no worse than they were on the previous day, and their temperature had diminished, No. 1 being 106° Fahr., and No. 2 104°·8 Fahr.

79. The good effect of the injection now seemed exhausted, the heifers rapidly got worse, and in a few days died. The disease had visited this farm very severely, only sixteen cattle having been saved out of 107.

Mr. Singleton's Farm, The Rookery.

80. The disease on this farm was also very virulent. Of an original stock of about sixty not one of those attacked had recovered. At my first visit over forty had been buried, and the rest were going rapidly. I was anxious to try the effect of injecting sulphite of soda, and for this purpose, on March 2, Mr. Singleton kindly placed at my disposal four two-year-old heifers which had shown first symptoms of illness that morning. The experiments at Mr. Findlow's having shown that the injection of half an ounce of sulphite of soda into the blood of an animal would do no harm, but would possibly do good (as in each case it was followed by a diminution of temperature), I determined to increase the dose; three-quarters of an ounce of sulphite of soda dissolved in three ounces of warm water were accordingly injected into the jugular vein of each of these animals, their temperatures before the operation being:—

	Deg.		Deg.
No. 3 .	105·2 Fahr.	No. 5 .	104·0 Fahr.
„ 4 .	104·2 „	„ 6 .	102·6 „

On visiting them the next day they were reported to be a little better, an improvement corroborated by the thermometer, which registered as follows:—

	Deg.		Deg.
No. 3 .	102·8 Fahr.	No. 5 .	101·9 Fahr.
„ 4 .	103·7 „	„ 6 .	100·8 Fahr.

The promising symptoms, however, did not last; Nos. 4 and 5 died on March 4, and on the 5th the surviving animals were worse. The injection, as in the former cases, resulted only in temporary good. (79).

Another calf, No. 7, taken ill that morning, its temperature being 106°, was then injected with one ounce of sulphite of soda. In this case it was intended to inject it with another ounce the next day.

81. Sulphite of soda producing no injurious action when added to the blood (even if it did but little good), it was determined to try bisulphite of soda, on calf No 8, its temperature just before the operation being 104°.

On March 6 I found No. 3 dying; No. 6 about the same as the day before, and Nos. 7 and 8 decidedly better. Their temperatures were:—

	Deg.		Deg.
No. 3 .	98·5 Fahr.	No. 7 .	104·0 Fahr.
„ 6 .	102·4 „	„ 8 .	100·4 „

No. 3 died the same day. Nos. 6 and 7 had each one ounce of sulphite of soda injected into the jugular vein on the other side of the neck; and No. 8 had half an ounce of bisulphite of soda again injected into it.

I was now obliged to leave this part of the country for some days, and, on my return, I found all my patients dead.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 7.

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 donations to the library announced. Mr. Marshall Hall and Mr. Heathcote Wyndham were formally admitted Fellows of the Society, and the following gentlemen were duly elected, viz.:—Mr. William Arnot, Bachelor Street, Liverpool; Mr. Edward H. Davis, Harley Road, Brompton; Mr. William Field Flowers, B.A., Guy's Hospital; Mr. Charles Wilson, Bridgewater Smelting Company, St. Helens; and Mr. C. R. A. Wright, B.Sc., Runcorn, Cheshire. For the first time were read the names of Mr. W. Chandler Roberts, Royal School of Mines; and Mr. Edward P. H. Vaughan, Patent Agent, 54, Chancery Lane. The names of candidates read for the second time were Professor Arthur Gamgee, M.D., Edinburgh; Mr. James H. Lightbown, Corporation Street, Manchester; Mr. Frederick Keating Stock, Darlington; and Mr. Edward Isaacs Sparks, Corpus Christi College, Oxford.

Professor J. A. Wanklyn read a paper "*On the Oxidation-Products of the Propione produced from Carbonic Oxide and Sodium Ethyl.*" By distillation with bichromate of potassium and dilute sulphuric acid the propione yielded acetic and propionic acids, without any evolution of carbonic acid; the change proceeds according to the following equation:—

$$C\left\{\begin{array}{l}C_2H_5\\C_2H_5\\O\end{array}\right. + O_2 = C\left\{\begin{array}{l}C_2H_5\\HO\\O\end{array}\right. + C_2H_4O_2.$$

The author considers this to be the first example of a ketone being resolved into acids of less carbon-condensation than itself, without at the same time giving rise to carbonic acid.

"*A Preliminary Notice on Phthalic Aldehyde*," by Professor H. Kolbe and G. Wirchen, was read by the Secretary. Early in the present year, the first named author* offered some suggestions regarding the possibility of obtaining from the acids themselves the alcohols and aldehydes of polybasic acids; and these experiments are a practical realisation of the production of an aldehyde. By acting upon phthalic chloride with zinc and hydrochloric acid, and treating the product successively with water and ether, a white, fusible, crystalline substance is obtained, which is the aldehyde in question. The same product may be formed by the action of sodium amalgam upon phthalic acid, and when the period of contact is prolonged, another body, seemingly the phthalic alcohol, is formed. The composition of the aldehyde is $C_{16}H_6O_4$. It resists for a long time the action of chromic acid.

An abstract of a paper, "*On the Preparation of Chrysammic Acid*," by John Stenhouse, LL.D., and Hugo Muller, Ph.D., was next read. The ordinary method of acting upon aloes with nitric acid for the production of chrysammic acid has been advantageously modified by conducting the operation in stages, and details are given for ensuring the removal from the product of picric and aloetic acids which are formed at the same time. The calcium, magnesium, copper, and other salts, have been prepared and analysed, and the acid itself is described as forming lustrous golden scales of considerable size, and very similar in appearance to the iodide of lead. The benzoyl-chrysammic acid and hydro-chrysammide have likewise been examined.

"*Chrysammic Ether*" has been prepared by Dr. Stenhouse by acting upon the chrysammate of silver with iodide of ethyl. After digesting for some time the excess of the latter is distilled off, and the substance in question extracted from the residue by warm benzol. From this solvent it separates on cooling in the form of hard yellow prisms, which cannot be fused without suffering decomposition. The analytical results established the formulæ

$$C_9N_2H_6O_6 = \left.\begin{array}{r}C_7N_2HO_5\\ C_2H_5\end{array}\right\} O.$$

A paper "*On the Platinum Bases; the Best Mode of Obtaining and Identifying Them*," by Mr. E. A. Hadow, was accepted as read. The author's communication embraces a valuable series of observations having reference to the properties and composition of the platinum bases. Several new compounds are described, and directions given for the identification of salts belonging to different groups. Mr. Hadow starts with the hydrochlorate of diplatosamine, which according to his analysis contains an atom of water hitherto overlooked. Its formula is stated thus:—

$$N_2H_6PtCl+HO.$$

By the action of nitrous acid upon this salt a new green compound has been formed, which appears under the microscope to consist of feathery crystals, and if the nitrate of diplatosamine be substituted a smalt-blue precipitate (minute dodecahedra) is obtained. In these compounds, which are best formed in acid solutions, the NO_3 is supposed to play the part of a base. Their composition is thus expressed,—

$$\text{Green salt . . } \left\{\begin{array}{r}2(N_2H_6PtCl)\\ NO_3,HCl\end{array}\right\}$$

$$\text{Blue salt . . } \left\{\begin{array}{r}2(N_2H_6PtO,NO_5\\ NO_3NO_5\end{array}\right\}$$

The distinction between Gros's and Raewsky's compounds are fully treated of, and the use of chloride of ammonium and sulphate of soda recommended as means of identifying them. The analysis of Raewsky's nitrate gave results exactly in accordance with Gerhardt's expression for this salt;

$$\dot{N}_4H_{12}\dot{P}t_2ClO_3,2NO_5+\dot{H}O.$$

The somewhat anomalous constitution of this salt led to an examination of the corresponding hydrochlorate, which, in the form of minute prisms, was found to have the composition $N_4H_{12}Pt_2Cl_3O$. By the action of dilute solutions of protochloride of platinum, strongly acidified with nitric acid, upon Raewsky's salts, coppery-red precipitates were formed, which had a variable composition, containing usually from 56 to 62 per cent. of platinum. The author believes them to be constructed on the type of the platinid cyanides, and suggests a provisional formula—

$$\left\{\begin{array}{l}5(N_2H_6Pt_2Cl_2)\\ \quad N_2H_6Pt_2Cl_2O_2,2NO_5\end{array}\right\}$$

The double hydrochlorates of diplatosamine with cadmium and mercury respectively were prepared, and, by a modification of the process which usually furnishes Magnus's green salt, a dove-coloured precipitate was obtained, which proved to contain sulphurous acid. This series of compounds will become intelligible by the following comparison:—

Magnus' green salt . . $N_2H_6PtCl,PtCl.$
Double mercury salt . $N_2H_6PtCl,HgCl.$
Double cadmium salt . $N_2H_6PtCl,CdCl.$
Dove-coloured compound $\left\{\begin{array}{l}N_2H_6PtCl,PtCl\\ N_2H_6PtCl,PtOSO_2\end{array}\right\}$

Mr. Ernest T. Chapman then gave a short account of "*Some Decompositions of Nitrite of Amyl.*" The reactions in question embrace those referring to the decompositions of nitrite of amyl in contact with (1) chromic acid, (2) diluted sulphuric acid, and (3) hydriodic acid. By the action of chromic acid the nitrite of amyl is converted, without elimination of gas, into nitric acid, valerianic acid, and valerianate of amyl. Sulphuric acid diluted with twice its bulk of water acts upon it with production of water, nitric oxide, sulphurous acid, and valerianate of amyl. Thus—

$$2(C_5H_{11}NO_2)+H_2SO_4=2H_2O+SO_2+2NO+ \\ C_5H_{11},C_5H_9O_2.$$

Hydriodic acid acts upon the nitrite of amyl, and, in the presence of phosphorus, furnishes nitric oxide and iodide of amyl.

Permanganic acid is believed to act like chromic acid.

Mr. Henry Bassett then described "*A Cyanogen-derivative of Marsh Gas.*" Chloropicrin was subjected to the action of cyanide of potassium, whereby a dark red semi-fluid substance was formed, in which two atoms of chlorine were replaced by cyanogen—CNO_2ClCy_2. When alcohol alone was employed as the liquid menstruum, the reaction became exceedingly violent, but the author found no difficulty in moderating the energy of the action when this solvent was diluted with two parts of water, and the chloropicrin was employed in small portions of 10 grammes only. The new product cannot be heated or even preserved at the ordinary temperature without undergoing decomposition, and exposure to a cold of 20° did not solidify it. Compounds with the oxides of lead and silver were prepared and analysed.

The President having moved a vote of thanks in favour of the authors of the several communications, invited Mr. A. Vernon Harcourt to deliver his lecture "*On the Course of Chemical Change*," the report of which is deferred until next week.

The meeting was very fully attended and was adjourned at a late hour.

The Secretary announced for the next (and last) meeting, on the 21st inst., a paper by Dr. F. Crace Calvert and Mr. Johnson.

Chemical Society.—The next meeting of this Society will take place on Thursday, at 8 p.m., when the following will be read:—"Action of Acids on Metals and Alloys," by Messrs. Crace Calvert and Johnson; "Constitution of some Carbon Compounds," by Dr. Debus.

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* *Jour. Chem. Soc.*, February 1866, p. 54.

THE BRITISH ASSOCIATION OF GAS MANAGERS.

On the Combustion of Gas for Economic Purposes.

A Lecture delivered by Dr. Letheby.

Mr. President and Gentlemen,—At the close of the last lecture which I had the honour of delivering to this Association at the meeting in Birmingham, I referred very briefly to the general phenomena of gaseous combustion, and to the principles of the economic use of coal gas. It was my intention, indeed, to have entered fully into this matter; but so much time was occupied in the examination of the chemical and physical properties of the most important constituents of coal gas, that little was left for the consideration of this part of our subject. I have therefore been requested to make it the especial subject-matter of this evening's lecture; and in order that you may follow me through the various details of the inquiry, it will be necessary to pursue it from the beginning.

The phenomena of visible combustion are always the results of energetic chemical action; and the heat and light which characterise it are the consequences of the violent collisions and rapid trembling of the combining atoms. When this collision occurs by the showering down, as it were, of gaseous atoms upon a solid, as you here see in the combustion of carbon and of iron in oxygen gas, and of antimony in chlorine, there may be a very intense ignition of the solid, but there is no flame. On the other hand, when the conflict is entirely among the particles of gaseous or vaporous matter, or matter in a finely divided and mobile condition, the phenomena are altogether different; for although, as before, the atoms or molecules of the burning body are intensely heated, yet from their mobility they give rise to that appearance called flame.

In all cases, therefore, we must regard flame as gaseous, or vaporous, or very finely divided matter intensely heated. That the particles of the gas or vapour must be themselves bodily and intensely heated to produce flame is evident from this—that when I burn hydrogen, or coal gas, or the vapour of ether, or alcohol by means of a finely divided solid, as I do here with a rosette of fine platinum wire, you see how the wire glows; but there is no flame, for the combustion is limited to the thin layer of gaseous matter which immediately surrounds the metal, and the temperature of the combustion is comparatively low. But if I raise it to a higher temperature, as will sometimes happen of itself, then the whole mass of escaping gas or vapour is thrown into a state of ignition, and it bursts into flame.

Let us pause for a while to study the complicated nature of this phenomenon. Whenever a gas or vapour burns in an atmosphere of another gas or vapour, as we here see in the flame of the burning gas and candle, the phenomena are very complicated. At the points of contact which are now at the outside of the flame, the collision of the particles, because of their rapid chemical union, is most violent; and here, therefore, we have the highest temperature; but as a portion of the outer atmosphere penetrates for some distance into the burning gas, it extends the conflict into the body of the flame, and there finding itself in the presence of complex particles, it closes with those whose energies are most active. In this manner the hydrogen of the hydrocarbon is burnt first, and the liberated carbon, standing for a while in an ignited state, forms the luminous shell of the flame; and within, waiting for the presence of air, or rather passing out to take part in the conflict, is the unchanged gas or vapour. Every common flame, therefore, consists of at least three parts—the inner layer of unchanged gas or vapour, next the shell or cone of luminous matter, and lastly the outer shell of perfect combustion. That there is always an inner portion of gas or combustible vapour in every common flame may be proved by drawing it out with a glass tube and burning it at the end. See how I do it here with the flame of burning ether, and the same may be done with all other flames.

And now we are prepared to ask why it is that different substances burn with such different degrees of luminosity. The answer is clearly to be found in the circumstance that different substances contain, or evolve, or produce different amounts of solid particles. In all these flames of hydrogen, and sulphur, and carbonic oxide, there are no solid particles to be heated; but in this gas, and candle, and paraffin lamp, the particles of soot or carbon are very numerous; and if it so happens that the products of the combustion are also solid particles, the intensity of the light is so much the greater. Look at the splendid combustion of phosphorus in oxygen, and of magnesium in air. In both cases you will notice that the products are a white powder, every particle of which at the moment of its formation is intensely heated. It follows from this that every circumstance which increases the number of solid particles, within a reasonable limit, or which prolongs the time of their ignition, or which exalts the temperature of it, increases the light of the flame, and conversely everything which destroys the particles or lowers their temperature will also destroy the light.

If I throw the solid particles of lime into this almost invisible flame of oxygen and hydrogen, you will notice how vividly I bring out the light; and so also if I give the vapour of a hydrocarbon as benzole, which is rich in carbon, to the hydrogen by merely passing it through a tube packed with tow and moistened with naphtha, you observe how brightly the hydrogen burns. In the same way we can increase the illuminating power of coal gas by passing it into a chamber containing naphtha; and experiment shows that with common 13-candle gas the illuminating power is increased about 4·5 per cent. by every grain of naphtha to the cubic foot.

On the other hand, if I destroy the solid particles by hastening their combustion, the light of the flame is diminished. Here, with a common Argand burner, I merely increase the flow of air to the gas by lengthening the glass chimney, or by enlarging the central aperture, or by driving the gas by great pressure through small openings, and you see how I destroy the light; and worse still if I mix air with the gas, so that the particles of carbon find themselves at once in the presence of atmospheric oxygen—there is no light at all. Let me blow out the gas-flame from this Argand burner, and put a piece of wire gauze upon the top of the glass chimney. The gas will now draw in the air and mix with it before it reaches the top of the chimney, and see how the light is destroyed. The same is the case with this burner of Professor Bunsen. It is a metal tube of 5 or 6 inches in length and from ½ to 1 inch diameter; the gas is admitted through a small aperture at the bottom of the tube, and just below this point there are four or five openings for the admission of air. As the gas issues from the jet and passes up the tube, it draws in the air, and this, mixing with the gas, burns at the top of this tube without any light, but with great heat. This indicates to us the disadvantage of allowing air, even in small proportion, to get into the gas; in fact, experiment shows that with common 12-candle gas the loss of light with different proportions of air will be as follows:—

Loss of Light from Air in Gas.

Per cent. Air.	Loss per cent.	Per cent. Air.	Loss per cent.
1	6	8	58
2	11	9	64
3	18	10	67
4	26	15	80
5	33	20	93
6	44	30	98
7	53	40	100

The practical conclusions from these inquiries are, that gas must be burnt with such a proportion of air as that, on the one hand, the particles of carbon shall be intensely heated, and shall remain as long as possible in an ignited state, and, on the other hand, they must not escape unburnt.

The difficulties in arriving at these results are almost insuperable, for every illuminating agent has its own particular conditions, and requires its own especial appliances to bring out the fullest effects.

Take, for example, the effect of different kinds of burners, each burning at its best, with the same gas (13-candle).

Relative Luminosity of different Burners, calculated for the same Consumption.

Kind of Burner.	Pressure at Burner.	Relative Value per foot Gas.
Single jet	0·50	100
Fishtail	0·25	146
Bat's-wing	0·18	153
Argand	0·17	198
Bengel	0·13	214

Again, the same kind of burner, but of different sizes, will give different values.

Relative Luminosity of Jets of different Sizes, calculated for the same Consumption.

Size of jet, Inch.	Pressure at Burner.	Relative Value per Foot Gas.
0·040	0·87	100
0·056	0·35	120
0·083	0·12	136
0·100	0·04	150
	Fishtails.	
0·036	0·47	100
0·045	0·39	194
0·056	0·24	293
0·062	0·39	319
	Bat's-wings.	
0·008	1·19	100
0·012	0·49	184
0·016	0·24	232
0·020	0·16	293
0·024	0·11	313
0·028	0·09	322
0·032	0·07	316
0·036	0·04	310
0·040	0·03	307

Argands of 15 Holes and 7-inch Chimney, consuming 5 Cubic Feet of Gas per Hour.

Size of Inner Hole.	Pressure, Inch.	Relative Value per Foot Gas.
0·70	0·66	100
0·57	0·46	108
0·48	0·17	117
0·44	0·17	120
0·43	0·17	115
0·42	0·17	110

And, again, the same burner with different pressures, and therefore different rates of consumption, will give different values, when calculated for the same quantity of gas.

Relative Luminosity of the same Jet (0·04 in.) *at different Pressures, calculated for equal Consumptions.*

Consump. per Hour, Cub. ft.	Pressure, Inch.	Relative Value per Foot Gas.
0·88	0·28	100
1·31	0·43	156
1·80	0·87	195
2·33	1·38	240
2·83	1·97	264
3·53	2·68	270
	Fishtails (0·03-*in. holes*).	
2·00	0·17	100
3·00	0·34	109
4·00	0·50	111
5·00	0·74	110
6·00	1·00	95
	Bat's-wings (0·015 *in. slit*).	
2·00	0·13	100
3·00	0·21	109
4·00	0·29	135
5·00	0·45	128
6·00	0·53	122
7·00	0·68	121
	Sugg's Argand 15 holes (0·45 *Internal Diameter; Hole*, 0·05 *in*).	
2·0	0·04	100
3·0	0·08	143
4·0	0·12	183
5·0	0·17	202
5·5	0·18	201
6·0	0·19	196

And so, also, with cannel gas, although in many cases the variations are not so great as with common gas, yet they are sufficiently considerable to be serious. This is seen by the following table, which I have drawn up from the experiments of Mr. King, of Liverpool:—

Relative Illuminating Power of Cannel Gas, when burnt from different Burners, and in different Quantities from the same Burner.

Power in Sperm Candles (120) *per foot of Gas.*

Kind of Burner.	1 ft. per hour.	2 ft. per hour.	3 ft. per hour.	4 ft. per hour.	5 ft. per hour.
Single jet	2·64	—	—	—	—
Lancashire fishtail (No. 2)	3·23	3·59	3·66	—	—
do. do. (No. 4)	3·59	3·95	4·11	4·0	—
London do. (No. 2)	3·49	3·61	3·89	3·85	—
Bat's wing	3·09	3·76	4·05	4·11	4·16
Sixteen-hole Argand	0·26	1·74	2·43	3·53	3·68
Winfield 28-hole Argand	0·28	2·04	3·09	3·57	3·77

What, then, is to be done in the apparent confusion of all these facts, and can any useful generalisation be made of them?

In the first place, we perceive that, of all kinds of burners, the single jet is the least effective.

Secondly, we notice that, although the bat's-wing and fish-tail burners are not subject to so great variations in power as others, and are, therefore, best suited for common use, yet they require certain precautions to be fully effective. The best burners are those which consume from 3 to 5 cubic feet of gas per hour, and the slits and holes should be so graduated that the gas issues at a pressure of from 0·08 to 0·12 of an inch for very poor gas (12-candle), and from 0·20 to 0·40 for 14-candle gas, and from 0·4 to 0·6 inch for cannel gas.

Thirdly, we find that Argand burners are only fit for gas of less than 18 or 19 candle power. For very poor gas (up to 13-candle), the best form of Argand burner is the porcelain Argand of France (the Bengel), which has the following measurements:—

Bengel Burner (Argand) of 30 Holes.

Total height of burner	3·150 inches.
From gallery rest to top	1·220 „
External diameter	0·886 „
Internal do.	0·354 „
Diameter of circle of holes	0·650 „
Do. of holes	0·024 „
Height of glass	7·87 „
External diameter of do.	2·00 „

The flame is protected from currents of air by a cage or basket of porcelain below, which is pierced with 109 holes of the 0·118 of an inch in diameter. This burner requires a pressure of from 0·15 to 0·25 for the proper consumption of the gas, and the rate at which it burns never exceeds 3·5 cubic feet per hour. This is the standard burner for France, and, compared with the best English burners, the value of the light for 5 cubic feet of 13-candle gas is as 113 is to 100.

In this country the best form of Argand burner is the

15-hole steatite burner of Mr. Sugg. The measurements of it are as follows:—

Sugg's Steatite (Argand) of 15 Holes.

Total height of burner	3·00 inches.
From gallery rest to top	1·10 ,,
External diameter	1·10 ,,
Internal	Variable, according to quality of gas.
Diameter of circle of holes	0·80 ,,
Diameter of holes	0·06 ,,
Height of glass	7·00 ,,
External diameter do.	2·00 ,,

The flame is protected by a perforated metal disc placed under the gallery, the perforations being 0·08 inch in diameter, and 8 in the inch linear.

The diameter of the inner hole or air-channel should vary according to the power of the gas, thus:—

For 12-candle gas	0·44 inch
,, 14 ,,	0·48 ,,
,, 16 ,,	0·55 ,,
,, 18 ,,	0·60 ,,

All these Argands have the holes the 0·06 of an inch diameter, and the pressure is only 0·07 of an inch instead of 0·17, as with the old Sugg of 0·04 diameter. Above 18 candles the bat's-wing is the best burner for educing the light, and it should be regulated from 4·5 feet to 4 feet, according to the richness of the gas. And now, before I leave this part of the subject, I will show you some of the contrivances which have been proposed for increasing the illuminating power of a poor gas.

You have already seen that the single jet gives proportionably less light than the double jet or fishtail, and this is because of the larger surface of the flame exposed to oxidation. In this experiment, when I bring the jets together, you will notice how the light is at once increased, the proportion of increase being shown in the diagram.

Relative Illuminating Power of Jets separate and together.

Size of Jet, Inch.	Pressure, Inch.	Relative value per foot gas. Separate.	Together.
0·067	0·24	100	164
0·083	0·20	100	190
0·100	0·12	100	184

But the pressure may be such as to spread out the flame too much, and then it is over-oxidated. To check this there are the contrivances of Hart, Williamson, and others, which are fishtail burners attached to a box stuffed with wool, or having a small aperture within, as compared with the aperture without. This offers resistance to the flow of the gas, and by making it tail a little it thickens the flame and brightens the light; but the same effect would also be produced by altering the tap, provided the tap is placed, as it always should be, at a distance of about 18 inches from the burner; in fact, if it is nearer than this, as is generally the case, there is no space or chamber for the equalisation of the pressure, and the gas always burns at a disadvantage.

Again, there are contrivances on the outside of the burners—as caps, and rings, and thickenings of the top of the jet—whereby the flow of air to the gas is checked and oxidation diminished.

Even with the Argand burner, if the gas is over-oxidated, as by burning it with too large an inner aperture, or with too high a chimney, or at too small a rate, the light is improved by checking the draught of air; and this may be done, as you see, by putting a cap of wire gauze over the chimney. In fact, the whole of these contrivances have for their object such an adaptation of the gas to the air, or the air to the gas, as that the flame is just short of smoking. Under these circumstances, the solid particles remain as long as possible in an ignited state, and yet at last they are perfectly consumed.

(To be continued.)

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY,

A Course of Twelve Lectures on Chemical Geology,

by Dr. Percy, F.R.S.

Lecture No. V.

(*Continued from page 261.*)

Sometimes we get silicates which are nothing more than mixtures of definite silicates. I have reason to believe that some kinds of glass present us with an illustration of this fact. I will not say that this is silicate of lead and silicate of potash, and has a perfectly definite composition. I am quite sure if there be two silicates—silicate of lead and of potash, those silicates are not composed of the same definite mixtures. It may be that these glasses are not composed of definite combinations. Therefore, when we get crystals we get different matters. We have many illustrations of the power which these substances have of enclosing foreign matters. It does not follow, for example, because I take a silicate and succeed in converting it into a crystallised mass that the crystal will be definite in composition, whatever might be the composition of the silicate. It is quite possible that this silicate in the act of crystallising may involve, so to speak, a quantity of foreign matter which in no way concerns the composition. It may be regarded as dirt enclosed in the crystal. The mineral kingdom presents us with many illustrations of this, and we cannot too fully bear the fact in mind. Here is a mineral artificially produced, and far finer in point of crystal than any we have in nature. It consists essentially of silicate of lime and silicate of alumina, and contains a little magnesia also; but in that mineral, definite as it is, and well crystallised as you observe, there is enclosed a quantity of matter uniformly diffused throughout the mass, which in no way enters into the chemical composition of that mineral. It is sulphide of calcium in that particular case. We must pay attention to that foreign matter. I dare say a great deal of difficulty has arisen in rightly interpreting the composition of such minerals from not regarding the fact of some of the constituents being foreign matter, and not chemically combined. There is no doubt that, in the case of a mineral of this sort, if we do not estimate the foreign matter, we shall be led to a very erroneous conclusion in attempting to construct a formula of its percentage composition; and I have no doubt that such false conclusions have not unfrequently been arrived at, especially in mineralogical reasoning. In the cooling or devitrification of glass this should be borne in mind. Slow cooling, as I have said, is the condition favourable to the devitrification or crystallisation of glass; rapid cooling, on the contrary, being favourable to the retention of the vitreous condition. Accordingly, then, as we cool a mass of glass slowly or rapidly we can obtain it vitreous or crystallised at will. Frequently in the same glass we find both specimens. In mounds of artificial silicates, or slags, as they are termed, in the proximity of furnaces, we frequently pick up lumps which present both characters. Now, we shall always find, other things being equal, that the external portion of the lump will be vitreous, simply because that portion has been most rapidly cooled. You may observe that over and over again.

Having said this much of the crystallisation of silicates, with reference to its bearing on the igneous rocks and the conditions under which they occur, let me next present to your notice some purely accidental forms of silicates which deserve attention, especially as we obtain these forms in nature, and find exactly similar forms occasionally produced in art. Therein consists the interest of the subject.

Here is a portion of silicate. It is a double silicate, similar in composition to a silicate artificially obtained. It is regularly porous throughout, presenting an appearance almost like that of a bee-hive. The cavities are more or less hexagonal or polygonal. This cellular form seems to be due in this particular case to the gradual and uniform elimination throughout the mass of some gaseous body during the act of solidification—in this case probably sulphurous acid. Another form deserving attention is an excessively light pumice-like body, produced by allowing one of these silicates, when cooling, to flow in contact with water—not *into* water, for in that case we get Prince Rupert's drops, which are well known; but to produce the pumice the viscous stream is allowed to flow in contact with water. It will then swell up and produce this very porous mass. The production of this pumice is one of the prettiest experiments I know. This illustrates the way in which pumice may have been formed in some cases undoubtedly. Here is a specimen of the artificial pumice. If I were to melt that mass, it would be nearly black. It is, in fact, nothing more than an iron slag which has been converted into a porous substance, which in some cases is as black as this specimen before you. This shows how very much colour depends on the state of aggregation. There is another form which we not unfrequently meet with in our furnaces, and of which nature presents very fine specimens. I allude to the capillary volcanic glass called Pelé's hair. Here is some of the natural mineral. It has been well described by Dana. The liquid lava from which it was produced was caught by the air and spun into these delicate threads. You will observe at one end little globules of the lava. Here is some which has been produced artificially in a furnace by a very strong blast coming in contact with the molten silicate.

It has been proposed of late, and indeed a patent has actually been taken out, to convert these masses of iron slag, which form such large accumulations in South Wales and elsewhere, into a useful product to act the part of manure. The plan adopted is to blow out the slag when molten into this hair-like state, so that it may be brought into a sufficient state of division to be serviceable. These slags all contain from one to two per cent of that most valuable matter, potash; but there it is, locked up in this insoluble form, and unless something is done to the slag it would remain so for ages, and would consequently be of no use as a manure: but if the slag is brought into a very fine state of division the potash may be made available. I have no doubt it would be so in this case. I understand that even before this patent was taken out this finely divided slag had been experimented upon extensively by a good observer with reference to its properties as a manure, and with very successful results. It consists essentially of silicate of lime and alumina with more or less potash—generally, as I have said, one or two per cent.

The fusibility of silicates is a point which greatly concerns the geologist. Some of them are excessively difficult to fuse. We can, it is true, by exposing them to the high heat of our furnaces, convert them into a soft, more or less pasty mass; but in vain should we attempt to pour them out of the crucible in which we perform the operation, they are so excessively infusible as that. Others, again, are excessively fluid even at comparatively low temperatures, and run out of the crucible without much difficulty in a stream almost as liquid as water. Well, between these two extremes we find every variety and degree, from the perfectly viscous to the perfectly fluid. Lava runs in a viscous stream. The surface may present no signs of incandescence at all, and yet underneath the crust there shall be running a viscous stream of lava. By plunging a walking-stick through the crust you can find the stream underneath, though no sign of that stream may appear on the surface. The same thing occurs in our blast furnaces. There will be the molten lava flowing with more or less viscosity; presently the exterior will become crusted with solid slag or solid lava; and yet within a little stream will continue to flow uninterruptedly exactly as in the case of the lava from volcanoes. Indeed it is as good an illustration as you can have of the motion of lava.

When lava or molten slag flows in this way it is apt to entangle, mechanically, foreign matter in its substance. Hence in lava we find foreign matter which has been lifted up, so to speak, by the stream in its course, and entangled and permanently retained. And what we find in lava we also find in a greater or less degree in those little lava streams which flow from our furnaces.

We will now proceed to consider the composition of silicates.

First of all we have those having a definite chemical composition—definite salts, for a silicate is, in fact, a salt. These are, first, those which are composed of silica, and are those bases which are represented by chemists and mineralogists by symbol RO; such, for example, as oxide of potassium, or oxide of sodium, or oxide of calcium, or oxide of magnesium, or protoxide of iron. This symbol represents that class of bases which consist of one equivalent of the metal and one equivalent of oxygen. Then we may have definite silicates consisting of another kind of base—that in which we find two equivalents of metal to three of oxygen—to wit, peroxide of iron, alumina, oxide of chromium, and other bodies. This base is represented thus, R_2O_3. Thirdly, we have silicates containing these two bases—namely, the RO and the R_2O_3. I shall present you with characteristic examples of all these as we proceed. We may have, also, not only chemical combinations of silicates of the RO base with silicates of the R_2O_3 base, but, fourthly, we may have mixtures of such silicates with each other—that is, a point which should not be neglected. Lastly, we have definite silicates—it may be one silicate or a compound of two or even more—which enclose a considerable quantity of foreign matter, or "dirt," as it is called, which enters in no way into the formula, but occurs as so much entangled mechanical matter accidentally present.

The varieties I have mentioned are,—

1. Definite silicates of the RO base.
2. Definite silicates of the R_2O_3 base.
3. Compounds of the above with each other.
4. Mixtures of the above with each other.
5. Definite silicates *plus* foreign matter.

Having laid down this general classification with reference to the anhydrous silicates particularly, we shall now pass in review some of those silicates. I shall make such a selection as I conceive will be most important in its bearing on geological phenomena.

The first of these is the well-known mineral called wollastonite or tabular spar. If we examine the conditions under which this mineral may be formed in our laboratories we may get a clue to the condition under which the rock containing it may have been formed. That is the bearing of all the details I am bringing before you. They are not mere chemical details, but I am endeavouring to give you their geological bearing.

We have here a specimen of this tabular spar. It is a very beautiful mineral. It crystallises in the oblique system. If we make an analysis of it, and determine how much silica it contains, and how much of base, we find that the oxygen of the silica is exactly double that of the base. It is essentially a silicate of lime, and hence we can represent the composition of this mineral, supposing it to be chemically pure, by this formula, adopting the old formula for silica—$3CaO2SiO_3$. That will give us the relation I mentioned—namely, six of oxygen in the silica, and three of oxygen in the lime, or two to one, the ratio between the oxygen of the lime and that of the silica being as one to two, or three to six.

With regard to its formation, it is certain that we can produce this mineral, and obtain it well crystallised by the direct action of heat. Only take lime and silica in the right proportions, mix them intimately, and expose the mixture to a very strong heat, and we shall get wollastonite, to all intents and purposes, and occasionally we may obtain it in comparatively fine crystals. Here is some made last year, which on the surface is as good a specimen as you could well have. There is a specimen on the table in which little dusty cavities happen to be formed. You will there see lime with beautiful crystals of wollastonite. That is formed by the direct process of heating the constituents together. There is another mode by which this mineral may be formed—namely, by the action of hot water under great pressure. We will speak of this action by an appropriate term derived from the Greek—hydrothermic action; an action which has clearly played an important part in the formation of a great many metamorphic rocks.

Daubrée has made this mineral by acting upon glass, silicate of lime, and an alkali, by heating it in water at 400° centigrade. Of course, that requires a high pressure, and the experiment must be made in strong tubes. There was dissolved out silicate of potash or soda, and there remained behind an opaque residue, not amorphous, but manifestly crystalline—manifestly so. It consisted of a mass of fine acicular or needle-shaped crystals. It was analysed, after being obtained in a state of purity by levigation, and found to have identically the same composition as tabular spar or wollastonite. It was wollastonite to all intents and purposes. Hence, then, we have two facts plainly proved to us, that this mineral may be formed under these two conditions—namely, by direct igneous action and by the action of water at a high temperature and under great pressure.

Wollastonite occurs in nature in connexion with garnet—that is a point of interest to bear in mind—with fluor spar, and with silver; in limestone at Pargas, in Finland, and also at Kongsberg, in Norway. It occurs in basalt, along with prehnite, in the Castle rock at Edinburgh; in Ceylon with garnet in gneiss, a metamorphic rock; in crystallised limestone and gneiss at Auerbach, with garnet, epidote, and even iron pyrites. You see how frequently it is associated with garnet. We find wollastonite in matter ejected by Vesuvius, and in lava near Rome. It is met with in New York county on the side of a vein of garnet and gneiss, and also with garnet and felspar, and garnet and quartz. It is interesting to bear in mind the association of tabular spar with these minerals, because if we know the conditions under which it may be formed, we get a very important clue to the condition under which the associated minerals may be produced.

Another very interesting mineral for us to consider is the well-known gem called chrysolite, and a beautiful metal it is; but it is a gem which is not so much appreciated as I think it deserves. We have here very fine specimens in this case, various in point of colour. It varies somewhat in composition. It is essentially a silicate of magnesia—a tribasic silicate, to use the old form of notation; that is to say, if we make an analysis of the mineral in a state of purity, we find it to contain magnesia, of which MgO is the symbol, and silica; but the oxygen of the silica is exactly equal to that of the magnesia. Consequently the mineral would consist essentially of three equivalents of oxide of magnesium or magnesia, or one of silica. We find corresponding combinations of silica with iron and other bases besides magnesia. That is the formula illustrating the composition of the pure mineral.

Chrysolite, or this combination, may be obtained, and not only obtained, but obtained crystallised, by directly heating its constituents together. If we take magnesia and silica in the proper proportions, and heat them together, we form the mineral, but unless we do something more than that we cannot obtain it crystallised. We have made a great many experiments with silicate of magnesia, but have not succeeded in obtaining it well crystallised, or even crystallised at all, by the direct action of heat; but if we employ a body which can act the part of a solvent at a high temperature, it will act as water does with many other bodies at the ordinary temperature. Let us select as a solvent a body which shall dissolve the compound at a high temperature, and which is, nevertheless, capable of being volatilised by a further continuance of heat. We will take for this purpose boracic acid, and mix it with this compound of silica and expose the whole to a high temperature, say in a porcelain furnace, where hard porcelain is made. In time the boracic acid will be volatilised, and leave a crystalline mass. Here is a specimen so produced by the late Professor Ebelmen. It is silicate of magnesia crystallised in this way.

(To be continued.)

ACADEMY OF SCIENCES.

June 4.

No communication on a chemical subject was read at this meeting. M. Ch. St. Claire Deville continued the memoir on the periodical variations of temperature observed in February, May, August, and November; and MM. Becquerel, father and son, contributed a memoir "*On the Temperature of the Air under, near to, and far from Trees.*" The influence of forests on temperature must needs be considerable, but its exact amount has not yet been settled; and the solution of the question can hardly be much advanced by the observations of the authors under a single chestnut tree. These observations, however, extended to the temperature of the tree itself, in which a hole 25 centimetres deep was bored to receive the thermometers. The observations extended from the 1st of August, 1865, to the 1st of May, 1866; and from the results the authors draw the following conclusions:—1. That the mean temperature of the air and trees are the same, whatever may be the size of the tree. An equilibrium is established with more or less rapidity, in the leaves very quickly, in the branches after a longer time, and in trunk still later. 2. When rapid and great variations of temperature take place in the air, they are not felt in the trunk of the tree. 3. The chemical reactions which take place in the tissues have no sensible effect on the temperature of the tree. 4. The maximum of temperature in winter is at 2 p.m.* in the open air, and 9 p.m. in the tree; in summer the maximum in the air is reached at 3 p.m., and in the tree at midnight; the mean variation in winter—that is, the difference between the means of the maxima and minima is sometimes four times less in the trees than in the air. 5. The sun appears to be the source from which all plants draw nearly the whole of the heat required for their existence.

M. Zaliwski-Mikorski announced to the Academy that he had made an improvement in Bunsen's battery. He has found that smearing the zincs with grease will answer the same purpose as amalgamating them. Ether and liquid hydrocarbons will answer the same purpose as oil. The oil, according to the author, interposes as a body rich in hydrogen, that is to say, as a combustible body.

NOTICES OF BOOKS.

New Researches on the Law of Chemical Proportions, on Atomic Weights, and their Mutual Relations. By M. J. S. Stas, Member of the Royal Academy of Belgium, Professor in the Military School, &c., &c., *Nouvelles Recherches, &c.* Memoir presented to the Royal Academy of Belgium, January 14, 1865.

It is five years since we had the honour of submitting to our readers the first series of researches by M. Stas "On the Relations Existing between Atomic Weights."† The object and results of his researches will be fresh in the memory of our readers. They were undertaken to test

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* The observations were made at Montargis, department of Loiret.

† See Vols. iv. and v. Chem. News.

the truth of Prout's law—that the atomic weights of all simple bodies are simple multiples of that of hydrogen. The result of the researches was to convince M. Stas that there is no simple divisor for the atomic weights of simple bodies—a conclusion which, we say shortly, is confirmed by the new researches now made public.

In the introduction to these new researches, which alone we notice, intending in our next volume to lay the matter more fully before our readers, the author replies to the critics of his first series. In England we may say that the conclusions of M. Stas were fully accepted. No recent English chemist had committed himself strongly to Prout's law, which, moreover, the late Professor Turner, and afterwards Professor Penny had shown to be at least open to doubt. The experiments of these chemists, however, can hardly be compared with those of M. Stas. In France it was otherwise. Dumas had published a work on the equivalents of simple bodies, in which he contended that the equivalents were always multiples of hydrogen either by 1, or by 0·5 or 0·25. M. Marignac, of Geneva, had also committed himself to a similar modification of Prout's law.

Dumas, as we saw by his address, in presenting these new researches to the French Academy a few days ago, is still unconvinced. It takes a great deal to convince M. Dumas. What M. Marignac will say we must wait to see, but a good part of this introduction is taken up by a reply to that chemist's criticisms of the former series.

It would take us too far on the present occasion to notice all M. Marignac's objections, but we may allude to one which, as M. Stas asserts, amounts to a denial of the principle on which the determination of atomic weights must rest. "It is not absolutely demonstrated," said M. Marignac, "that many compound bodies may not contain constantly and normally an excess, very small no doubt, but still appreciable in very delicate experiments, of one or another of their elements." "This opinion," M. Stas well remarks, "if founded on fact, will upset all our fundamental notions. The law of definite proportions, the law of multiple proportions, cease to be mathematical laws, and become only limited laws."

But M. Stas has convinced himself that the law of chemical proportions is not a limited law. He believes he has proved that it is the expression of a mathematical relation. He believes also that he has demonstrated that the atomic weight of the same body, determined in combination with different elements by independent methods, comes out identical within the limits of exactitude, which it is possible to obtain by our means of investigation.

The researches we shall publish will, we think, prove this, and, deferring for the present a longer abstract of this introduction, we will now only quote without remarks the author's equivalents calculated from different standards:—

	O=16.	H=1.
Oxygen	—	15·960
Silver	107·930	107·660
Nitrogen	14·044	14·009
Bromine	79·952	79·750
Chlorine	35·457	35·368
Iodine	126·850	126·533
Lithium	7·022	7·004
Potassium	39·137	39·040
Sodium	23·045	22·980

It must be pointed out here that the exact relation of hydrogen to oxygen is not known with certainty, but the author infers, for several reasons, that taking hydrogen as a unit the atomic weight of oxygen cannot exceed the numbers given above.

Here, for the present, we must leave the subject. In a future number we shall give a longer abstract of this introduction; and the papers which will follow will show that M. Stas has bestowed such skill and care on these researches as never before were brought to bear on the subject; and if his results are not exact, absolute demonstration with our present means is altogether out of the question.

But what does it matter, some who look over the numbers just printed may ask? Why may we not assume the truth of Dr. Prout's simple law, and employ the nearest whole numbers? To such, M. Stas replies in the last sentence of this introduction. "When our object is to instruct, or to expound the reality of the phenomena of nature, it is no more allowable to substitute error for truth, than it is possible to compound with a principle which we know is not true."

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

1332. R. Rowland, New York, U. S. A., "An improvement in the manufacture of metallic acetates and carbonates simultaneously with the production of vinegar and glucose."—Petition recorded May 9, 1866.

1403. J. Thomas, Battersea, Surrey, and A. Prince, Trafalgar Square, Middlesex, "Improvements in the means of treating scoria or slag of copper ores, iron pyrites, or scoria from other ores containing iron, and of reducing titanic iron ore, for the purpose of extracting the iron therefrom."—May 17, 1866.

1411. J. Sharp and R. Smith, Blackford, Perth, N. B., "An improved combustible and inextinguishable compound."—May 18, 1866.

1442. J. J. Marcais, Paris, "Certain improvements in the treatment of slags, ores, and compounds of tin."—May 22, 1866.

Invention Protected by the Deposit of a Complete Specification.

1518. G. T. Bousfield, Loughborough Park, Brixton, Surrey, "Improvements in tanning hides and skins, and in currying leather."—A communication from M. W. Page, Franklin, Merrimac, U. S. A.—Petition recorded May 31, 1866.

Notices to Proceed.

200. C. G. Penney, Greenwich, "Improvements in the treatment and utilisation of certain waste products resulting from the combustion of boghead, cannel, and other coals and minerals, and from the treatment of china clay and other analogous substances."—Petition recorded January 22, 1866.

319. J. B. Grant, Euston Road, Middlesex, "Improvements in apparatus or machinery for distilling and refining petroleum and other oils."—February 1, 1866.

498. E. J. C. Welch, Harrow, Middlesex, "Improved apparatus for carburetting air and gas."—February 16, 1866.

727. A. V. Newton, Chancery Lane, "An improvement in the melting of iron." A communication from E. C. Haserick, Lake Village, N. Hampshire, U.S.A.—March 9, 1866.

1214. A. Bernard, Paris, "A process of decolorising albumen extracted from the red blood of animals."—April 30, 1866.

CORRESPONDENCE.

Continental Science.

Paris, June 12.

Oh! that chemists would take Captain Cuttle's advice, and when they find out a thing make a note of it. Here now is M. De Frarière, who some years ago discovered that he could transform honey into wax, as good wax as a bee could make, by adding to some honey diluted with water, first, a little American potash, and then a little of some sort of acid. But he has forgotten the name of the acid, and the discovery, which would be so useful in these days, is lost; not, however, altogether hopelessly. M. De Frarière gives us a clue to its rediscovery. He has satisfied himself that the acid poison of the sting has something to do in the matter. When bees are making wax they are very quiet, he tells us, and make no attempts to sting; and if they should by chance sting any individual the effect is but slight. When, however, the animal is eating only honey, it is extremely irritable, and in the absence of Christian skin will make stabs with his sting at the straw and wood of the hive, indicating clearly that at this time the animal is incommoded by the distension of the poison vesicle, the contents of which were before employed in the production of wax. If, now, we knew for certain the nature of the acid poison, we might hope with every probability of success to imitate the process which goes on in the body of the bee. Would, any chemist like to obtain a quantity of the poison to analyse? If he should, this is the way in which M. De Frarière says he may procure it.

Go round in the evening and prop up the hives a little way, so that the cold night air may enter. For the sake of warmth the bees will collect in a compact body with their posterior extremities turned outwards. Early in the morning go and remove the hive completely, and then give a smart rap on the stall. At this every bee will simultaneously protrude his sting, at the end of which will be seen a dew-like drop of the poison. To remove this you must provide yourself with a soft sponge slightly moistened, with which you gently wipe the mass of posteriors presented; and having repeated this with several hives, you will possibly have collected sufficient of the poison to wash from the sponge and analyse, or see if you can convert honey into wax with it. The author suggests also that the poison may be useful as a counter-irritant.

The recent notices of nitro-glycerine remind one of a paper by Dr. Schuchardt on the poisonous properties of that body. The ordinary effects are well known; the violent headache, giddiness, and throbbing of the temples which a very small dose will produce. But it seems that to cause death a comparatively large dose is required. The author thinks he took as much as ten drops at a time, and although made exceedingly ill, he was quite well the next day. As nitro-glycerine is not volatile like nitro-benzole, no accidents can occur through the lungs. But there is no doubt it is absorbed by the skin, and workmen who handle it get violent headaches. Dr. Schuchardt is decidedly of opinion that some precautionary measures respecting the manufacture and sale of the article should be adopted, although he thinks phosphorus, cyanide of potassium, and corrosive sublimate far more dangerous poisons.

MISCELLANEOUS.

The Unity of Force.—In a lecture on "The Relation of the Forces which Act upon Matter" recently delivered by Mr. George F. Rodwell, the lecturer in conclusion spoke as follows:—"In thus briefly considering the mutual relation of the forces which act upon matter, I have endeavoured, by showing the intimate nature of their relationship, to lead you step by step to that grand generalisation—the hypothesis of the unity of force. We have seen that force can no more be annihilated than matter; that when force of one kind disappears it is but transmuted into force of another kind; that force is inseparable from matter. Inseparable from matter because the so-called forces are movements of matter; they are movements of atoms—whether of that subtle matter called *ether* which pervades all space, whether of more gross matter—in various directions and with various velocities. There is ceaseless atomic change going on around us; the attributes of atoms are for ever mutating, but the atoms themselves endure eternally the same. Force comes to us from the sun. The sun is the centre of the atomic motion of the Universe; the primal wave impulse starts from it and is propagated on and on by the ether till the waves impinge upon worlds, and the matter of which they are constituted takes up the motion and transmits it to their uttermost parts. These atomic movements are the life-principle of the Universe. But let us not attribute too much to force. There is a tendency among the scientific of the present day to make force all-powerful; to merge the known omnipotency of the Creator into the assumed omnipotency of one of His creations, and this arises from the too great exaltation of the intellect, from what I may call too great pride of intellectual power. By the study of the internal constitution of matter and of the various attributes of its atoms we are brought a step nearer to the Divine mind; but let us not try to exalt our finite intellects, as if it were possible to cope with His infinite intellect; let us not try to understand why God created certain forces, certain forms of matter, certain immutable laws. Let us rather bow our heads reverently and pause before we enter the storehouse of creation; O let us enter therein in no careless spirit, with no pride of intellect, but with humility. The wings of science can never raise us to heaven, but they can raise us to such a height above the earth that we are able to take in at one view more of its beauties than can be seen from below. What a wonderful idea does it give us of creative power to think of the millions of atoms in the minutest visible particle of matter, all obeying certain laws with as much precision as a revolving world; all influenced by certain modes of motion, and by them producing the changes which are perpetually occurring throughout the Universe. The laws regulating the movements of atoms are as immutable as the laws regulating the movements of worlds. Atoms move in numbers, harmoniously, rhythmically, like planets in their courses round the sun, and like them they produce music unheard by us. The Pythagorean theory of the music of the spheres may be extended to atoms, which are indeed but microcosms. Shakespeare has beautifully alluded to the theory of Pythagoras in the following lines:—

> "Sit, Jessica. Look how the floor of heaven
> Is thick inlaid with patines of bright gold;
> There's not the smallest orb which thou beholdest
> But in his motion like an angel sings,
> Still quiring to the young-eyed cherubim.
> Such harmony is in immortal souls;
> But while this muddy vesture of decay
> Does grossly close us in, we cannot hear it."

I would ask you, in conclusion, to think sometimes amid the daily affairs of life of the changes in matter which are going on around you, and of their cause. In a beam of sunlight visualise in your minds myriads of waves of ether streaming down from the sun and communicating their motion to the brain as light; in the warmth which it brings, think of waves moving less quickly than the light-waves, and communicating their motion to the brain as heat; and in its train there follows the vivifying principle of plants, of animals, of man,—it is the old Promethean fire bringing down life to the earth. Finally, in all matter think of atoms in everlasting vibration,—now in one direction, now in another, some singly, some in groups—all obedient to the Divine command impressed upon them at the creation of the world."

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.

J. A.—The best kind of bluish-black writing ink is made by adding a strong solution of soluble prussian blue to good gall ink.

R. C. M.—Mr. Nobel has an agent in London, whose address we will obtain.

Received.—Iota.

Books Received.—"Lord Bacon as Natural Philosopher," by G. F Rodwell (Pamphlet).

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

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

Part II.

Theory of Types and Atomicity.

Section IV.—*Atomicity of the Elements.*

(Continued from page 207.)

M. Cahours has generalised these conclusions, and given them a clearer form, by insisting upon the fact that all compounds containing tin and alcoholic radicals arrive at a state of stable molecular equilibrium—that is to say, at the state of saturation — only when 2 equivalents of their tin ($Sn = 59$) are combined with 4 equivalents of a radical or of a monobasic element, so as to make the general formula of all these combinations

$$Sn_2X_4.$$

Here are some examples* :—

Sn_2Cl_4 = 4 vols. Chloride of tin.†
Sn_2Et_4 = 4 vols. Perethylide of tin.
Sn_2Me_4 = 4 vols. Permethylide of tin.
$Sn_2Et_2Me_2$ = 4 vols. Diethyl-dimethylide of tin.
Sn_2Me_3Et = 4 vols. Trimethylethylide of tin.
Sn_2MeEt_3 = 4 vols. Methyltriethylide of tin.
Sn_2Et_3Cl = 4 vols. Chloride of triethylide of tin (chloride of sesquistannethyl.)
Sn_2Et_3I = 4 vols. Iodide of triethylide of tin.
$Sn_2Me_2I_2$ = 4 vols. Diiodide of dimethylide of tin.

The smallest quantity of tin that exists in these volatile compounds of tin being represented by $Sn_2 = 118$, we may look upon this quantity as representing the weight of one atom of tin. Hence the general formula of all these saturated compounds of tin becomes

$$SnX_4.$$

Tin itself, *in its saturated compounds*, plays the part of a tetratomic element.

I say "in its saturated compounds," for in those which are not saturated, in the chloride $SnCl_2$, for example, it plays a different part. This point is very important, and I will illustrate it by another example from the same class of compounds. It follows from the works of M. Baeyer‡ that the methylated compounds of arsenic, when they are saturated, belong to the type

$$AsX_5.$$

The following are known :—

$AsMe_4Cl$	Chloride of tetramethylarsonium.
$AsMe_3Cl_2$	Dichloride of trimethylarsonium.
$AsMe_2Cl_3$	Trichloride of dimethylarsonium.
$AsMe\ Cl_4$	Tetrachloride of monomethylarsonium.

The compound $AsCl_5$, which would correspond to the perchloride of phosphorus PCl_5, has not as yet been obtained. In the other compounds which form part of this saturated series, the arsenic acts as a pentatomic element. But, independent of this series, there exists another in which it enters as a triatomic element.

$AsMe_3$	Arsentrimethyl.
$AsMe_2Cl$	Monochloride of arsendimethyl.
$AsMeCl_2$	Dichloride of arsenmonomethyl.
$AsCl_3$	Trichloride of arsenic.

The compounds belonging to this second series are not saturated. In contact with chlorine the three first absorb 2 of its atoms, and are converted into the compounds of the saturated series AsX_5. But it is none the less true that in arsentrimethyl or in trichloride of arsenic the arsenic only exhibits a combining power represented by 3 units, just as the nitrogen in ammonia only exhibits a combining power represented by 3. And it is also to be remarked that with respect to chlorine the combining capacity of arsenic is exhausted in the trichloride, as with respect to hydrogen it is exhausted in arseniuretted hydrogen. We may conclude from these facts that the atomicity of an element can change with the combinations into which it enters. And this proposition is sufficiently important for us to seek to establish it by other examples. We have already considered carbon as diatomic in oxide of carbon and as tetratomic in carbonic acid, because it manifests§ a combining power equal to two units in the former, and to four units in the latter.

Nitrogen seems to us diatomic in binoxide of nitrogen, triatomic in ammonia, pentatomic in sal-ammoniac—

$$N''\Theta''$$
$$N'''H_3$$
$$N^{v}(H_4Cl)$$

Phosphorus is triatomic in phosphuretted hydrogen and in protochloride of phosphorus, pentatomic in the perchloride.

$$\overset{'''}{P}H_3$$
$$\overset{v}{P}Cl_5$$

Iodine is monoatomic in monochloride of iodine, triatomic in perchloride.

$$ICl$$
$$\overset{'''}{I}Cl_3$$

Lead is diatomic in the dichloride, tetratomic in the tetrethylide or in the tetramethylide.

$$\overset{''}{Pb}Cl_2$$
$$\overset{iv.}{Pb}Et_4$$
$$\overset{iv.}{Pb}Me_4$$

We also know by the law of multiple proportions that the combining capacity of the elements is satisfied by degrees until it arrives at a maximum which it does not exceed. This maximum combining capacity represents, according to some authors, the atomicity; it is invariable for each element, for it is shown by the limit of saturation. But for me the word atomicity has a more extended meaning, which I will define. I will endeavour to specify the part which each element plays in any given combination to give to it its actual combining power, and not that which it might assume in another compound. Can we say, absolutely, that nitrogen is a triatomic element? Then we do not account for its position in sal-ammoniac, where the sum of the elements combined with it represents 5 units of chemical force. Can we say the tin is tetratomic because it can combine with 4 atoms of chlorine? Then we do not consider its value of combination or substitution in the stannous compounds, where it represents only 2 units of combination ($SnCl_2$ = stannous chloride). Shall we say, as a final instance, that iron is hexatomic or tetratromic or triatomic?‖

We do not consider its part in the ferrous compounds where it equals 2 atoms of hydrogen or chlorine

($FeCl_2$ = ferrous chloride).

The true meaning that we attribute to the word

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* *Annales de Chimie et de Physique*, 3rd series, vol. lxii., p. 257. 1861.

† HO = 2 vols.

‡ *Annalen der Chemie und Pharmacie*, vol. cvii., p. 257. 1858.

§ I say "manifests," not possesses.

‖ $FeCl_3$ = Ferric chloride.

atomicity will now be apparent. This word expresses less the *virtual* and *absolute* combining capacity of an element or group, than the *actual* combining capacity which it possesses in a given compound, and which may vary in other compounds.¶

And on this head I will point out that the word *capacity* of combination does not seem to me the correct term; for it implies the idea of a latent force. I will then define atomicity considered in the elements as *the equivalence of the atoms—*that is to say, *their value of combination or of substitution.* This value may change for one and the same element, according to the combinations into which it enters. Nitrogen can unite with 3 atoms of hydrogen, it can replace 3 atoms of hydrogen in a great number of organic compounds, but it can also combine with 4 atoms of hydrogen + 1 atom of chlorine. It is then at once triatomic and pentatomic, according to the combinations into which it enters. Similarly iodine can unite with 1 atom of hydrogen, or replace 1 atom of hydrogen (Ꞓ_2H_6 and Ꞓ_2H_5I), but it can also combine with 3 atoms of chlorine and replace 3 atoms of hydrogen.**

It seems to me useless to insist upon this point; I simply wish to point out in conclusion that the elements act, in this respect, like groups or compound radicals themselves. We know, in fact, that the group Ꞓ_3H_5 is sometimes monoatomic and sometimes triatomic. All admit that it is so. If, then, the atomicity of groups, which depends upon that of the elements may vary, we must also admit that the latter may likewise vary.

Measure of the Atomicity.—Nothing is more simple than to determine the atomicity of an element when it is in combination with another element known to be monoatomic—such as hydrogen or chlorine. The atomicity of this element in a given compound is expressed by the sum of the monoatomic elements which are combined with it. It is evident, likewise, that the compound groups which equal one monoatomic element may similarly give the measure of the atomicity. It is thus with the alcoholic radicals ethyl (Et), methyl (Me), which have already served to fix the atomicity of tin and arsenic.

Again, it is sufficient to glance at the table on page 90 to understand how the atomicity of an element is determined by the number of monatomic elements with which it can combine.

Similarly the measure of the atomicity is free from difficulty in the case of the combination of a simple body with a *single* polyatomic element. In oxide of carbon, carbon only displays 2 affinities, since it is joined to a *single* atom of diatomic oxygen. We express this by saying that it is diatomic in oxide of carbon. But when several atoms of oxygen Θ or of another polyatomic element enter into combination with another simple body, it may not be correct to express the atomicity of the latter by the sum of the affinities residing in the atoms of oxygen. In fact, two cases may here be met with. Either all the affinities of the oxygen are saturated by those of the other element; and thus it is with carbonic, silicic, phosphoric, boracic, stannic acids, &c.

$$\overset{iv.}{\text{Ꞓ}}\overset{''}{\Theta}_2 \qquad \left.\begin{matrix}\overset{v.}{P}\\ \overset{v.}{P}\end{matrix}\right\}\overset{''}{\Theta}_5$$

$$\overset{iv.}{Si}\overset{''}{\Theta}_2$$

$$\overset{iv.}{Sn}\overset{''}{\Theta}_2 \qquad \left.\begin{matrix}Bo'''\\ Bo'''\end{matrix}\right\}\overset{''}{\Theta}_3$$

Or else the atoms of oxygen partially saturate each other, forming, so to say, a chain at the extremities of which other elements join on. Can we say that chlorine is heptatomic in anhydrous perchloric acid?

$$\left.\begin{matrix}Cl\\ Cl\end{matrix}\right\}\Theta_7,$$

That it is tetratomic in hydrated perchloric acid?

$$\left.\begin{matrix}Cl\\ H\end{matrix}\right\}\Theta_4.$$

By no means. In these compounds the atoms of oxygen join on to each other, each losing one affinity by its union with each of its neighbours, so that the last alone preserve one affinity free, which is satisfied either by the hydrogen or by the chlorine.

$$\overset{'}{Cl}\text{-}\overset{''}{\Theta}\text{-}\overset{''}{\Theta}\text{-}\overset{''}{\Theta}\text{-}\overset{''}{\Theta}\text{-}\overset{''}{\Theta}\text{-}\overset{''}{\Theta}\text{-}\overset{''}{\Theta}\text{-}\overset{'}{Cl}$$

Anhydrous perchloric acid.

These remarks also apply to the metals; the atomicity of the latter is not always measured by the sum of the affinities existing in the polyatomic elements combined with them. Thus, in the peroxides which contain 2 atoms of oxygen, the metals should not necessarily be considered as tetratomic; they may be diatomic, for the 2 atoms of oxygen joined together only leave free 2 affinities, which are satisfied by the diatomic metal. We may suppose that in these compounds the atoms are symmetrically arranged round a centre.

The instability even of these peroxides, the facility with which they lose an atom of oxygen, the manner in which they behave with hydrochloric acid, are all characteristic traits which distinguish them from other oxides containing, like them, 2 atoms of oxygen, but in which all the affinities of the oxygen are saturated by a tetratomic metal. On this account stannic acid evidently belongs to a different type to peroxide of manganese, and these differences are perfectly expressed by the formulæ

$$(Mn\Theta)''\Theta \text{ and } Sn\Theta_2.$$

Similarly we should not say that manganese is necessarily hexatomic in manganic acid,

$$Mn\Theta_3,$$

or that iron is necessarily tetratomic in pyrites.

$$FeS_2.$$

Iron *may* be tetratomic in pyrites, but this is not certain; for the tetrachloride

$$FeCl_4$$

¶ It is evident that there are here two ideas, each of which is important, and which must not be confused. The maximum combining power of an element, that which it possesses in reality, and which it exerts in its saturated compounds, must be distinguished from the combining value or value of substitution which it shows in a given compound. The first is measured by the sum of the units of chemical force that exist in the element, the second by the sum of the units of chemical force that it shows in a compound saturated or non-saturated. The maximum combining power is invariable; the value of substitution may change. If we call the former *atomic power* or *atomicity* we must find a term corresponding to the latter, as the German word *Æquivalentigkeit* corresponds to *Atomigkeit*. I do not undertake to find a word to express this idea of "equivalent power of the atoms" which shall at the same time be French, and I do not care to make one which should not. In face of this difficulty I thought proper to apply the word atomicity to this wider idea, as ancient as the atomic theory—namely, this capacity of variable combination of one body with another which is exhausted by degrees, as is shown by the law of Dalton. The absolute or maximum atomicity, which some persons call atomicity, appears thus as a particular instance of the power of combination exerted by bodies; it is the complete manifestation of it. It is likewise plain that this is merely a question of words; the ideas are clearly separate from each other.

** M. Schützenberger has described (*Comptes Rendus*, vol. liv., page 1016) a combination containing

$$\left.\begin{matrix}(\text{Ꞓ}_2H_3\Theta)_3\\ I'''\end{matrix}\right\}\Theta_3$$

in which the triatomic iodine of the chloride Cl_3I, by replacing 3 atoms of the hydrogen of 3 molecules of acetic acid

$$3\left[\left.\begin{matrix}\text{Ꞓ}_2H_3\Theta\\ H\end{matrix}\right\}\Theta\right]$$

joins together the remainders of these 3 molecules.

corresponding to pyrites has not yet been discovered, and the faculty which iron possesses of combining with 2 atoms of sulphur does not give a certain measure of the combining power which it displays in pyrites, since the two atoms of sulphur may be joined together. Each of them thus losing an unit of chemical force, we may imagine that the group

$$[\overset{''}{S}-\overset{''}{S}]''$$

might saturate

$$Fe''$$

in pyrites, or else that the group

$$[Fe''-S'']''$$

might combine with S''.

These examples, which might easily be multiplied, are such as to show that the atomicity which a simple body possesses in certain compounds is only measured exactly by the number of monoatomic elements or groups which are combined with a single atom of this simple body.

(To be continued.)

Process for Determining the Quantity of Bismuth in an Alloy with Lead, by M. Patera.

The alloy is dissolved in nitric acid, and a strip of lead as pure as possible is placed in the solution. The bismuth is quickly deposited upon the lead. If the amount of bismuth in the alloy is large, water must be added to the solution as the metal is precipitated. When the bismuth ceases to deposit in the form of a black powder the strip of lead is removed from the solution, the precipitate is washed by decantation, first with water, and then with alcohol, and finally collected on as small a filter as possible to be dried and weighed.—*Les Mondes*, 1866, No. 6, 234.

A Quick Process for Estimating Uranium in Minerals, by M. Patera.

A weighed quantity of the mineral is dissolved in nitric acid, taking care not to employ a large excess of acid. The solution is now diluted with water, and without filtering supersaturated with carbonate of soda. It is now boiled to complete the solution of the uranium, and to promote the separation of the carbonates of iron, lime, &c. The filtered solution of oxide of uranium in carbonate of soda now contains only traces of foreign substances, and the uranium will be precipitated in the form of uranate of soda with an excess of acid, on the addition of caustic soda. The orange yellow precipitate is collected on a filter, washed for a short time and then dried. It is then removed from the filter and heated to redness in a platinum crucible, the ashes of the filter, burnt apart, being added to the precipitate. The mixed residues are now placed on another filter and again washed, dried, and ignited as before. The residuum of this second calcination is uranate of soda with excess of acid (NaO_2,U_2O_3) from the weight of which the amount of uranoso-uranic oxide in the mineral may be calculated. 100 parts of the uranate of soda with excess of acid represents 83 parts of uranoso-uranic oxide.

The author has made a number of experiments with other processes for the sake of comparison, and finds the process described above sufficiently exact for determining the commercial value of uranium ores.—*Les Mondes*, 1866, No. 6, 234.

TECHNICAL CHEMISTRY.

On the Application of Disinfectants in Arresting the Spread of the Cattle Plague—Report to Her Majesty's Commissioners, by William Crookes, *F.R.S.*

(Continued from page 280.)

82. The following is a tabular statement of the progress of these cases:—

Table showing Results of Injecting Sulphite and Bisulphite of Soda into the Blood of Animals suffering from Cattle Plague.

Number.	Substance injected.	Temp. just before injection.	2nd Day.	3rd Day.	4th Day.	5th Day.	—
		°F.	° F.		° F.		
1	½ oz. of sulphite of soda.	106·2	106·0	—	—	Died.	
2	½ oz. ditto	106·1	104·8	—	—	Died.	
3	¾ oz. ditto	105·2	102·8	—	—	98·5; died this day	
4	¾ oz. ditto	104·2	103·7	Died.			
5	¾ oz. ditto	104·0	101·9	Died.			
6	¾ oz. ditto	102·6	100·8	—	101·2	102·4; 1 oz. of sulphite of soda	Died on 6th day.
7	1 oz. ditto	106·0	104·0; 1 oz. of bisulphite of soda	—	—	—	Died on 6th day.
8	½ oz. of bisulphite of soda	104·0	100·4; ½ oz. of bisulphite of soda.	—	—	—	Died on 6th day.

83. Two things are clearly shown by this table. In the first place, the course of the disease was decidedly checked. In Mr. Singleton's painfully-acquired experience of the effect of the plague, such an occurrence as this had not happened before. In almost every case the course of the disease had been remarkably uniform. An animal was observed to show signs of illness one morning, the next day it was worse, and on the third or fourth day it invariably died. Now, Mr. Singleton himself pronounced each animal treated by injection better the next day, and a reference to the table shows that the thermometer confirmed this decision. Moreover, the amount of this decrease of temperature bears a relation to the quantity of antiseptic used. Thus, when half an ounce of sulphite was injected, the average fall of temperature in the next twenty-four hours was 0·75° F. With three-quarters of an ounce, the fall in twenty-four hours was 1·7° F. With one ounce, the fall was 2° F., whilst with half an ounce of bisulphite of soda, the fall in the same time was 3·6° F.

84. In the second place, not only did the injection effect a temporary good for twenty-four hours, but it caused the animals to survive longer. On this farm, when an animal was taken ill, death ensued generally within four days. But on referring to the table (82.) it is seen that No. 3 (which had received the smallest quantity of antiseptic) lived one day longer than usual. No. 6 (which had received a little more antiseptic injection) lived two days longer than usual; whilst Nos. 7 and 8 (which had received the largest quantity of antiseptics) lived four days beyond the usual time. In all probability, if time had allowed further experiments, so as to find how large a dose of sulphite or bisulphite of soda could be borne in safety by the animals, and especially if they had been kept in disin-

fected sheds, and received careful nursing and appropriate medical treatment during the progress of the trials—some, if not all, of the cattle under experiment would have been permanently cured.

Injection of Carbolic Acid.

85. This was tried at first very carefully, and in dilute solution; the extraordinarily energetic action exerted by it on vital phenomena rendering it not unlikely that its direct addition to the blood of an animal already weakened by the disease would be rapidly fatal. The first experiment was tried at Mr. Fenna's, near Beeston. Three ounces of a solution of carbolic acid, containing one per cent., were very slowly and cautiously injected into the jugular vein of a heifer (No. 9) just beginning to show signs of the disease. It appeared no worse for the operation. The next day it seemed about the same; but Mr. Fenna, having in the meantime obtained some medicine reputed to be infallible, was unwilling to allow me to continue the experiment.

86. At this farm I was fortunate enough to find a severe case of the plague in a small, well-closed shed. The peculiar odour attending the disease was most offensive. I spent several hours in this shed examining the atmosphere, and collecting specimens as formerly at Mr. Daniel's (49 *a. b.*). Infected air was also drawn over microscopic slides moistened with glycerine. The specimens here obtained were forwarded to Dr. Lionel Beale for microscopic examination.

87. I was courteously allowed to make several trials of carbolic acid injection at Mr. Dutton's farm, near Peckforton; the experiments took place on March 13, and five cows were subjected to the treatment. Emboldened by the previous result (85.), I worked on this occasion with a solution of pure carbolic acid containing four per cent. The first cow (No. 10) was injected with an ounce and a half of liquid, containing twenty-six and a quarter grains of the pure acid. It is probable that this injection was rather too rapidly performed, for the animal appeared distressed by it, and trembled all over; in about three minutes, however, she quite recovered the temporary ill effects.

It appeared evident that if harm were to follow the injection of carbolic acid the mischievous effect would be immediate; but that if the fluid could pass through the heart, without exerting its paralysing action on that organ, and could get into the circulation, no present ill effects need be anticipated. I therefore determined to push these experiments as far as possible, increasing the quantity of carbolic acid until it produced a fatal result.

88. The next operation was on cow No. 11, in which three ounces of solution (containing 52½ grains of pure carbolic acid) were very slowly injected. No bad effect followed.

89. Increasing the dose, cow No. 12 had injected into her vein 4½ ounces of solution (equal to 78¾ grains of carbolic acid); this also was followed by no immediate ill effect.

90. Cow No. 13 was then treated with six ounces of solution (containing 105 grains of pure carbolic acid) in two portions of three ounces each; five minutes interval elapsing between each injection. The first three ounces produced a slight trembling, but not so severe as in the case of cow No. 10; as she seemed better in a few minutes, the second dose of three ounces was injected. This proved too much, or was pumped in too hurriedly; for almost before I had finished, the animal trembled violently, its eyes projected, its breathing became laborious, it fell down and expired.

The result could scarcely be attributed to the accidental injection of air into the vein, for the distress began with the injection of the first syringeful, and was only increased by the second; nor is it likely that this accident would happen twice consecutively. I was particularly careful on this point, and the construction of the instrument rendered such an occurrence scarcely possible with ordinary precaution. It is probable that the injection was performed too rapidly, or that the vital powers were lower than usual.

91. In the case of the remaining animal, No. 14, I decided to inject as large a dose as it would bear, stopping the operation at the first sign of trembling, and delivering the liquid very gradually. The first syringeful caused no bad symptoms, and I had just finished injecting the second dose when trembling commenced. It was rather violent for a short time, but soon went off, and in five minutes the animal appeared as well as before. This cow, therefore, bore without inconvenience the injection of six ounces of a 4 per cent. solution, containing 105 grains of pure carbolic acid.

Careful observations with the thermometer were taken before each operation. There were no more diseased beasts on the farm, or I should have carried my experiments still further.

92. On visiting the farm the next day I was told that all the animals seemed better, and on testing them with the thermometer (93.), that statement was confirmed. I gave directions that each animal was to be drenched with half a wine-glassful (one ounce) of carbolic acid in a quart of warm water every morning; but in other respects they might be treated as Mr. Tomlinson, a skilful cow doctor, should direct.

Business now calling me to London, I was unable to watch the further progress of these cases; this is to be regretted, as a series of daily thermometric observations would have been of great value in suggesting further experiments. I had, however, frequent accounts sent me. Cow No. 14 continued to improve slowly, until convalescent. She is now quite well. Nos. 10, 11, and 12 remained in apparently the same state for four days; they then changed for the worse and died. It is not improbable that, had I been able to inject a further quantity of carbolic acid, during the four days in which they were thus hovering between recovery and relapse, it would have turned the scale, and some of them, at all events, would be now alive and well.

93. The following table gives the thermometric observations:—

Table showing Results of Injecting Carbolic Acid into the Blood of Animals suffering from the Cattle Plague.

No.	Grains of Carbolic Acid injected.	Temperature before Injection.	2nd Day.	3rd Day.	—
—		°F	°F		
10	26¼	105·4	103·8	Better.	Died on 6th day
11	52½	103·8	102·8	Better.	Died on 6th day.
12	78¾	104·8	104·4	Better.	Died on 6th day.
14	105	103·7	103·1	Better.	Recovered.

94. If future experiments prove that injection of carbolic acid, or other antiseptic, will do good, it is an operation very easily performed (78.). I have injected

five animals, and taken thermometric observations within an hour. Sulphite or bisulphite of soda apparently occasion some pain, as the animals struggle very much. With carbolic acid, I found them tolerably quiet.

95. I have calculated the proportion which the carbolic acid bore to the whole quantity of blood in these operations. Taking the whole amount of blood in the animal at 150 pounds, there were injected into—

No. 10, one part carbolic acid in 40,000 of blood.
" 11 " " 20,000 "
" 12 " " 13,300 "
" 14 " " 10,000 "

It is worth mentioning, incidentally, that in the case of cow No. 14 (which recovered), the proportion of carbolic acid, injected into the blood, would have been enough to keep from decomposition the whole quantity of that liquid for a considerable time. In Nos. 10, 11, and 12 the proportion of carbolic acid would probably not have been sufficient for that purpose.

96. I am informed by Dr. Calvert that cresylic acid has much less coagulating power on albumen than carbolic acid, and my own experiments (37.) entirely confirm this statement. I have now in preparation in my laboratory a quantity of cresylic acid in a state of purity, to be employed as an injection, if further opportunities of prosecuting these inquiries be afforded me. Xylic acid, the member of the same series above cresylic acid, is also under preparation. This is also a powerful antiseptic, and it is possible that further investigation may show that this body possesses other valuable properties.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 7.

Prof. W. A. Miller, *M.D., F.R.S., President, in the Chair.*

In continuation of our report of last week, we now give an abstract of the lecture delivered by Mr. A. Vernon Harcourt "*On the Observation of the Course of Chemical Change.*" The lecturer said that the investigations of chemists had usually been directed to the products of the transformation of matter rather than to the nature of the change itself. Exceptions were, however, to be noticed in M. Berthelot's "Researches on Etherification," and in Messrs. Bunsen and Roscoe's paper "On the Chemical Action of Light," read before the Royal Society some seven or eight years ago. In the instance last named, the authors recognised a peculiar power or property, which they designated "photo-chemical induction," and by which they explained the comparatively slow action of bromine on tartaric acid, and that in the combination of hydrogen and chlorine gases by exposure to light a certain interval of time elapsed. In the observation of the *result* of chemical change we had passed through the earlier or qualitative period, and were prepared to grapple with the most difficult of the quantitative problems which presented themselves in the science of the present day. With regard, however, to the second class of investigations, treating of the *course* of chemical change, we were still in the earlier stage. Of the small number of experiments which proceeded at a slow or moderate rate, there were but very few in which the action was simple and could be interrupted at any moment for further examination. Two reactions had engaged the author's attention:—1st. The action of permanganic acid upon oxalic acid; and 2nd. The action of peroxide of hydrogen upon hydriodic acid. Neither of these were influenced in any appreciable degree by the diffused light of day, although a direct exposure to the sun's rays certainly hastened the operation of the permanganic acid. In both these reactions the author contrived to have no other than soluble products, and in the former it was necessary to avoid the formation of binoxide of manganese.

Action of Permanganic Acid upon Oxalic Acid.

This action was experimentally demonstrated, and, inasmuch as by the reduction of the potassic permanganate in presence of sulphuric acid a certain proportion of the manganous sulphate must always be formed, the lecturer considered it necessary to add this ingredient to the mixed solutions. An experiment was shown in which the time required for the reduction of the permanganate was proved to be dependent upon the proportion of free sulphuric acid employed. Equal quantities of the oxalic acid, manganous sulphate, potassic permanganate, and water, were rapidly mixed (in four test glasses) with one, two, three, and four cubic centimetres of dilute sulphuric acid respectively, and at the expiration of three minutes all further action was stopped by the addition of iodide of potassium, when by the varying tints due to the liberation of free iodine the extent of action was distinctly appreciable to the eye, and could be measured by a standard solution of hyposulphite of sodium. The following numerical results were obtained by Mr. Harcourt, and exhibited in a series of diagrams.

Table I.—Variation of Sulphuric Acid.

Relative weights of substances employed—

$K_2Mn_2O_8, 5H_2C_2O_4, 2MnSO_4, xH_2SO_4.$

Actual weight of potassic permanganate, ·015 grms.
Volume of solution, 330 c.c.
Temperature, 16° C.
Duration of each experiment, 4 mins.

Molecules of sulphuric acid.	Percentage of residue.	Percentage of chemical change.
x	y	$100 - y$
2	78·2	21·8
4	64·0	36·0
6	48·9	51·1
8	36·5	63·5
10	28·4	71·6
12	22·6	77·4
14	17·6	82·4
16	14·3	85·7
22	7·7	92·3

Table II.—Variation of Manganous Sulphate.

Relative weights of substances employed—

$K_2Mn_2O_8, 5H_2C_2O_4, 10H_2SO_4, xMnSO_4.$

Actual weight of potassic permanganate, ·015 grms.
Volume of solution, 330 c.c.
Temperature, 16° C.
Duration of each experiment, 4 mins.

Molecules of manganous sulphate.	Percentage of oxidising residue.	Percentage of chemical change.
0·0	99·2	0·8
0·25	97·2	2·8
0·5	95·3	4·7
0·75	93·9	6·1
1·0	90·3	9·7
1·25	86·4	13·6
1·5	78·4	21·6
1·75	52·3	47·7
2·0	29·9	70·1
2·25	20·6	79·4
2·5	17·1	82·9
2·75	16·0	84·0
3·0	15·4	84·6
4·0	14·9	85·1
5·0	14·7	85·3
10·0	14·2	85·8

Table III.—Variation of Oxalic Acid.

Relative weights of substances employed—

$K_2Mn_2O_8,3MnSO_4,15H_2SO_4,xH_2C_2O_4$.

Actual weight of potassic permanganate, ·015 grms.
Volume of solution, 100 c.c.
Temperature, 16° C.
Duration of each experiment, 3 mins.

Molecules of oxalic acid.	Percentage of residue.	Percentage of chemical change.
x	y	$100-y$
0	100·0	0·0
1	79·5	20·5
2	57·7	42·3
3	37·1	62·9
4	22·2	77·8
5	12·6	87·4
6	8·3	91·7
7	15·2	84·8
8	38·4	61·6
9	73·6	26·4
10	83·0	17·0
11	86·6	13·4
12	88·2	11·8
15	90·3	9·7
20	91·3	8·7
30	91·0	9·0

Table IV.—Variation of Time.

Relative weights of substances employed—

$K_2Mn_2O_8,15MnSO_4,3H_2SO_4,5H_2C_2O_4$.

Actual weight of potassic permanganate, ·015 grms.
Volume of solution, 100 c.c.
Temperature, 16° C.
Duration of each experiment, x minutes.

Duration of experiment.	Percentage of residue.	Percentage of chemical change.
x	y	$100-y$
·25	91·0	9·0
·5	81·0	19·0
1	65·8	24·2
2	51·9	48·1
3	42·4	57·6
4	35·4	64·0
5	29·8	70·2
6	25·7	74·3
7	22·2	77·8
8	19·4	80·6
9	17·3	82·7
10	15·5	84·5
15	10·4	89·6
20	7·8	92·2
30	5·5	94·5
40	4·4	95·6

The destruction of the oxalic acid was in this way shown to follow a perfectly regular course, as demonstrated by the curves indicated in a second series of diagrams which the lecturer had drawn up with the assistance of Mr. Esson.

Action of Peroxide of Hydrogen upon Iodide of Potassium,—In this case the lecturer believed that the course of the change would be more accurately followed in consequence of the greater simplicity of the reaction. As a convenient source of peroxide of hydrogen, Mr. Harcourt used a mixture of peroxide of sodium with an excess of dilute sulphuric acid, which he found to be much more permanent than the pure peroxide of hydrogen. Of this solution suitable quantities were measured out by a graduated pipette. A known volume was added to a mixture of starch, iodide of potassium, and excess of sulphuric acid, diluted with a large proportion of water, and contained in a tall glass cylinder, the mouth of which was closed by a cork, perforated for the insertion of a thermometer, glass mixer, and a small aperture was left for the convenience of introducing the necessary chemical reagents. The state of equilibrium, when disturbed by the operation of the peroxide, was at once indicated by the production of a blue colour (iodide of starch). Commencing with a scarcely appreciable blue tinge, Mr. Harcourt added 10 c. c. of the peroxide (deep blue), and then a single drop of hyposulphite of sodium, which decolourised it, and noted the time during which the solution remained colourless; then, upon addition of a second drop of the hyposulphite, a longer interval was required for the production of the blue colour; and, again, the third interval was longer than the second. (In the actual experiments bubbles of carbonic acid gas were used to agitate the liquid and promote the exclusion of atmospheric oxygen, and the unit of hyposulphite was measured from a syphon-dropping bottle, which delivered only four or five drops per minute, and each drop was received into a narrow glass tube open at both ends.

The intervals of time observed between the periods of production of the blue colour were—

I.—1′ 35″
II.—2′ 30″
III.—6′ 20″.

The temperature was an element of great importance, since the changes occurred with twofold rapidity at a point 10° C. above the ordinary temperature. With respect to the action of the hyposulphite, the lecturer stated that it decolourised the blue iodide of starch by forming tetrathionate of sodium, and he had ascertained that in such dilute solutions the mineral acid was no longer capable of decomposing the alkaline hyposulphite. The main conclusion established by the author's experiments was to the effect that the amount of change occurring in any given time is directly proportional to the amount of peroxide of hydrogen existing in the fluid at that time.

Mr. Esson was then invited to favour the Society with an explanation of the mathematical principles upon which the curves shown in the diagrams had been constructed.

After a vote of thanks had been moved by the President, and cordially seconded, the meeting was adjourned.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, by Dr. Percy, F.R.S.

Lecture No. V.

(Continued from page 286.)

Here is a specimen of iron chrysolite, to which I now direct your attention. In various metallurgical operations we frequently obtain an analogous silicate—a compound of silica and protoxide of iron, in exactly the same proportions atomically, and presenting exactly the same crystalline form as the silicate of magnesia. This is a very fine specimen of crystallised silicate of protoxide of iron. It is called iron olivine, or iron chrysolite. We can make it without any difficulty simply by heating together silica and protoxide of iron, or peroxide of iron, which is another oxide. If peroxide of iron is used it will lose part of its oxygen at a high temperature, and yield protoxide. We can thus obtain the silicate of protoxide of iron very well crystallised indeed. It is a substance accidentally obtained in furnace operations. It occurs in lavas, in basalt, in obsidian, and in greenstone—all minerals which are clearly the result of igneous action; and what is remarkable is that it occurs in certain specimens of meteoric iron. There are, for example, cellular cavities filled with this chrysolite in Pallas's meteorite, and in a piece from South America there are cellular masses of iron, the cells of which are filled with this chrysolite. It is difficult to me to understand how it got there, because if the iron had ever been melted the difference of specific gravity would have caused the silicate of magnesia to float to the top of the iron, and there would have been a separation of the two. Mr. Sorby, of Sheffield, has lately attempted to explain it on other principles, but I do not think he has made out his point. It is a matter of great interest. I do not think that chrysolite has ever been produced by hydrothermic action. As far as we know, it has been the result entirely of igneous action.

The next mineral with which we have to deal is augite, a well-known mineral. It is also known as pyroxene, and crystallises in the oblique system. It plays a very important part in the composition of many igneous rocks. The relation between the oxygen in the bases contained in this silicate and the oxygen of the silica is the same as in wollastonite—three equivalents of base of the RO type, and two of silica, but in this case the base RO is represented not by lime alone, as in wollastonite, but by lime, magnesia, protoxide of iron, and protoxide of manganese, and sometimes alumina is present.

There are a great many varieties of this pyroxene. It occurs in numerous forms which are met with in mineralogical cabinets. I am happy to say that the taste for mineralogy is rapidly reviving. It is one of the most charming pursuits; and it has the advantage that the specimens can be kept for any length of time without difficulty. They do not require continual attention. There is a light coloured variety of augite, containing chiefly silicate of lime and magnesia. The dark coloured specimen contains a larger proportion of protoxide of iron.

We can make pyroxene artificially. It has been not unfrequently met with in furnace operations. We have some so formed from Germany. The form of the crystal is certainly that of augite. I may call your attention especially to one of the cases in the museum above, where you will find magnificent specimens of crystals of pyroxene, which are too large to bring down here. If you will take the trouble to examine them, you will see the mineral to greater advantage than it can be exhibited on the lecture table.

Now, this mineral, pyroxene, has been made also by hydrothermic action by Daubrée, by the action of alkaline mineral water from a thermal spring—that which occurs at Plombières—on glass. By the action of the concentrated water of Plombières on glass he obtained diopside, which is a variety of this mineral. Pyroxene occurs in volcanic rocks associated with garnet; in veins traversing serpentine in association with garnet and talc, and also in limestone and some varieties of dolomite.

We have, then, arrived at the fact that this mineral may be produced by direct igneous action, or by the agency of very hot water—hydrothermic action.

Amphibole, or hornblende, as it is called, is the next silicate of which I shall speak. The system of crystallisation of amphibole is the same as that of augite, but the angles differ. The composition also varies. We are informed that by fusion amphibole or hornblende may be converted into augite. This is stated on the authority of Benthier, Mitscherlich, Rammelsberg, and Gustave Rose, all no mean authorities. It is curious that by the action of heat we can convert these minerals into one another. Thus we get a clue to the conditions under which these minerals may have been produced — a clue respecting temperature, and so on. We find very numerous varieties in nature; take, for example, tremolite, actinolite, asbestos, and pargasite.

This amphibole or hornblende occurs especially in a particular variety of granite called syenite, in which the mica is replaced by this hornblende. Light varieties occur in granular limestone, dolomite, granite, and so on.

The next mineral is one of high interest, not unfrequently employed as a gem—namely, garnet. I beg your attention to the chemical composition of this mineral. We have three atoms of the base of the RO type, combined with silica (SiO_3)—that is, a tribasic silicate; *plus* a silica having a base of the type R_2O_3. Thus we get the type of garnet—$3ROSiO_3+R_2O_3SiO_3$.

It is not for me on the present occasion to describe the mineralogical varieties of garnet. Some of them are very beautiful, and highly appreciated as gems, especially the carbuncles.

Our principal business regards its formation. There is some doubt as to whether we have really obtained true garnet artificially. I am by no means satisfied on the point. I will present you with one specimen which I obtained a good many years ago from a mineral collector who brought it to me from Scorland. It came from the bottom of one of the iron melting furnaces there. This is a rather repulsive-looking specimen; but there are some crystals on it which are like garnet. They are not enough for analysis; but they have been examined by Professor Miller, of Cambridge, and found to have the precise outward appearance of garnet. There is a statement that Studer, a Swiss mineralogist, has obtained garnet directly by fusing together its constituents. I should like to see a specimen. Here is a small piece of mineral, said to be garnet. It was presented to me after the last course of Sir Charles Lyell.

With regard to the formation of garnet in nature, our information may be said to be very imperfect. It is very desirable that search should be made for it in furnace products.

The next mineral—and I will conclude this lecture with that—is an interesting volcanic product called humboldtilite or mellilite. These two names were supposed formerly to represent two different minerals, but it is now found that humboldtilite and mellilite are identical. The crystalline form is prismatic. It occurs in lava at Vesuvius, and also at Capo di Bove with nepheline. It also occurs on a large scale in our iron furnaces, and sometimes magnificently crystallised. It is not a very attractive mineral. Humboldtilite consists essentially of a silicate of lime and a silicate of alumina. The oxygen in the silicate of lime is equal to that of the silica; hence it is a tribasic silicate. The oxygen of the lime in the silicate of lime is equal to that of the silica, and the oxygen of the alumina in the silicate of alumina is equal to that of the silica; but the oxygen of the lime series is just double that of the alumina. This represents exactly the formula of this mineral: $2(3CaO, SiO_3)+Al_2O_3SiO_3$. Artificially obtained, it frequently includes a little foreign matter—silicate of calcium, and the like. Humboldtilite occurs in square crystals, occasionally translucent, and nearly always unmodified. It is sometimes modified. I have seen two modifications in the course of 20 or 30 years. There is a specimen in which the form is modified at the angles, but the substance is identical with humboldtilite or mellilite. The crystals in this specimen are finer, as far as I know, than any which nature has yet produced.

THE BRITISH ASSOCIATION OF GAS MANAGERS.

On the Combustion of Gas for Economic Purposes.

A Lecture delivered by Dr. Letheby.

(Continued from page 284.)

And now I am anxious to draw your attention to the effect of rarefying the atmosphere, for it has been noticed that the intensity of a flame is much less at high altitudes than at low. This was particularly observed by Dr. Frankland and Professor Tyndall in the autumn of 1859, when they were making experiments on the combustion of candles at the top of Mont Blanc. They noticed that although the candles burnt at the same rate as they did in the valley of Chamounix, yet the flames were blue, and large, and feeble. Dr. Frankland was so much struck with the phenomenon that he afterwards made it the subject of careful investigation. He found, indeed, that a gas-flame, like that of a candle, gave less and less light with the rarefaction of the air in which it was burning;

and his results show that the loss of light is about 5·1 per cent. for every inch of diminished mercurial pressure, up to a rarefaction of 14 inches. If, for example, the light of a flame be equal to 100 at 30 inches of the barometer, it is but 94·9 at 29 inches, and 89·8 at 28 inches; and so on up to 14 inches, when it is only 18·4 per cent. of the original light. Fortunately, in our photometrical inquiries the loss of light is equally great with the gas and the standard, or the variations of atmospheric pressure from day to day, or even from hour to hour, would show a marked difference in the value of the light. As it is, a variation of 3 inches of the barometer must cause a difference of more than 15 per cent.; and it is not improbable that this may have something to do with visible variations in the light of the public lamps. Certain it is that the same gas in places at different altitudes will have very different values. The gas, for example, which in London has the value of 100, would be but 91 at Munich, and only 61·5 in Mexico. Indeed, the difference would be greater than this, for not only is the light actually less for equal consumptions, but as the volume of the gas expands with the rarefaction and temperature, the real value of the same quantity of gas as measured by the meter in Mexico would be only 46·2. Even in London the difference in the value of the light when the barometer is 31 as compared with what it is at 28 is fully 25 per cent.; and it may well be that this difference is noticeable.

If the rarefaction of the gas and air are carried to a very great extent they cease to burn. The flame of coal gas, as well as that of a candle and of spirit of wine and ether, is extinguished at a rarefaction of about 1-6th of the atmosphere; hydrogen, at 1-7th; sulphur, at 1-15th; and phosphorus, at 1-60th. On the contrary, if the atmospheric pressure is increased, the luminosity of a flame is also increased, and it would seem that up to considerable pressures the rate of increase is in the observed proportion of 5·1 per cent. for every inch of mercurial pressure; and by doubling the atmospheric pressure the light of a gas-flame rises from 100 to 252. So marked is this on the luminosity of flame, that it is not difficult to make a spirit-lamp glow like a candle, or even to make it smoke.

And then there is another circumstance which influences the light of a flame—namely, the temperature at which the combustion is going on. If the temperature is lowered, the light is also proportionally diminished. This is noticed in the flame of a candle which requires snuffing, when the charred wick and the head of sooty carbon radiates the heat and lowers the temperature of the flame. But if by any means the temperature is increased, an opposite effect is produced. I have here a contrivance which was originally designed by Mr. Bowditch, and which has been somewhat modified by Dr. Frankland. It is a common Argand burner and glass, with another glass around it; and it is so arranged that all the air which supplies the burner must pass down between the glasses and be heated before it reaches the flame. The temperature which it thus acquires is from 500° to 600° Fahrenheit, and it passes to the flame as a sort of hot blast. The result of it is that the light for the same volume of gas is increased about 67 per cent, and for equal lights it is found that there is a saving of 46 per cent. of gas.

Illuminating Power with and without the external Glass in Sperm Candles of 120.

Consumption per hour. Cubic feet.	Illuminating Power without Glass.	Illuminating Power with Glass.
2·2	—	13·0
2·6	—	15·5
3·3	13·0	21·7
3·7	15·5	—

These are the results with cannel gas, but I do not find there is a like increase of power with common gas.

Lastly, there are cases where the amount of carbon in the vaporous matter is so abundant that contrivances are needed for its oxidation. All these contrivances are plans for diminishing the supply of the combustible and increasing the flow of air. In the paraffin candle the wick is adapted for a small supply of the material; and in the benzole and paraffin lamps there are caps or deflectors, with slits for blowing the air upon the sides of the flame. In the camphine lamp there are additional deflectors in the form of a central button, and a throttled chimney for directing the air upon the inside and outside of the flame; and in the Carcel lamp the oxidation is increased by the length of the chimney. In all cases, however, the points for consideration are—the best means for effecting perfect and prolonged combustion; and having attained this we have to take care that the light is not destroyed by the medium of transmission. Glass is very transparent, but yet it destroys a notable proportion of light, and when the surface is ground the loss of light is often considerable:—

Loss of Light by Glass Globes.

Clear glass destroys	12 per cent.
Slightly ground in pattern	24 „
Half ground	35 „
All ground	40 „
Opal glass	60 „

And lastly I have to refer to the methods which are adopted for estimating the value of the light of gas. These are as follows:—

1. By observing the durability of a jet of gas of a given height from an aperture of a given size.
2. By ascertaining the pressure necessary to obtain a flame of a given height from the same jet.
3. By noting the height of the jet when the gas is burning from an aperture of a given size and at a uniform pressure.
4. By ascertaining the quantity of air which is required to destroy the light of a flame burning at a given rate.
5. By comparing the light with a standard flame.

The first method of testing the illuminating power of gas was often used by the late Dr. Fyfe, of Glasgow, and when it was conjoined with another test—namely, the amount of condensation by chlorine, it was much relied on. The jet which he used had a diameter of the 1-33rd of an inch, and the flame was kept at a uniform height of 4 inches. In this way he found that a given volume of gas of different qualities burnt out in different times, thus:—

Durability of a Cubic Foot.

Common Newcastle coal gas	50·5 minutes
Wigan cannel	57·0 „
Lesmahago	65·0 „
Wemyss	75·0 „
Boghead	81·0 „

Secondly, he further ascertained that the pressure necessary to make a gas burn from an aperture of a given size, and with a flame of a given height, was also the exponent of the quality of the gas; for the better the gas the less the pressure at which it burns, and the less also is the consumption to produce a flame of a given height. For example, with a jet 1-40th of an inch diameter, and a flame 5 inches high, the following were the rates and pressures of different gases:—

Pressure, Inch.	Consump. per Hour, Cub. ft.	Specific Gravity of Gas.
0·6	0·67	0·841
0·8	0·77	0·729
1·0	0·86	0·552
1·2	0·94	0·595
1·4	1·02	0·551
1·6	1·09	0·515
1·8	1·15	0·486
2·0	1·21	0·461

His deductions from these results were, that the specific gravity of the gas—or, in other words, its quality—was inversely as the square roots of the pressures, and that the volume consumed in a given time was as the square roots of the pressures. He relied so much on this test, that he thought it capable of taking the place of both the meter and photometer.

The third method of ascertaining the value of gas is by observing the height of a flame at a given pressure from a jet with an aperture of a given size. This method has been adopted by Mr. Lowe, and it goes by the name of Lowe's jet. It is, as you perceive, a modification of the preceding, for a poor gas will burn with a shorter flame than a rich gas; and, by using a jet with an aperture of 0·04 of an inch in diameter, and a pressure of 0·5, the flame of 14-candle gas will be just 6 inches in height.

The fourth method for determining the quality of gas is by ascertaining the quantity of air necessary to destroy its light. The best instrument for determining it is the apparatus designed by M. Erdmann, and which is called a gas-prover. It is a sort of Bunsen burner, with a contrivance for graduating the supply of air. Erdmann recommends the gas to be turned on until there is a flame of a given height, and then the supply of air is admitted until the light is destroyed. This, however, is not the proper way to use the instrument. The gas should first be turned on at a given rate—viz., at the rate of 0·84 of a cubic foot per hour—and then the quantity of air necessary to destroy the light should be read off. In this way reliable results may be obtained, for the richer the gas the more air is required.

I referred in my last lecture to this diagram, which has been prepared from the experiments of Mr. King, of Liverpool.

Illuminating Power of Gas, as estimated by Erdmann's Gas-Prover, the Gas burning at the rate of 0·84 *cubic feet per Hour.*

	Description of Gas.			
	Newcastle Coal.	Equal Parts Newcastle and Wigan.	Wigan Coal.	Boghead Coal.
Height of flame (inches) . .	1·87	2·00	2·75	5·50
Number of index prover . .	14·72	23·39	32·78	61·84
Relative value of ditto . .	1·00	1·59	2·22	4·15
Coefficient of power . . .	0·70	0·70	0·72	0·70
Illum. power (coefficient=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

Lastly, the common method for ascertaining the illuminating power of gas is by comparing it with a standard flame.

In this country the standard was formerly a wax candle burning at the rate of 120 grains per hour, but the variations in the value of the light were so great that it was abandoned; for, as a wax candle requires snuffing, it was difficult to decide when it was burning in a proper manner. After numerous experiments extending over a year, I ascertained that, for equal consumption, the light of wax and sperm was as 14 to 16—in other words, the power of sperm was just one-seventh greater than that of wax.

At present, the standard flame in this country is a sperm of six to the pound, burning at the rate of 120 grains per hour. But for some time past this standard has also become uncertain—first, because there has been great irregularity in the construction of the wicks; and, secondly, because the sperm is being adulterated with wax and paraffin, or both. The irregularity of the wick causes a variation in the rate of burning from 116 grains per hour to 140; and the real value of the light in the two cases, when reduced to the standard consumption of 120 grains per hour, is as 96 is to 116. The adulteration of the sperm with wax and paraffin also affects the value of the light, for the former gives 13 per cent. less light than sperm, and the latter gives 23 per cent. more light. These irregularities are becoming so serious that we must ere long change the standard.

In France the standard is a Carcel lamp of specified dimensions in every particular, burning refined colza oil at the rate of 648 grains per hour. With proper precautions this standard appears to be very uniform, care being taken that the consumption of the oil is never less than 617 grains per hour, or more than 679.

And now, in concluding this part of the subject, I will direct your attention to the comparative power and value of the most important illuminating agents.

Relative Value of different Illuminating Agents.

Name.	Rate of Consump. per Hour.	Illum. power (Sperm 120.)	Quantity = 14 Candles.
Cannel gas . .	4 feet .	. 18·67 .	. 3 feet.
Coal gas . .	5 ,, .	. 14·00 .	. 5 ,,
Benzole . .	301 grs. .	. 4·91 .	. 857 grs.
Paraffin oil . .	265 ,, .	. 7·11 .	. 522 ,,
Sperm oil . .	686 ,, .	. 10·00 .	. 960 ,,
Colza oil . .	648 ,, .	. 9·01 .	. 1008 ,,
Paraffin candles .	122 ,, .	. 1·46 .	. 1171 ,,
Sperm ,, .	132 ,, .	. 1·35 .	. 1440 ,,
Wax ,, .	168 ,, .	. 1·43 .	. 1652 ,,
Stearic ,, .	140 ,, .	. 1·13 .	. 1732 ,,
Composite ,, .	144 ,, .	. 1·08 .	. 1858 ,,
Tallow ,, .	145 ,, .	. 0·83 .	. 2542 ,,

With regard to the value of other illuminating agents, as the magnesium light, the oxyhydrogen or Drummond light, and the electric light, little can be said, as they vary so much with the consumption of the material.

In the case of the magnesium light, I find that when a wire the 100th of an inch in diameter is doubled and twisted, it burns at the rate of 2·4 grains per minute, and gives the light of about 69 standard sperm candles; an ounce of the wire, therefore, is equal in light-giving power to rather more than 3½ lbs. of sperm candles. The power of the Drummond or oxyhydrogen light varies with the combustible used. With

Coal gas and air it is equal to			19	candles.
,, ,,	oxygen	,,	29	,,
Alcohol ,,	,,	,,	68	,,
Ether ,,	,,	,,	76	,,
Hydrogen	,,	,,	153	,,

And the power of the electric light varies from 650 candles to 1444, the average being about 1000.

All these agents are expensive, and they give a light which is characterised by intensity rather than by quantity, but as the light is pure as well as powerful, it is frequently used for signals and for photographic purposes, and also for theatrical illustrations.

I now pass to a very interesting part of our subject—namely, the cause of the marked differences in the colour of the flames of different substances; and in order that you may perceive the reason of this, let me remind you that a pure white light, with all the colours of the spectrum, is never obtained but by the intense ignition of solid or molten matter. This is so with the phosphorus flame, and with the magnesium, the oxyhydrogen, and the electric light. In all these cases there are particles of concrete solid matter in a state of intense ignition, but in the case of coal gas, and in that of other burning hydrocarbons, the light is never pure unless it is intensified by very energetic combustion. The reason of this is that the particles are only heated to the point of yellow whiteness; for Dr. Draper has shown that, according to the temperature, an ignited solid (as a spiral of platinum heated by the galvanic current) passes through all the tints of the spectrum from red to white, according to the intensity of the heat, and these tints and temperatures are somewhat as follows:—

Very dull red . .	about	970°	Fahrenheit.
Cherry-red . . .	,,	1500	,,
Full red	,,	2000	,,
Dull red, white, or orange	,,	3000	,,
Yellow white . . .	,,	4000	,,
Greenish white . .	,,	5000	,,
Bluish white . . .	,,	6000.	,,
Perfect white . . .	,,	7000	,,

If, therefore, the temperature of combustion is not sufficiently high, the light is never pure. This is especially so with the creamy lagging flame of underburnt gas, and with the smoky flame of hydrocarbons rich in carbon, as benzole, turpentine, and paraffin; but if the combustion of these flames is intensified by a proper supply of air, the temperature of the ignited carbon is increased, and the light becomes purer and purer, so that when it is thrown upon coloured objects it displays the tints in a more or less perfect manner. Such a flame, when examined with the prism, gives a spectrum like that of solar light with all the tints of the rainbow. This is the speciality of pure light from an ignited solid. If, however, the vaporous matter does not contain solid particles in a free or concrete form, the ignition of it produces only certain tints of the spectrum, and hence its variable colours. Examined, therefore, with a prism, we see only those bands of colour which are characteristic of the flame.

I will show you this by moistening little balls of coke with the chlorides of the following metals, and then introducing them into the colourless flame of a Bunsen burner, or, better still, into that of Griffin's blast jet; and you note how different are the tints, and how they fail to illuminate certain colours of these dyed ribbons.

Chloride of sodium gives a rich yellow flame,
Chloride of copper „ a deep blue-green flame,
Chloride of strontium „ a rich scarlet flame,
Chloride of barium „ a pale pea-green flame,
Chloride of lithium „ a bright crimson flame,
and a salt of thallium „ a beautiful grass-green flame.

The chlorides are used because they are the most volatile, and they exist in the flame in a vaporous condition. These tints are so characteristic of the several metals, that they afford the most delicate means of discovering their presence; but the great fact which modern investigations have brought out is the circumstance that the spectrum of these flames consists of certain well-defined and constantly placed bands of colour. This diagram will show you the spectra of the metals which I have been using; and so true and constant are the positions and tints of these bands, and so delicate are the manifestations of them, that they become the means of discovering the merest traces of the several metals. But I must not pursue this further, except by showing you the differences in the tints of this spectrum and ribbons when examined with the pure white light of burning magnesium.

And now I will briefly describe the contrivances which are used for increasing, or rather I should say for fully developing, the temperature of burning gas. I have shown you that the light of a flame depends on the presence of ignited carbon; if, therefore, by any contrivance we can at once burn this carbon, and not permit it to stand as it were idle in an ignited condition, the temperature must be considerably increased. This is the principle concerned in all the contrivances for developing the heat of gas.

One of the simplest means of accomplishing this is to mix a sufficient quantity of air with the gas before it reaches the place of combustion; and this is easily done by putting a cap of wire gauze upon the chimney of an Argand burner, and setting fire to the gas above it. The effect of this arrangement is that as the gas passes from the burner to the top of the chimney, it draws in a quantity of atmospheric air, which freely mixes with it and burns the solid particles. The same is the case with the burner of Bunsen, which I have already described; and you will note how strongly it ignites this platinum crucible. The same arrangement is adopted by Mr. Griffin in his reverberatory furnace, which is a Bunsen's burner enclosed in a clay chamber. I have here another contrivance of the same nature called an *atmopyre*, which is used by Professor Hofmann in his furnace for effecting organic analysis. It is a hollow cylinder of baked pipe-clay pierced with a large number of small holes. When it is placed on a small fishtail burner, the gas, in issuing from the holes, draws in a sufficient quantity of atmospheric air to make it burn at all the apertures with a clear blue light; and thus the temperature is so much increased that the entire body of the numerous cylinders composing the furnace becomes almost white hot.

But we shall find that a still higher temperature is obtained by blowing air into a large volume of flame. This is the plan adopted by Mr. Herapath in this blow-pipe jet. Observe how intensely it ignites a mass of platinum wire; and by putting together a number of these jets, as Mr. Griffin has done, in this arrangement, which he calls a blast-furnace, you will perceive what a high temperature is obtained; and by surrounding the blast with a case of baked clay, so that the heat may be concentrated, the temperature is sufficiently high to melt all the common metals. As much as a quarter of a hundredweight of cast-iron can be melted at a time in one of these furnaces, and 3 or 4 lbs. of cast-iron or copper can be thus melted in fifteen minutes. Even the very refractory metals, as nickel and cobalt, can be thus fused.

And if instead of atmospheric air a jet of oxygen is used, as I will now show you, the temperature is still higher. This is the principle of Deville's furnace, which is a jet of oxygen blowing into a large flame of coal gas, and directed down upon the refractory substance, the whole apparatus being enclosed in a chamber of non-conductors. With this furnace large masses of platinum are easily melted, the platinum being placed upon a hollow bed of lime. I have seen a mass of platinum, weighing about 350 lbs., which had been melted in this manner, and I was informed by Messrs. Johnson and Matthey, the platinum assayers of Hatton Garden, that the mass required six hours for its fusion. During that time about 360 cubic feet of coal gas and the like quantity of oxygen were used; in fact, Deville found in his experiments at the *Ecole Normale*, that it required a little more than a cubic foot of gas and a cubic foot of oxygen to melt a pound of platinum. The temperature of the flame must be enormous; calculated from the thermotic powers of gas with air and oxygen, it may be said that it is equal to about 5228° of Fahr. when air is used, and 14,320° Fahr. with oxygen.

(To be continued.)

ACADEMY OF SCIENCES.

June 11.

The chemists still seem to be making holiday. The *Compte-Rendu* again contains no chemical paper. In place of them we have this week the address of M. Chevreul on presenting to the Academy the first volume of his "History of Chemical Knowledge." The address was intended to explain the principles on which the book has been composed. It would seem to be a profoundly philosophical work, but in his address M. Chevreul appears to us to exhibit a want of that clearness which distinguishes most French philosophical writers. The special title of the book is, *The Connexions of the Sciences within the Domain of Natural Philosophy set forth according to the* A POSTERIORI *Experimental Method, under the double relation of Analysis and Synthesis.* It comprises six books: 1. Ideas of general philosophy. 2. Chemical ideas, divided into six categories. 3. The relations of chemistry with the history of living beings. 4. Distribution of the natural sciences according to the manner in which the human mind proceeds to the investigation of the unknown, going from the *concrete* to the *abstract*, and returning from the abstract to the concrete. 5. Ideas which at first sight appear to be independent of chemistry. The object of the work, M. Chevreul explained, is to show the mutual relations of the natural sciences by considering them exclusively from the *à posteriori* experimental method point of view. We shall not follow the author far in his address. He tells us that the essential character of the natural sciences resides in the *demonstration* of the propositions which respectively compose them. For all his knowledge of the outer world and of himself man is indebted to two faculties of his mind, *analysis and synthesis*, one of which acts naturally as a control to the other, and together give the conviction of truth. At a future time we may make the acquaintance of M. Chevreul's book itself, and perhaps be able to give our readers a better idea of the author's system than we could supply by condensing this address. It looks rather formidable to see a number of metaphysical ideas introduced into the study of chemistry, but we shall probably find that there is nothing to be alarmed at.

NOTICES OF BOOKS.

The New and Old Notation of Chemistry; in a Complete Set of Tables, giving the Formulæ of all the more Important Compounds, according to Each System, and a Table of the Elements, with their New and Old Atomic Weights. By Sidney W. Rich. London: Jackson and Townson. 1866.

These tables have been compiled especially to accompany the old editions of Manuals of Chemistry which do not contain the formulæ according to the new notation, and we may say that they will be found very useful by students.

Journal für Praktische Chemie. No. 5. 1866.

The original articles in this Journal consist of a paper by Dr. K. Frisch *On the Basicity of Tartaric Acid*, describing carefully executed determinations, which prove that in tartaric acid not merely two but three or four equivalents of hydrogen may be replaced by a metal. The author, for example, has formed a quadribasic tartrate of zinc

$$C_8H_2Zn_4O_{12}+HO,$$

and a tribasic and quadribasic tartrate of lead. Another original paper is by Dr. H. Fleck *On the Separation of Cobalt from Nickel*, for effecting which the author gives a simple process based upon the insolubility of sulphide of cobalt in cyanide of potassium. A solution of the two metals is rendered ammoniacal, and is then exposed to the air in a shallow dish as long as any change of colour happens. When no further change is observed yellow sulphide of ammonium is added, and the mixture evaporated on a water bath until all the ammonia is driven off. A solution of cyanide of potassium is now added, in which the sulphide of nickel dissolves, giving a clear yellow solution, while the sulphide of cobalt remains behind. We shall give a further account of this process in our next volume. The Journal also contains a part of the memoir by Fritzsche *On the Solid Hydrocarbons in Coal Tar*, in which he describes *Chrysogen*, and to which we have before alluded, Dr. Hofmann's memoir *On the Action of Terchloride of Phosphorus on the Salts of the Aromatic Monamines*, and also papers by Martius and Griess, which we have noticed before.

Some short practical notices by Stolba will find a place in our "Miscellaneous" columns.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

1471. J. D. Whelpley and J. J. Storer, Boston, Mass., U. S. A., "Improvements in the use and application of fuel and of chemical reagents to eliminate its impurities, or those of the substances it is to heat."—Petition recorded May 26, 1866.

1495. G. Haseltine, Southampton Buildings, Chancery Lane, "An improved composition for removing incrustations, and preventing the formation of the same in steam-boilers."—A communication from J. J. Lavo and P. M. Chouteau, St. Louis, Miss., U. S. A.—May 29, 1866.

1439. J. Hinks and J. Hinks, Birmingham, "Improvements in lamps for burning petroleum, oil, and other volatile liquid hydrocarbons."—May 22, 1866.

1469. G. F. Göransson, Gefle, Sweden, "Improvements in blast furnaces and in the manufacture of iron therefrom."—May 25, 1866.

Notices to Proceed.

322. W. B. Nation, Hatcham, Surrey, "Improvements in the purification and hardening of paraffin wax."—Petition recorded February 1, 1866.

332. H. Larkin, Leighton Road, N.W., and R. Purkis, Cheam, Surrey, "Improvements in the manufacture of paper by the employment of a fibre not hitherto used in this manufacture."—February 2, 1866.

397. C. A. McEvoy, Bedford Square, Middlesex, "Improvements in torpedoes or submarine explosive instruments."—February 7, 1866.

729. R. Larkin, Old Brompton Road, Middlesex, "Improvements in means or apparatus for obtaining light by the combustion of magnesium."—March 9, 1866.

1297. A. Pocheron, Passages des Petites Ecuries, Paris, "Improvements in the manufacture of glass."—May 7, 1866.

1381. W. De La Rue, Bunhill Row, and H. Muller, Gower Street, Middlesex, "Improvements in treating residues of pyrites, usually called burned ores."—May 15, 1866.

1518. G. T. Bousfield, Brixton, Surrey, "Improvements in tanning hides and skins and in currying leather."—A communication from Mr. W. Page, Franklin, New Hampshire, U.S.A.—May 31, 1866.

CORRESPONDENCE.

Dr. Muspratt's Chalybeate, &c.

To the Editor of the Chemical News.

Sir,—Since I discovered last July the *chloride of iron* in the spa, now called "Dr. Muspratt's Chalybeate,[*] or the Chloride of Iron Spring," I have paid a great deal of attention to the waters of Harrogate and *the vicinity*. Some weeks ago I had occasion to test the water from the saline chalybeate (Kissingen) in the Montpellier Gardens. Mr. West, F.R.S. (of Leeds), when analysing this water in 1840, tabulated in his results that it contained twenty *grains of sulphate of soda* in the gallon! On referring to my friend Dr. Hofmann's analysis made in 1854, he gives *no sulphates in the spring*. Mr. West gave six grains of carbonate of soda in the Kissingen water; Dr. Hofmann, *not any of this salt*. The water does not exhibit *a trace of sulphate*, but in its stead a comparatively large quantity of baryta, as well in solution, after precipitation by boiling (chloride of barium), as in the deposit produced on ebullition (carbonate of baryta, strontia, &c.). It gives a very faint indication of *iron* in the hot filtrate, which is singular, as the reaction of the water is *alkaline*. The presence of barytic and other salts in some of the waters of Harrogate may now be accounted for from the fact that at Pateley Bridge (ten or eleven miles from Harrogate) there is ore (carbonate of baryta, eviscerating lead, &c.), which is worked by the Yorkshire Mining Company. I am engaged with several

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[*] Dr. Kennion first proposed this name, which was seconded by Dr. Herapath; and in the Chemical News of last July the editor kindly remarked, "A name we consider appropriate."

of the waters from the most important springs, and shall later on forward you full analyses. Before closing this letter, I may state a fact which may prove interesting, especially to your Medical readers, that Dr. Kennion has found the *chloride of iron* most efficacious "in cases of fatty degeneration of the heart." I am, &c.,

SHERIDAN MUSPRATT, M.D.

College of Chemistry, June 14, 1866.

Solubility of Gold in Alkaline Sulphides.

To the Editor of the CHEMICAL NEWS.

SIR,—On looking into an old work on chemistry by "Macquer," published more than a century ago, I met with the following, which I think may interest your readers. I am, &c. ALFRED BIRD.

Birmingham, June 13.

"To Dissolve Gold by Liver of Sulphur.—Mix together equal parts of common brimstone and a very strong alkali,—for instance, nitre fixed by charcoal. Put them in a crucible and melt the mixture, stirring it from time to time with a small rod.

"There is no occasion to make the fire very brisk, because the sulphur facilitates the fusion of the fixed alkali. Some sulphurous vapours will rise from the crucible, the two substances will mix intimately together, and form a reddish compound.

"Then throw into the crucible some little pieces of gold, beat into thin plates, so that the whole do not exceed in weight one third part of the liver of sulphur. Raise the fire a little. As soon as the liver of sulphur is perfectly melted, it will begin to dissolve the gold with ebullition, and will even emit some flashes of fire.

"In the space of a few minutes the gold will be entirely dissolved—especially if it was cut and flatted into small thin leaves.

"The process here delivered is taken from M. Stahl. The design of that ingenious chemist's inquiry was to discover *how Moses could burn the golden calf*, which the Israelites had set up and worshipped, while he was on the Mount; how he could afterwards *reduce the calf to powder*, throw it into the water which the people used, and make all who had apostatised drink thereof, as related in the Book of Exodus.

"'M. Stahl,' having first observed that gold is absolutely unalterable and indestructible by the force of fire alone, be it ever so violent, concludes that without a miracle Moses could not perform the above-mentioned operations on the golden calf, any way but by mixing some matter qualified to dissolve it. He then takes notice that pure sulphur does not act upon gold at all, and that many other substances which are thought capable of dividing or dissolving it, cannot, however, do it so completely as is necessary to render that metal susceptible of the effects related. He then gives the method of dissolving it by liver of sulphur, described in the process.

"Liver of sulphur dissolves likewise all other metals, but 'M. Stahl' observes that it attenuates gold more than any other metallic substance, and unites much more intimately than with the rest. This appears from what happens on attempting to dissolve in water any of the mixtures resulting from the union of another metal with the liver of sulphur, for then the metal separates, and appears in the form of a powder or a fine calx; whereas when gold is united with the liver of sulphur the whole compound dissolves in water so perfectly that *the gold even passes with the liver of sulphur through the pores of filtering paper*. If an acid be poured into a solution of this combination of gold and liver of sulphur, the acid unites with the alkali of the 'hepar,' and the gold falls to the bottom of the liquor along with the sulphur, which doth not quit it. The sulphur thus precipitated with the gold is easily carried off by a slight torrefaction, after which the gold remains exceedingly comminuted.

"The sulphur of this compound may also be destroyed by torrefaction without the trouble of a previous solution and precipitation, and then also the gold remains so attenuated as to be miscible with liquors, and floats on them, or swims in them in such a manner that it may easily be swallowed with them in drinking.

"From all this 'M. Stahl' concludes there is great reason to believe it was by means of the liver of sulphur that Moses divided and in a manner '*calcined*' the golden calf, so that he could mingle it with water and make the Israelites drink it."

MISCELLANEOUS.

Albert Gold Medal of the Society of Arts.—The Council of the Society of Arts have this year awarded this medal to Professor Faraday "for his discoveries in electricity, magnetism, and chemistry, which in their application to the industries of the world have so largely promoted arts, manufactures, and commerce." The health of Professor Faraday not admitting of his attendance at a public meeting, Mr. Hawes, Vice-President of the Society and chairman of the Council, accompanied by Sir Thomas Phillips, Vice-President of the Society, and Mr. Le Neve Foster, the Secretary, waited upon the Professor at his residence on Saturday last and presented him with the medal.

Sodium at Sea.—We extract the following from an American paper, the *Boston Commercial*:—"We understand that the ship *S. T. Joseph*, recently arrived here from Liverpool, had a narrow escape on the passage. It seems, as the matter is reported to us, that among the cargo was a box marked sodium, which was placed on deck, with instructions to the effect that if there was any trouble with it from getting wet or otherwise, to throw it overboard. Soon after getting out to sea the captain took a dislike to this box, supposing it might be something of the nature of lime, and possibly might set the ship on fire. So he ordered a couple of old salts to pick it up carefully, and throw it over the stern. Instantly on its striking the water a terrific explosion occurred, and an immense column of water was thrown up, filling all hands who witnessed it with consternation and amazement."

Test for Gilt Articles.—To ascertain when an article is gilt or made of a gold-coloured alloy, Weber makes use of a solution of bichloride of copper, which makes a brown spot on an alloy, but produces no effect on a surface of gold.

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. XII. 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., II., and VII. are out of print. All the others are kept in stock. Vol. XIII. commenced on January 5, 1866, and will be complete in 26 numbers.

Nitroglycerine.—The agent of Mr. Nöbel in London is Mr. C. F. Cusel, 64, Wood Street, E.C.

Received.—A Constant Subscriber and O. H. B. L. Both shall receive an answer next week. A Student shall appear next week,

Books Received.—Problems from Williamson's Chemistry.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

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

PART II.

THEORY OF TYPES AND ATOMICITY.

SECTION IV.—*Atomicity of the Elements.*

(Continued from page 291.)

In this way there would be no doubt about the atomicity of iron in the ferric compounds, since we know, by the classic experiments of MM. Deville and Troost, that two volumes of this chloride contain six volumes of chlorine. Therefore, one molecule of ferric chloride contains six atoms of chlorine, and the smallest quantity of iron that exists in the ferric chloride, and, generally, in any ferric compound is represented by 112. Iron, then, seems to be hexatomic in the ferric compounds, or rather, ferricum seems to be hexatomic. This conclusion, which results from the density of the vapour of ferric chloride, is strengthened by considerations arising from the chemical constitution of certain ferric compounds, and the beautiful researches of M. Scheurer-Kestner have, on this point, led to very significant results.[*]

Among other compounds, this chemist described some acetonitrates of iron belonging to the type—

$$\left.\begin{matrix}H_6\\H_6\end{matrix}\right\}Θ_6$$

and in which, H_6 being replaced by ferricum, a single atom of hydrogen is replaced by nitrous gas, an evident proof that the molecules of these compounds cannot present a complication less than that expressed by the following formulæ:—

$$\left.\begin{matrix}H_6\\H_6\end{matrix}\right\}Θ_6 \qquad \left.\begin{matrix}\overset{vi.}{Ffe}\\H_6\end{matrix}\right\}Θ_6$$

Type. Normal ferric hydrate.

$$\left.\begin{matrix}\overset{vi.}{Ffe}\\4(Ꞓ_2H_3Θ)'\\(NΘ_2)'\\H\end{matrix}\right\}Θ_6+4H_2Θ \qquad \left.\begin{matrix}\overset{vi.}{Ffe}\\3(Ꞓ_2H_3Θ)'\\(NΘ_2)'\\H_2\end{matrix}\right\}Θ_6+2H_2Θ.$$

Tetracetonitrate of iron. Triacetonitrate of iron.

The sign Ffe represents in these formulæ 112 of iron, or, if preferred, an atom of ferricum, an atom of ferrosum (= 56) being represented by the symbol—

$$Ꞙe.$$

Ferricum, then, is formed by the union of two atoms of ferrosum, and in the preceding formulæ we may replace the sign—

$$\overset{vi.}{Fe} \quad \text{by the sign} \quad \overset{vi.}{Ꞙe_2}.$$

But here there is a difficulty. How can two atoms of diatomic ferrosum form, by uniting, a hexatomic couple

$$Ꞙe_2?$$

M. Friedel has removed this difficulty in a very ingenious manner, by considering each of these atoms, not as diatomic, but as tetratomic.[†] It may be admitted that iron is tetratomic[‡] in pyrites[§]—

$$ꞘeS_2.$$

If, then, we suppose that two atoms of tetratomic iron unite by exchanging an affinity, this couple Fe_2, which has thus lost two affinities, should be hexatomic. It is in this case with iron as with carbon in the compounds containing $Ꞓ_2$, and this ferric chloride may be compared to the perchloride of carbon—

$$\overset{vi.}{Ꞙe_2Cl_6} \qquad \overset{vi.}{Ꞓ_2Cl_6}.$$

Ferric chloride. Chloride of carbon.

As long as these two atoms of iron remain united, they preserve their combining power, which is equal to six units. They preserve it in all the ferric compounds, and, when they are again separated, the ferric combination is thereby destroyed, as an organic combination containing 2 atoms of carbon is destroyed when these 2 atoms are separated from each other. The couple

$$Ꞙe_2$$

is ferricum. It is a true double atom, which acts as a radical in the ferric compounds. It is plain that this idea is fundamentally the same as that above given, and expressed by the symbol Ffe. There is only a difference in the form, in the notation, but this is not unimportant, because, being based upon analogies furnished by organic chemistry,[||] it accounts for the hexatomicity of ferricum.[¶]

It must, however, be admitted that this idea, when applied to aluminium, becomes slightly arbitrary, since we are forced to admit in the aluminic compounds, which are isomorphous with the ferric compounds, the couple $\overset{vi.}{Al_2} = 54$, which would be formed of 2 atoms of tetratomic aluminium. Now we know of no compound of aluminium corresponding either to pyrites or to the ferrous compounds; but since this is merely a question of notation, we may disregard it. The fundamental part is ascertained. The quantity of iron that exists in a molecule of any ferric compound is never less than 112; the quantity of aluminium that exists in any aluminic compound is never less than 54. These quantities equal 6 atoms of hydrogen. The densities of the vapour of the chlorides of iron and aluminium are conclusive on this point, and in no case ought iron or aluminium to be considered as triatomic.

If this were so, the chlorides of these metals should contain 3 atoms of chlorine, and we should have—

$$ꞘeCl_3 = 2 \text{ volumes.}$$
$$AlCl_3 = 2 \text{ volumes.}$$

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[*] *Comptes Rendus*, vol. liii., p. 653.

[†] *Bulletin de la Société Chimique*, vol. v. p. 201.

[‡] With the reservations expressed (p. 751), since the tetrachloride, $FeCl_4$, is not known.

[§] See also an article by M. Erlenmeyer, *Zeitschrift fur Chemie und Pharmacie*, vol. v., p. 87 and 129.

[||] Here is one of these analogies; the allyle group $Ꞓ_3H_5$ is monoatomic and triatomic. When two triatomic allyle groups unite, we obtain a tetratomic group. Free allyle combines with 4 atoms of bromine,

$$\left.\begin{matrix}(Ꞓ_3H_5)'''\\Br_3\end{matrix}\right\} \qquad \begin{bmatrix}Ꞓ_3H_5\\Ꞓ_3H_5\end{bmatrix} \qquad \begin{bmatrix}Ꞓ_3H_5\\Ꞓ_3H_5\end{bmatrix}Br_4$$

Tribromide of allyle. Allyle. Tetrabromide of diallyle.

[¶] There are several ways of regarding the radical of the ferric combinations. Gerhardt admitted 2 equivalents for iron, represented by 28 and $\frac{2 \times 28.}{3}$ He represented these two equivalents by the signs Fe and fe, and the corresponding oxides by the formulæ $Fe_2Θ$ and $fe_2Θ$. This idea is perfectly correct, and applicable to the construction of equivalent formulæ.

But if we examine the quantity of iron which exists in a molecule of a ferric compound, we find that this quantity is equal to 112, and we can now admit one of two things—either this matter represents a particular aggregation of the matter of iron, *one* hexatomic atom; or else it represents *two* atoms of tetratomic iron. In this second hypothesis iron possesses in all its combinations only one atomic weight = 56, which coincides with that deduced from the specific heat. But the substitution value of the atom of iron may change; it is sometimes diatomic and sometimes tetratomic, and we can name as ferricum a couple of two atoms of tetratomic iron. Such a couple acts as a hexatomic radical. I have adopted this hypothesis, which seems the simplest. I will, however, mention one very remarkable fact, which seems to prove that such couples sometimes act as true atoms. H. Rose has proved that the combinations of hyponiobium which contain 2 atoms of niobium, $\overset{vi.}{Nb_2}$, cannot be directly transformed into combinations of niobium, which circumstance has led him to admit that these two sorts of compounds contain two radicals which differ from each other in their allotropic state.

While we know that these formulæ ought to be doubled.

These considerations may be applied to *cuprosum* and to *mercurosum*. In the cuprous and mercurous salts two atoms of diatomic copper or mercury are joined together. As each of them loses an affinity by uniting with its neighbour, it follows that the couples—

$$\text{Ꞓu}_2 \quad \text{Ħg}_2.$$

are diatomic. The cuprous and mercurous chlorides are then represented by the formulæ—

$$\text{Ꞓu}_2\text{Cl}_2 \text{ and } \text{Ħg}_2\text{Cl}_2.$$

In truth the latter would seem to be invalidated by the density of the vapour of calomel, which is only half the theoretical density deduced from the formula $\text{Ħg}_2\text{Cl}_2$. But we may reasonably suppose that this is a case of dissociation; for we know how readily the mercurous compounds resolve themselves into mercury and mercuric compounds.[**]

It must be added that the formula $\text{Ꞓu}_2\text{Ꞩ}$ of cuprous sulphide harmonises with the well-known fact of the isomorphism of this sulphide with sulphide of silver—

$$\text{Ag}_2\text{Ꞩ}.$$

Such are the considerations which we would offer upon the atomicity of the elements. It is a theory of yesterday, whose consequences are daily being developed. And yet the fundamental idea on which this theory is based is as ancient as the atomic theory itself; it is the law of multiple proportions. It rests upon this fact, that the combining power of one element for another is exhausted by degrees until it reaches a maximum which it does not exceed.

But it is far from this scarcely defined idea to the general theory of saturation, so important on account of the consequences which flow from it concerning the molecular constitution of bodies. We must also remark that the old statement of the law of multiple proportions did not always give the true molecular formulæ. I will give an instance of this in conclusion.

Let us take the best known example, and represent, according to Berzelius, the composition of the compounds of oxygen and nitrogen. We have the following series:—

N_2O = 2 vol. protoxide of nitrogen
N_2O_2 = 4 vol. binoxide of nitrogen
N_2O_3 = ,, nitrous acid
N_2O_4 = ,, hyponitric acid
N_2O_5 = ,, nitric acid.

These formulæ show well that the combining power or the affinity of the nitrogen for the oxygen is exhausted by degrees. But they do not represent quantities which are comparable; they give inexact ideas about the relative sizes of the molecules. The true molecular formulæ of the compounds of oxygen and nitrogen are the following, which are referred to the same volume:—

$N_2\Theta$ = 2 vol. protoxide of nitrogen
$N\Theta$ = ,, binoxide of nitrogen
$N_2\Theta_3$ = ,, nitrous acid
$N\Theta_2$ = ,, hyponitric acid
$N_2\Theta_5$ = ,, anhydrous nitric acid.

In this series the molecular complication of the different compounds is in accordance with their density. The protoxide, denser than the binoxide, shows a greater molecular complication. And this fact harmonises with other physical properties of the two gases. The former is condensable, the latter is permanent; which circumstance it would be difficult to explain if the binoxide were a gas of greater molecular complication than the protoxide.

Note on the Existence of Lithium, Barium, and Strontium in the Medicinal Springs of Harrogate, by R. H. Davis, *Pharmaceutical Chemist.*

The discovery of chloride of barium in a saline ferruginous water at Harrogate last November, by Dr. W. A. Miller, suggested to me the desirability of testing the remainder of the numerous waters in this locality, both sulphurous and ferruginous, to ascertain if this new constituent had made its appearance in any of the others.

I have submitted the residues of above thirty of the medicinal springs of Harrogate to spectrum analysis, and the results of this investigation are more important than were at first anticipated; they all, without exception, show the presence of lithium in the waters, strontium is present in the majority, and barium exists in a great many.

The revelations made by the spectroscope were followed by gravimetric determinations of the baryta and strontia in the principal springs, with the following results in grains, calculated for an imperial gallon of each of the waters:—

	Baryta Carbonate.	Strontia Carbonate.	Lime Sulphate.	1854[*] Lime Sulphate.
Old Sulphur Well . .	6·075	3·242	,,	·182
Montpellier Strong Sulphur Well	7·135	2·499	,,	·594
Montpellier Mild Sulphur Well.[†]	6·075	2·559	,,	12·104
Hospital Strong Sulphur Spring		trace	4·696	51·660
Hospital Mild Sulphur or Magnesia Well . .	3·541	trace	,,	1·215
Starbeck Sulphur Spa .	3·940	trace	,,	·870
Montpellier Saline Chalybeate or Kissingen Spring	7·657	2·815	,,	,,

The above determinations were made upon 0·1 gallon of each of the waters, and the mean of two or more determinations is given. The method adopted was by evaporating the water nearly to dryness, adding sulphuric acid in sufficient quantity to convert the salts into sulphates, igniting, dissolving out the soluble salts, and treating the insoluble residue as directed by Fresenius for separating the sulphates of baryta, strontia, and lime.

The following experiments tend to show that the baryta and strontia exist as carbonates in the waters:—

The deposit on the basins of the wells, after being thoroughly washed, gave very distinct spectra of barium and calcium, but only faint of strontium.

A portion of sulphur water allowed to stand for some time until it became turbid, was filtered; the precipitate, after being thoroughly washed, gave distinct spectra of barium and calcium.

A portion of sulphur water was boiled for some time; the precipitate collected and washed gave distinct spectra of barium, strontium, and calcium.

The saline chalybeate water treated in a similar manner gave corresponding results.

[**] The density of the vapour of calomel=8·35. It leads to the formula—

$$\text{Ħg}\text{Cl}.$$

The density of the vapour calculated according to the formula—

$$\text{Ħg}_2\text{Cl}_2 = 16·308.$$

[*] This column gives the sulphate lime found by Professor Hofmann in 1854, proving at that date the absence of baryta, as the presence of baryta now proves the absence of sulphates.

[†] The quantity of saline constituents in this water has greatly increased since 1854, probably occasioned by percolations from an adjoining strong sulphur spring.

The lithium will exist as chloride; it was found completely removeable by alcohol from the residues of the waters.

The presence of baryta and strontia in these springs is a matter of surprise, as there is undoubted evidence that baryta was not a constituent twelve years since, and strontia, if at all, the merest trace.

In 1854 most careful and elaborate analyses were made by Professor Hofmann of ten of the principal medicinal waters of Harrogate; almost all contained sulphate of lime in varying proportions, as given in the above table. From the presence of sulphate lime the absence of baryta will at once be inferred; but there is also direct proof, inasmuch as a special experiment was made with the saline residue of the old sulphur well water to note if there was an appreciable quantity of sulphate strontia in solution, but without success;[‡] had baryta been present, the search for strontia would of course have revealed it.

When these new constituents first made their appearance in the waters, it is impossible to say. They were certainly present eighteen months since; this I have been able to verify with saline residues of these waters prepared at that time, and which have been kept sealed up until examined for the above purpose.

From whence the springs derive these new constituents the following may, perhaps, help to explain:—

The double carbonate of baryta and strontia is found extensively associated with the ore in the lead mines at Pateley Bridge, some ten or twelve miles from Harrogate, in a westerly direction. As the strata dip east from thence there is a strong probability that this double carbonate approaches much nearer Harrogate, though at a very great depth. Their former absence may have been occasioned by their precipitation in the earth by sulphate lime carried down by the rain, and their recent presence may be the consequence of diminished percolation of surface water occasioned by deficiency of rainfall or more systematic drainage of the land. The great diminution of sulphate lime in the Hospital Strong Sulphur Spring since 1854 is in accordance with this theory.

As several of the principal German Springs, including Ems, Seltzers, etc., contain baryta, no apprehension need be entertained that the discovery of it in the medicinal waters of Harrogate will be at all prejudicial to their reputation, or in any way diminish their efficacy.

Harrogate, June 9.

[It is due to the author of the above paper to say that it was received at our office more than a month ago, but its publication has been unavoidably delayed until now.—Ed. C. N.]

TECHNICAL CHEMISTRY.

On the Application of Disinfectants in Arresting the Spread of the Cattle Plague—Report to Her Majesty's Commissioners, by William Crookes, *F.R.S.*

(Continued from page 293.)

Conclusion.

97. In concluding the report of my experiments, I cannot avoid expressing regret that they are not more complete. Had more time been at my disposal, I hoped to have been able to settle certain important questions, relating to the laws of infection, which are necessarily only imperfectly treated in this report.

Experiments of this kind necessarily occupy much time. Weeks have been spent in the fruitless endeavour to find appropriate spots, where satisfactory experiments could be performed; and when all has been arranged, longer time has elapsed before any result could be established, during which period the experiments required unremitting watchfulness, to guard against the manifold sources of error.

98. Were time and opportunity allowed me for prosecuting these researches, I would point out the following experiments, as being likely to yield valuable results—

a. Continue the examination of the action of carbolic and cresylic acids on insects, animalcules, and microscopic animal and vegetable organisms, and extend it to xylic acid and other powerful antiseptics of this class, such as eugenic acid, methyl-oxy-phenic, and methyl-oxy-cresylic acids, &c. (36. 39. 40.).

b. Try various methods of readily disinfecting sheds, cattle trucks, &c. It is probable that the liquid pulverisers, as used for the inhalation of medicated liquids, would rapidly diffuse carbolic acid, pure or in solution, wherever its action was needed. The employment of this instrument will also give the means of employing non-volatile disinfectants, such as permanganate of potash, perchloride of iron, and other metallic salts, for purposes of atmospheric disinfection.

c. Examine the atmosphere from different parts of infected sheds, with standard solutions of permanganate of potash, and estimate quantitatively the organic matter therein contained (57. *d.*).

d. Draw infected air through gun cotton, and afterwards dissolve the latter in ether, or other appropriate solvent, and examine the residue under the microscope (57. *b.* 86.).

e. Collect the exhaled breath from diseased animals and cause healthy animals to breathe it. (This experiment must be carefully arranged, so as to avoid communicating infection by other means than through the lungs.)

f. Draw infected air from sheds, and the breath of diseased animals, through spiral glass tubes, artificially cooled with ice, or by Krohne and Sesemann's ether spray apparatus, as used for local anæsthesia. Examine the condensed liquid chemically and microscopically (57. *c.*).

g. With the condensed liquid obtained in the last experiment, inoculate healthy animals, both before and after mixing with it carbolic acid or other antiseptics.

h. With the liquid collected from the eyes and nostrils of diseased animals, inoculate healthy animals, both before and after mixing with it various quantities of carbolic acid or other antiseptics (42.).

i. Inoculate healthy animals with infected cotton wool, obtained as in experiment *d.* Repeat this, after exposing the infected wool to the vapour of various antiseptics (43. 57. *b.*)

j. Try if the infection is produced through the stomach by adding to the food infected liquids.

k. Try if the infectious matter is on the skin, by washing a portion of it, and inoculating a healthy beast with the liquid.

l. Condense the volatile matter of the fæces of diseased animals, and try if the infection is present in it.

m. Examine the gas which collects under the skin in cases of emphysema, chemically, microscopically,

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[‡] "Report on the Medicinal Waters of Harrogate," by A. W. Hofmann, F.R.S., p. 10, reprinted in the *Pharmaceutical Journal*, vol. 14, page 77.

and in relation to its power of communicating infection.

n. Continue the experiments on injecting antiseptics into the blood of diseased animals (77. to 96.). In this manner, try the action of sulphites, bisulphites, hypophosphites, and the substances mentioned in experiment *a.* The injections can be repeated several times on the same animal, by tying in the vein a tube furnished with a stopcock.

o. Repeat, several times, the experiment of placing together in the same shed a healthy and a plague-stricken animal, and endeavour by any method which promises best to save the diseased animal from death, and avert the pestilence from the healthy one. Previous experiments (56. 65.) show that the favourable solution of this problem is far from unlikely.

p. Try the preventive and curative effect, once or oftener in twenty-four hours, of submitting the animal for a certain time in a small chamber filled with strong disinfecting or antiseptic vapour, so that the whole current of the blood and substance of the tissues may be speedily and strongly impregnated with it (46.).

q. Repeat some or all of the foregoing experiments on sheep; and try any fresh experiments which may be suggested in the course of the inquiry.

Experiments *g*, *h*, and *i* will show beyond a doubt whether the virus of cattle plague is destroyed by carbolic acid. Valuable information would be gained by occasionally pushing the experiments *n* and *p* to a fatal issue. It is probable that the carcase of a diseased beast, killed by either of these experiments, will be found to be efficiently disinfected; and should this prove to be the case, the administration of a fatal dose of disinfectant will usefully replace the poleaxe.

99. In dealing with the cattle plague it is possible to try testing experiments of a nature wholly inadmissible where human beings are concerned; and thus it is feasible to suppose that from the lessons derived from this pestilence we might obtain insight into means of preventing, or even curing, zymotic diseases. Thus the theoretical views, the experiments, and results recorded in the preceding pages, possess an interest beyond the immediate sphere of cattle plague. They point forcibly to the possible prevention and cure of all zymotic diseases which attack the human race, and thus possess a far wider and more momentous significance than if they related only to cattle. Every argument brought forward, every experiment detailed, and every result obtained in the course of this investigation, apply with overwhelming force to such visitations as typhus and typhoid fever, small-pox, diphtheria, and to that terrible scourge which for some time past has been threatening our shores.

100. The free use of the disinfecting agents here pointed out might not only save the country from the ravages of this pestilence, but it would ameliorate the physical condition of the people. Although foul sewage and putrefying animal matter are probably insufficient to generate the first septic germ of zymotic disease, there can be no question that when such diseases do attack a population they spread with the greatest virulence wherever such putrescent materials abound. Highly important results might be expected to follow the general use of antiseptics, whether applied to farm buildings, where large quantities of manure are produced, or to sewage, whatever its destination,—whether allowed to fester in cesspools, pollute our rivers, or return to the soil. In tracts of land to which sewage, disinfected with carbolic acid, has been applied, the sheep are free from foot-rot, the potatoes from disease. Obnoxious insects, such as turnip-fly, gnats, and dung-flies, are absent; and grubs, larvæ, and the lower forms of animal life, and infusoria (the invariable accompaniments of putrefying matter) disappear; whilst vegetation becomes remarkably healthy and luxuriant. It is also highly probable that those imperceptible, but injurious emanations from the soil, known as malaria, would be destroyed, for Dr. Angus Smith* has conclusively proved that the putrefactive decomposition in soils, which produces malaria, does not take place in presence of very minute quantities of carbolic acid; and Dr. M'Culloch has shown that the unhealthiness of many parts of England may be traced to such exhalations. It therefore may be expected that, by extending the sphere of operation of these preventive appliances, we may not only diminish the loss of much valuable property and much sustenance of the people, but even diminish the risk and extend the term of the natural life of man.

April 25, 1866. WILLIAM CROOKES.

NOTICES OF BOOKS.

Bulletin Mensuel de la Société Chimique de Paris, &c. May, 1866.

THE proceedings of the Chemical Society of Paris offer one or two papers of interest. M. Wyrouboff on April 20 gave a detailed account of his *Researches on the Colouration of Fluor Spar*, which he attributes in all cases to organic matter. The author has been led to the following conclusions:—1. That fluor spar is of aqueous origin. 2. That the colouring matters are carbides of hydrogen, probably derived from bituminous limestones, which by decomposition furnished part of the materials of the spar. 3. That the odour of the Welsendorff spar, said by Schrötter to depend on ozone, and by Schönbein and Meissner on antozone, is really owing to the presence of a hydrocarbon in the fissures of the stone. And, lastly (4), that the phosphorescence remarked in some spars results from the decomposition of the colouring matter. A few extracts from this paper, giving the author's methods of examination, will no doubt be of interest to our readers.

M. Weltzien communicated the second part of his memoir *On Peroxide of Hydrogen and Ozone and Antozone.* The author does not believe in antozone, and takes the old view of the constitution of peroxide of hydrogen. Ozone, he takes it to be proved, is simply condensed oxygen.

The marc resulting from the manufacture of cider has been submitted to dry distillation, and M. Tissandier has examined the products obtained. These consisted of a gas of good illuminating power, and of course a tar. The gas was found to be composed of olefiant gas, with small amounts of acetylene, vapour of benzole, and traces of carbonic oxide. The water contained empyreumatic matters and a little acetic acid. From the tar the author obtained benzole, carbolic acid, creosote, paraffin oil, and paraffin. By the action of nitric acid on the tar he procured a new yellow colouring matter of great strength and beauty, which it seems has been introduced into commerce under the name *Mandarin Yellow.* We shall return to the account of this dye in our next volume. The remaining papers call for no notice.

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* "On the Production and Prevention of Malaria." By Dr. R. Angus Smith, F.R.S.—Memoirs of the Literary and Philosophical Society of Manchester, vol. i., 1861.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

1014. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the apparatus for the treatment of certain fatty and oily substances in order to obtain products therefrom."—A communication from H. E. Renner, Paris. —Petition recorded April 9, 1866.

1445. E. Gripper, Southwark, "Improvements in the treatment of grains from brewers, distillers, and vinegar makers, rendering them more suitable for the food of cattle, and for brewers' purposes as a substitute for patent malt, and also in treating the wort or liquor extracted from the said grains in order to convert it into spirits or liquids suitable for manufacturing purposes."—May 23, 1866.

1468. E. Büchner, Frankfort-on-the-Maine, Germany, "Improvements in the manufacture of gas."—May 25, 1866.

Invention Protected by the Deposit of a Complete Specification.

1649. G. T. Bousfield, Loughborough Park, Brixton, Surrey, "An improved process of utilising waste vulcanised india-rubber, and manufacturing hard rubber therefrom."—A communication from C. McBurney, Roxbury, Mass., U.S.A.—Recorded June 19, 1866.

Notices to Proceed.

402. R. W. Armstrong, Belleck, Fermanagh, "Improvements in preparing clay, dust, and similar materials for making earthen and other ware, and in machinery for moulding hollow articles in earth, clay, and other like materials."—Petition recorded February 9, 1866.

468. J. Barlow, Bolton, Lancashire, "Improvements in bleaching, dyeing, printing, and sizing cotton and other yarns or threads."

471. J. Soames and J. K. Soames, Greenwich, Kent, "Improvements in purifying paraffin."—Feb. 14, 1866.

478. J. Young, Limefield, Mid Lothian, "Improvements in distilling coal shales and other substances."

484. P. Ward, St. George's, Bristol, "Improvements in preparing materials for preventing and removing incrustation in steam boilers for lubricating machinery, and for scouring cloth and other substances."—Feb. 15, 1866.

490. E. Dreveton, Queen Street, London, "Improvements in preparing champagne and sparkling wines, and in the apparatus to be employed therein."—Feb. 16, 1866.

1171. S. Sequelin, Deptford, Kent, "Improvements in the purification, clarification, and preparation of animal and vegetable wax, tallow, oils, and other similar waxy and fatty substances."—April 26, 1866.

CORRESPONDENCE.

Nitrogen and Ozone.

To the Editor of the Chemical News.

Sir,—It is a curious and at the same time suggestive fact, that in all cases where any direct combination is known to take place between nitrogen and oxygen, ozone is also present. It is also generally allowed by chemists that the first result of a combination between nitrogen and oxygen, whatever the subsequent decomposition and recomposition may be, is N_2O_3—a compound which, according to Dr. Hofmann, is the perfectly balanced and self-satisfied body of the nitroxygen series. Now, coupling this to the recent discovery of M. Soret, that ozone is a teratomic oxygen, I think that there is some reason for believing that at ordinary temperatures at least nitrogen combines only with ozone.

The equation representing the combination of nitrogen with oxygen, seems to me likewise to point to this conclusion. What is the mode of expressing the formation of N_2O_3 from N and O, that chemists adopting the newer views are obliged to adopt? Why the following complex formula,—

$$(NN)+(NN)+(OO)+(OO)+(OO)=2(N_2O_3).$$

Here, then, we are quite unable to express the formation of one molecule of N_2O_3, but are obliged to make two by bringing together two molecules of nitrogen and three of oxygen. How simply, on the other hand, could the process be represented, if we supposed the nitrogen as only capable of combining with ozone,—

$$(NN)+(OOO)=(N_2O_3).$$

One molecule of nitrogen *plus* one molecule of ozone gives one molecule of N_2O_3.

Should you think this subject not unworthy of the consideration of your readers, I should be glad if you would give this letter a place in your columns.

I am, &c. A Student.

Royal College of Chemistry, June 10.

MISCELLANEOUS.

University of London.—The following are lists of candidates who passed the respective examinations indicated:—D.Sc. Examination, Branch IV.—Charles Graham, University College. Branch V.—Alexander Morrison Thompson, private study; William Marshall Watts, Owens.

University College Prizemen.—Analytical Chemistry, Professor Williamson, F.R.S.—Gold Medal: A. Grey, of London; certificates, 2, F. G. Doney, of Abbeymead; 3, W. W. Houlder, of Norwood.

Chemical Society.—The next meeting of this Society will be held on Thursday, July 5, when the following papers will be read:—Mr. Schorlemmer, "Hydrocarbons in Crude Benzol, &c." Mr. Thorp, "Use of Metallic Copper in Organic Analysis." Dr. Williamson, "Constitution and Representation of Chemical Compounds."

Dr. Odling on Cyanogen.—We have much pleasure in announcing that the next volume of the Chemical News will contain a series of lectures on Cyanogen, by Dr. Odling, forming part of his course on organic chemistry delivered at St. Bartholomew's Hospital.

Telegraph Wires Melted.—A most extraordinary occurrence took place along the line of the Nashville and Decatur Railroad, between Columbia and Pulaski, lately during a thunderstorm. A full mile of the telegraph wires were melted, and divided over that whole distance into small fragments, irregular in shape, and many of them no longer than a buck shot or a small rifle ball. The fragments found along the whole distance would not, if put together consecutively, make more than thirty feet in length. The glass insulators were bursted, and the poles shivered into fragments.—*Scientific American*.

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.

The large space occupied by the Index in this number obliges us to defer the completion of Dr. Letheby's lecture until our next.

A Constant Subscriber.—The agent for Carre's freezing apparatus is Mr. J. R. Sheppard, 106, Leadenhall Street, London, from whom the machines can be obtained.

C. H. B. L.—A galvanised iron vessel into which you could put the vessel containing the milk and surround it either with ice or a freezing mixture. A mixture of equal parts of salt, sal-ammoniac, and nitre would probably be cheapest, but you would require a good deal.

Books Received.—"Companion to the British Pharmacopœia," by Peter Squire, F.L.S., third edition; "Chemical Addenda: being a Brief Exposition of the Salient Features of Modern Chemistry," &c., by the Rev. B. W. Gibsone, M.A., &c.; "Braithwaite's Retrospect of Medicine," Vol. LIII.—January to June, 1866.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Note on By-products in the Preparation of Propylene,

by HENRY BASSETT.

THE reaction between iodide of allyl, mercury, and hydrochloric acid is generally considered to yield nothing but pure propylene, Gerhardt, however, stating that the gas thus obtained contains traces of a compound containing chlorine or iodine, which may be condensed by a freezing mixture.

Having occasion to prepare a quantity of propylene by the process in question, the gas was passed through a bottle containing cold water, when a considerable quantity of liquid was condensed. This was separated, and again treated with mercury and hydrochloric acid till no further action took place, and then washed, dried, and submitted to fractional distillation. It was thus separated into two portions, the larger being heavier than water, almost incombustible, and boiling very constantly at 90°. Determinations of carbon, hydrogen, and iodine were made, the results agreeing closely with the formula C_3H_7I, and the substance is obviously identical with the iodide of propyl obtained by Simpson by the action of hydriodic acid on iodide of allyl.

The other portion was lighter than water, and burned with a very smoky flame tinged with green at the edges. It had a strong ethereal smell, and boiled between 40° and 45°. It contained a large quantity of chlorine, and only a mere trace of iodine, but I was unable to fix its composition by analysis, owing to the accidental loss of my whole product; there can, however, be very little doubt that it is the chloride corresponding to the iodide described above, formed by the direct combination of propylene and hydrochloric acid—chloride of propyl boiling at 40°.

By the action of sodium-amalgam on the iodide, in presence of acetic ether, a small but appreciable quantity of oily mercury compound was formed, whereas Wanklyn's β iodide of hexyl, to which this iodide is probably analogous, was found by Frankland not to produce a trace.

The compound thus formed seems, however, to differ somewhat in properties from the compounds of mercury with the normal alcohol-radicals, as it has a decided tendency to crystallise, and the fine crystalline precipitate formed by addition of iodine to its alcoholic solution is rapidly altered by evaporation, or by the addition of water, a red substance being precipitated, and the liquid acquiring an intolerably pungent smell. The small quantity obtained prevented anything like an examination of its nature, &c., which, however, would possess some interest.

On Peroxide of Hydrogen and Ozone (Second Part),

by M. C. WELTZIEN.*

M. WELTZIEN first notices the commonly-received opinion that peroxide of hydrogen is water containing an atom of oxygen in loose combination, which is easily separated and transferred to oxidisable bodies. According to this view oxygenated water is a powerful oxidiser. The author adds, however, that pure peroxide of hydrogen in aqueous solution does not decompose spontaneously, and is not an oxidising substance in the ordinary sense of the word. Schönbein has proved that phosphorous acid and phosphorus may exist for some time in contact with peroxide of hydrogen. He has also shown that water in contact with phosphorus and air, and therefore containing phosphorous acid, may be boiled for some hours without losing the power of rendering starch blue in the presence of ferrous sulphate. A dilute solution of peroxide of hydrogen may be concentrated by heat, and, according to Schönbein, the peroxide may be distilled with ether. Meissner, however, denies that the peroxide can exist in a state of vapour.

But Weltzien states that the peroxide may be distilled without ether. If, he says, a dilute solution of oxygenated water be placed in a retort with the neck turned up, so as to prevent the projection of any of the liquid into the receiver, and then one half be distilled, the distillate will give the reaction of peroxide of hydrogen with ether and chromic acid.

Schönbein considers oxygenated water as water united with *positive active* oxygen (antozone); Meissner regards it as water *positively* polarised by antozone. M. Lenssen goes further, and asserts that acid solutions of peroxide of hydrogen contain *positive active* oxygen, while alkaline solutions contain *negative active* oxygen. Schönbein and Meissner, too, both often speak of the oxidation of water by antozone.

Water is only decomposed by chlorine at a boiling temperature, or under the influence of light, and then but slowly; its decomposition by ozone has never been observed, and such a decomposition would seem to be paradoxical. Peroxide of hydrogen, however, is easily decomposed by chlorine, bromine, and iodine, as well as by ozone, oxygen being set at liberty.

From a comparison of the action of chlorine and that of ozone on the peroxide of hydrogen, M. Weltzien is convinced—1. That all the oxygen disengaged in these reactions comes from the peroxide of hydrogen—

$$Cl_2 + H_2\Theta_2 = 2HCl + \Theta_2$$
$$\Theta + H_2\Theta_2 = H_2\Theta + \Theta_2.$$

2. That the hydrogen is held with much less force in

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* Abstract from *Bulletin de la Société Chimique, &c.*, May, 1866, p. 322,

the peroxide than in water, and hence the peroxide is an energetic reducing agent.

Starting from this point of view, that in all the reactions the two atoms of oxygen in the peroxide leave the compound together either as a molecule of free oxygen, or to enter into a new combination, we have, in the first instance, a reduction in the strict sense of the word, and in the second also a reduction, notwithstanding that there is found at the same time a combination richer in oxygen.

As illustrations of the first we have—

$$Ag_2[\Theta + H_2]\Theta_2 = Ag_2 + H_2\Theta + \Theta_2$$
$$Ag_2[\Theta_2 + H_2]\Theta_2 = Ag_2\Theta + 2H_2\Theta + 2\Theta_2$$
$$CaCl_2[\Theta_2 + 2H_2]\Theta_2 = CaCl_2 + 2H_2\Theta + 2\Theta_2.$$
$$\left.\begin{array}{l} H_2cr\Theta_3[\Theta + H_2]\Theta_2 \\ H_2ci\Theta_3[\Theta + H_2]\Theta_2 \end{array}\right. + H_2\Theta_2 = H_6Cr\Theta_6 + 2H_2\Theta + 3\Theta_2$$
$$\left.\begin{array}{l} Kmn\Theta_2[\Theta_2 + 2H_2]\Theta_2 \\ Kmn\Theta_2[\Theta_2 + 2H_2]\Theta_2 \end{array}\right\} = 2HK\Theta + H_6Mn\Theta_6 + 4\Theta_2.$$

Thus there are as many molecules of oxygen set free as there are molecules of peroxide of hydrogen required to produce the reaction.

As examples of the second class we have, among others, the following:—

$$H_3As\Theta_2[\Theta + H_2]\Theta_2 = H_3As\Theta_4 + H_2\Theta$$
$$H_3P\Theta_2[\Theta + H_2]\Theta_2 = H_3P\Theta_4 + H_2\Theta.$$

In other cases we have the molecule of peroxide of hydrogen added to the molecule of the body presented to it, whether this is an elementary molecule or a compound molecule formed of atoms of various elements. From this fixation of the peroxide results a hydrate of a metal, of an acid, or a peroxide, according to the nature of the body acted on by the peroxide of hydrogen.

The following are examples:—

Metallic hydrates—$Mg + H_2\Theta_2 = H_2Mg\Theta_2$
$Fe + 3H_2\Theta_2 = H_6Fe\Theta_6.$
$Al + 3H_2\Theta_2 = H_6Al\Theta_6.$
$2Tl_2 + 4H_2\Theta_2 = 2HTl\Theta + H_6Tl\Theta_6.$*

Hydrates of acids—$As_2 + 3H_2O_2 = 2H_3As\Theta_3.$
$S\Theta_2 + 2H_2\Theta_2 = H_2S\Theta_4.$†

(To be continued.)

TECHNICAL CHEMISTRY.

New Method for Extracting Bromine and Iodine from Seaweeds, and of Estimating Iodine by Means of Alkaline Hyposulphites,‡ *by M.* ED. MORIDE.

SODA has long been obtained by burning dried seaweeds in open trenches. But great loss is sustained in this primitive operation; part of the alkaline salts are transformed into sulphuretted products or insoluble silicates. Chlorides of magnesium and iodides of sodium are decomposed, and then hydrochloric acid, iodine, bromides, and chlorides of sodium volatilise.

Many attempts have been made to directly obtain the soluble salts contained in the weeds by means of maceration, both cold and hot; but the transportation of them to the factory was often impracticable, the product of the maceration decolourised with difficulty, and the evaporation of the liquids was expensive.

In England Mr. Edward Stanford has lately submitted the weeds to dry distillation. The results of the operation were empyreumatic oils and carbonaceous residues, from which latter he extracted the salts, and then the bromine and iodine; this method is also a failure,* necessitating, as it does, considerable manual labour, large quantity of material, and difficult transport.

My method avoids all these inconveniences. In fact, I merely carbonise the previously dried weeds in the open air during all weathers, and on the spot where they are collected, using a portable apparatus—a kind of small furnace, which produces a charcoal which I then easily and quickly wash in a displacement apparatus. 100 parts of fresh weed generally represent 20 parts of dry, 7.5 of carbonaceous residue, and 3 of ashes.

As to the quantities of iodine and bromine, they vary according to the kind of plant employed; thus, as proved by M. Gaultier de Claubry, it is the large laminaria which contain most iodine.

The product of the lixiviation is concentrated in vats heated by steam; I then extract the sulphates of potash and the chlorides of sodium and potassium; then, after having added a hypochlorite or some hyponitric acid treat them by benzol in a special apparatus so arranged that the carbide of hydrogen removes the iodine from the liquids to give it to the soda or potash, and then thus regenerated proceed indefinitely.

The mixture of alkaline iodide and iodate is next precipitated by hydrochloric acid, or better still, by chlorinated liquids, residues of the manufacture of bromine, and the iodide obtained is then dried. Finally, the bromine is extracted from the liquids freed from benzol, either by treating by sulphuric acid and peroxide of manganese and distilling, or by directly eliminating it in a liquid state in the liquids concentrated and strongly acidulated.

Estimation of Iodine.—The method by which I propose to estimate iodine is based on two well-known principles: one, the solubility of iodine in benzol or petroleum; the other, the decolouration of iodised solutions by hyposulphite of soda, which, on account of its stability, is preferable to the sulphite, or sulphurous acid recommended by Dupasquier and M. Bunsen.

The operation is as follows:—

First prepare a normal liquid containing, for each litre of water, about forty grammes of hyposulphite of soda, so that fifty cubic centimetres of this solution will completely decolourise one gramme of iodine.

Then take ten cubic centimetres of the iodised liquid to be tested, diluted with water, if it be very concentrated or rich in iodine; then add carefully, after it has been acidulated with hydrochloric acid, some drops of hyponitric acid. When it becomes yellow, shake it with benzol or petroleum, which will immediately turn rose or violet. Separate the iodised benzol from the acid liquid, and repeat the operation until the solvent liquid ceases to become coloured.

Collect the iodised benzol resulting from these treatments, and wash it with distilled water, which will remove all traces of chlorated or bromated compounds without removing any appreciable quantity of iodine. Then, while stirring incessantly, add, by means of a burette, graduated to tenths of cubic centimetres, the normal hyposulphite liquid until all colour is destroyed; each cubic demi-centimetre of the normal liquid will correspond to one centigramme of iodine contained in the liquids assayed.

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* As this oxide does not appear to exist, there is formed—
$H_2Tl\Theta_4$ and $2H_2\Theta$.

† Schönbein regards this action as a case of the reduction of oxygenated water: $HO_2 + SO_2 = HO + SO_3$.

‡ *Comptes Rendus*, vol. lxii., p. 1002.

* M. Moride is mistaken: Mr. Stanford's works, we believe, are in active and profitable operation.

It is always necessary to desulphurise solutions containing sulphides, sulphites, or hyposulphites, by boiling them with nitric, sulphuric, or hydrochloric acid.

To ascertain the purity of commercial iodines, dissolve fifty centigrammes or one gramme, in diluted alcohol, and operate as above.

To ascertain the quantity of iodine in dry or wet sea plants, cut them into small pieces; place them in a porcelain capsule and cover them with alcohol; set fire to the alcohol, carefully stir the mass with a glass rod, and the carbon will be obtained, without loss of iodine; then well wash the latter, and act on the solution as above described.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 21.

Prof. A. W. Williamson, *Ph.D., F.R.S., Vice-President, in the Chair.*

The minutes of the previous meeting were confirmed. Mr. Charles Phillips and Mr. W. F. Flowers were formally admitted Fellows of the Society, and the following gentlemen were duly elected, viz.:—Dr. Arthur Gamgee, University of Edinburgh; Mr. J. H. Lightbown, Corporation Street, Manchester; Mr. Frederick Keating Stock, Darlington; and Mr. Edward Isaacs Sparks, Corpus Christi College, Oxford. For the first time were read the names of Mr. Robert Biggs, Deputy-Coroner, 17, Charles Street, Bath, and Mr. David Page, Galebeck Powder Mills, near Kendal. For the second time were read the names of the following candidates, viz.:—Mr. W. Chandler Roberts, Royal School of Mines; and Mr. Edward P. H. Vaughan, Patent Agent, of Chancery Lane and Primrose Hill.

Dr. F. Crace Calvert offered some interesting observations embodied in a paper by Mr. Johnson and himself, entitled "*On the Action of Acids upon Metals and Alloys.*" The authors have examined the actions of the common mineral acids, especially nitric, sulphuric, and hydrochloric acids, upon the metals zinc, tin, and copper, and upon the most important of their alloys, particularly brass and bronze. The results obtained are of great scientific interest, besides having a practical value in connexion with the applications of these metals in the arts. The most important conclusions established by the authors may be thus stated:—1st. The extent of action of any acid upon an alloy cannot always be predicted from the known effects of the same acid upon the individual metals. 2nd. A variation in the proportion of the constituent metals, no greater even than 10 per cent., will sometimes entirely change the character of an alloy so far as regards its corrosion by or solubility in acids. 3rd. The influence of water in modifying the action of acids upon metals and alloys is in nearly all cases very considerable. Amongst other interesting facts, Dr. Calvert mentioned the following:—Cubes of pure zinc were prepared and submitted to the action of sulphuric acid of various degrees of concentration, *i. e.*, from the monohydrate to a dilute acid containing in all ten atoms of water, for a uniform period of time—two hours—and at various degrees of temperature. With the concentrated acid there was no action in the cold, but when heated to 150° C. the metal slowly dissolved with evolution of sulphurous acid. If the zinc be acted upon with the tetra- or penta-hydrated sulphuric acid, much sulphuretted hydrogen was set free, accompanied by traces of sulphurous acid; and with acids containing seven atoms and upwards of water only hydrogen was evolved. Unless water were present in sufficient amount to dissolve the sulphate of zinc formed, there was, of course, a retardation of the action. The condition of the metallic surface had a marked influence upon the rate of solution. A newly-filed cube of pure zinc, washed with alcohol and dried, was scarcely acted upon by $SO_3, 9HO$ in the cold, whilst a similar cube (centimetre), left exposed to the air for a week and thereby slightly oxidised, dissolved to the extent of 3 grammes in the same acid in two hours. Copper placed in contact with oil of vitriol at 150° C. gave off sulphurous acid only, but in the flask were found, besides sulphate of copper, the sulphide of that metal and free sulphur. The same acid acting upon tin also gave sulphurous acid and free sulphur; and the acids, $SO_3, 4HO$, and $SO_3, 5HO$, dissolved tin with evolution of mixtures of HS and SO_2, without formation of a metallic sulphide. With respect to the action of monohydrated sulphuric acid upon the alloys of copper and zinc the authors found that a brass composed of these metals in the proportion of their atomic weights, or CuZn, dissolved uniformly, giving off sulphurous acid; that when the amount of copper was increased the metal dissolved *faster* than did other alloys containing an excess of zinc. With the terhydrated sulphuric acid the contrary result was observed, although sulphurous acid was in this case also the gaseous product of the reaction. The alloy, CuZn, containing nearly equal parts by weight of copper and zinc, was uniformly dissolved by nitric acid of specific gravity 1·14; but when a more dilute acid was employed, viz., that having specific gravity 1·08, the zinc and copper were dissolved in the proportion of 5:1, by 24 hours' immersion. The action of concentrated hydrochloric acid was somewhat remarkable; the alloy CuZn lost only the zinc, a cube of spongy copper remaining undissolved. With dilute acid, specific gravity 1·05, none of the zinc was dissolved out in the space of an hour, but with the alloys containing four or five atoms of zinc to one of copper nearly all of the zinc entered into solution. Alloys containing more than two atoms of zinc to one of copper were rapidly attacked by dilute nitric acid of specific gravity 1·10, whilst the alloy CuZn was scarcely affected; more copper conferred even a greater degree of protection. With respect to the bronzes, the alloys CuSn and Cu_2Sn were but very slightly attacked by nitric acid, specific gravity 1·25, whilst alloys containing a larger proportion of either constituent were much more rapidly dissolved. The alloys containing copper in excess were protected from the action of concentrated hydrochloric acid, whilst those containing tin in excess dissolved much more rapidly than the individual metals. All alloys of copper and tin were to some extent protected against the action of concentrated sulphuric acid; the behaviour of those containing 10, 15, and 35 per cent. of copper was nearly identical.

Dr. Stevenson made inquiries respecting the anomaly observed in the simultaneous liberation of sulphurous acid and sulphuretted hydrogen from zinc and sulphuric acid; and

Dr. Letheby inquired whether at the point of transition from sulphurous acid to sulphuretted hydrogen any free hydrogen was liberated.

Dr. Calvert said the facts stood thus:—Bihydrated sulphuric acid did not act in the cold upon pure zinc, but that at 130°C. sulphurous acid was freely evolved, accompanied by a little sulphuretted hydrogen. At the temperature of 150°C. a mixture of the gases appeared—lead paper was blackened, whilst the odour indicated sulphurous acid—and when more diluted acids were employed, such as the hydrates containing from 3 to 6 atoms of water, the gas evolved was chiefly sulphuretted hydrogen. He had not ascertained whether any free hydrogen was contained in the evolved gases.

Mr. Warington, jun., said this reaction reminded him of the occasional production of orange sulphide of antimony in the flasks used for the preparation of antimonietted hydrogen, which he had ascertained was due to the too free use of the oil of vitriol bottle.

Dr. Debus then delivered a discourse "*On the Constitu-*

tion of some Carbon Compounds." The lecturer resumed the subject of a communication to the Society which was read in January last. Starting from the ethylic and propylic hydrides, the author proceeded to examine their respective oxygen derivatives, and suggested that the hydrocarbons C_2H_6 and C_3H_8 were made up of certain residues (CH_3 and CH_2) of the marsh gas molecules employed in their preparation, thus—

Methylic hydride (marsh gas) H, CH_3
Ethylic hydride (methyl) . CH_3, CH_3
Propylic hydride . . . CH_3, CH_2, CH_3.

Oxygen may be present in organic compounds, either in the form of the water-residue hydroxyl, $HO = \dot{H}$, or as a substitute for hydrogen; we have, therefore, amongst others—

Alcohol . . . . . $CH_3, CH_2\dot{H}$
Acetic acid . . . . $CH_3, CO\dot{H}$

The whole series of bodies derivable from ethylic hydride and from propylic hydride respectively were shown in two diagrams.

Table 1.

$CH_3, \quad CH_3$ = Ethylic hydride
$CH_3, \quad CH_2\dot{H}$ = Ethylic alcohol
$CH_3, \quad COH$ = Aldehyde
$CH_3, \quad CO\dot{H}$ = Acetic acid
$CH_2\dot{H}, \quad CO\dot{H}$ = Glycollic acid
$COH, \quad CO\dot{H}$ = Glyoxylic acid
$CO\dot{H}, \quad CO\dot{H}$ = Oxalic acid
$CH_2\dot{H}, \quad CH_2\dot{H}$ = Glycol
$COH, \quad COH$ = Glyoxal

Table 2.

$CH_3, \quad CH_2, \quad CH_3$ = Propylic hydride
$CH_3, \quad CH_2, \quad CH_2\dot{H}$ = Propylic alcohol
$CH_3, \quad CH\dot{H}, \quad CH_3$ = Pseudo-propylic alcohol
$CH_3, \quad CH_2, \quad COH$ = Propionic aldehyde
$CH_3, \quad CO, \quad CH_3$ = Acetone
$CH_3, \quad CH_2, \quad CO\dot{H}$ = Propionic acid
$CH_2H, CH_2, \quad CO\dot{H}$ = Lactic acid (α)
$CH_3, \quad CH\dot{H}, \quad CO\dot{H}$ = Lactic acid (β)
$CH_3, \quad CO, \quad CO\dot{H}$ = Pyruvic acid
$CO\dot{H}, \quad CH_2, \quad CO\dot{H}$ = Malonic acid
$CO\dot{H}, \quad CH\dot{H}, \quad CO\dot{H}$ = Tartronic acid
$CO\dot{H}, \quad CO, \quad CO\dot{H}$ = Mesoxalic acid
$CH_3, \quad CH\dot{H}, \quad CH_2\dot{H}$ = Propyl-glycol
$CH_2\dot{H}, CH\dot{H}, CH_2\dot{H}$ = Glycerin
$CH_2\dot{H}, CH\dot{H}, CO\dot{H}$ = Glyceric acid

The author proceeded in the next place to quote a number of examples in order to show that the modes of formation, decompositions, and other chemical properties of the members of both groups were fully accounted for in the integral formulæ proposed; thus from sodium-methyl and carbonic acid we obtain sodic acetate, and from cyanide of methyl, CH_3, CN, in a similar manner, alkaline acetates and ammonia; and, conversely, the acetates furnish marsh gas and, by electro-decomposition, methyl itself. Then, the different groups, $CH_3, CH_2, CH, CO\dot{H}$, &c., impart to the bodies in which they are contained certain specific properties; thus, an organic substance comports itself like acetic aldehyde when it contains the group COH; acid properties may be inferred from the presence of $CO\dot{H}$; and the ketones owe their peculiar properties to the group CO contained in them. The author stated in conclusion that, according to present experience, the water residue $\dot{H}$ cannot occur more than once in combination with the same atom of carbon; thus we have ethylic alcohol, $CH_3, CH_2\dot{H}$, and ethylic glycol, $CH_2\dot{H}, CH_2\dot{H}$, but neither methyl-glycol nor ethyl-glycerin, $CH_2\dot{H}, CH\dot{H}\dot{H}$, is known to chemists, although their preparation has been frequently attempted. It would therefore be possible to draw up a complete list of all the possible oxygen-derivatives of a hydrocarbon of known constitution, and to determine *à priori* the properties of the several compounds. This has been done for propylic hydride, and Dr. Debus finds that *thirty-seven* oxygen-derivatives are theoretically possible, of which 17 only are yet known.

The CHAIRMAN moved a vote of thanks to the respective authors, and announced that it had been decided by the Council to hold one more meeting before adjourning for the vacation. There were still a few papers in hand, and he was himself prepared to lay before the Society a proposal relating to *Chemical Notation*. An extraordinary meeting would therefore be held on Thursday, July 5.

Dr. ODLING read the titles of the papers in question; they were as follows:—"*On the Reduction of the Oxides of Nitrogen by Metallic Copper,*" by Mr. Thorpe. "*Note on Ethyl-hexyl Ether,*" by Mr. Schorlemmer; and, by the same author, "*On the Hydrocarbons in Crude Benzol.*" Dr. Williamson's subject was "*On the Constitution and Representation of Organic Compounds.*" The meeting was then adjourned.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, May 4, 1866.

Sir HENRY HOLLAND, *Bart., M.D., D.C.L., F.R.S., President, in the Chair.*

On Recent Progress in the History of proposed Substitutes for Gunpowder, by Professor F. A. ABEL, *F.R.S., V.P.C.S., Chemist to the War Department.*

THE changes which have been effected in the composition of gunpowder since its first application as a propelling agent, have been limited to small variations in the proportions of its constituents. But the modifications which have from time to time been introduced into the details of its manufacture, *e.g.*, the preparation of the ingredients, their incorporation, and the conversion of the mixture into compact masses (grains, &c.) of different size and density, have been sufficiently important and successful to secure the fulfilment by gunpowder, in a more or less efficient manner, of the very various requirements of military science and of different branches of industry.

The characteristics of gunpowder, as an explosive material of permanent character, the action of which is susceptible of great modification, are mainly ascribable to the peculiar properties of the oxidising agent, saltpetre. Frequent attempts have been made to replace this constituent of gunpowder by other nitrates (such as those of sodium, lead, and barium); but, although materials suitable for blasting operations have been thus prepared (such as soda-gunpowder, and barytic powder, or *poudre saxifragine*), all mixtures of this class, hitherto produced, have exhibited important defects, when compared with gunpowder manufactured for propelling purposes.

The well-known oxidising agent, chlorate of potash, which differs from saltpetre only in containing chlorine in the place of nitrogen, is far more energetic in its action upon oxidisable bodies than any of the nitrates. Thus, a mixture of chlorate of potash with charcoal alone deflagrates as violently as gunpowder, and is far more readily inflamed by percussion than the latter; while a mixture analogous to gunpowder, containing chlorate of potash in place of saltpetre, detonates violently when struck with moderate force, and acts far too destructively, on account of the rapidity of its explosion, to admit of its safe employment in fire-arms.

Many years ago, a mixture known as German or whiet gunpowder, and consisting of chlorate of potash, ferrocyanide of potassium, and sugar, was proposed and tried without success as a substitute for gunpowder; and since then many preparations of similar character have been suggested for employment either as blasting and mining agents, or for use in shells, or even for all the puposes to which gunpowder is applied. The most promising of these, claimed as discoveries by Mr. Horsley and Dr. Ehrhardt, are mixtures of chlorate of potash with substances of permanent character and readily obtained, containing both carbon and hydrogen; such as tannic and gallic acids, and some kinds of resins. These mixtures are much less violently detonating than most of the explosive mixtures containing chlorate of potash, while, if well prepared, they are decidedly more powerful, as explosives, than gunpowder. For blasting purposes, some of these mixtures probably possess decided advantages over ordinary blasting powder, and possibly they may also be susceptible of employment for sporting purposes; but they are not applicable to fire-arms used for war-purposes, because, in order to ensure the requisite uniformity of action, the ingredients must be submitted to proper processes of incorporation, &c., such as are applied to the manufacture of gunpowder; and this treatment would render the mixtures far more violent, and consequently destructive in their action upon fire-arms, than if used in the form of crude mixtures.

A comparatively very safe application of chlorate of potash to the production of a substitute for gunpowder was made about six years ago by a German chemical manufacturer, M. Hochstädter. Unsized (blotting) paper was thoroughly soaked in, and coated with, a thin paste consisting of chlorate of potash, finely-divided charcoal, a small quantity of sulphide of antimony, and a little starch, gum, or some similar binding material, water being used as the solvent and mixing agent. The paper was rolled up very compactly and dried in that form. In this manner, very firm rolls of an explosive material are obtained, which burns with considerable violence in open air, and the propelling effect of which, in small arms, has occasionally been found greater than that of a corresponding charge of rifle powder. Moreover, the material, if submitted in small portions to violent percussion, exhibits but little tendency to detonation. But as no reliance can be placed on a sufficient uniformity of action, in a fire-arm, of these explosive rolls, this alone sufficed to prevent their competing with powder. The same description of explosive preparation, differing only from that of M. Hochstädter in a trifling modification of its composition, which is certainly not likely to lead to its greater success, has recently been brought forward in this country by M. Reichen and Mr. Melland.

One or two other much cruder explosive preparations, containing chlorate of potash, alone or in conjunction with saltpetre, have met with some application to blasting purposes. One of these consisted of spent tan, in small fragments, which was saturated with the oxidising agent, and afterwards dusted over with sulphur. When flame or a red-hot iron is applied to this preparation, it deflagrates very slowly and imperfectly; but when employed in blast-holes, where it is confined within a small space, it developes sufficient explosive force to do good work. In addition to comparative cheapness, the great advantage of safety was claimed for this material by its inventor, a claim which was substantiated by the partial destruction by fire, on two occasions, of a manufactory of the substance near Plymouth, without the occurrence of an explosion.

The accidental explosions of gunpowder which are occasionally heard of, occur, in most instances, at the manufactories, and in the course of some operation (especially that of incorporation) to which the explosive mixture is submitted. The only means of guarding against, or reducing as much as possible, the liability to the occurrence of these accidents, consist in the strictest attention to the precautionary measures and regulations, which experience has proved to be essential to safety, and which, in spite of the strictest supervision, are unquestionably sometimes overlooked or imperfectly carried out by workmen. Explosions of gunpowder, generally of a serious character, do occur, however, though very rarely, during the transport of the material, or in the magazines where it is stored. The great explosion of a gunpowder magazine at Erith in September, 1864, specially directed the attention of Government and the public generally to the necessity of adopting measures for reducing, as much as possible, the risk of occurrence of such disastrous accidents. Hence, much interest has recently been excited by a well-known method of rendering gunpowder less dangerous in its character, which has been brought prominently before the public by Mr. Gale, and which consists of diluting powder, or separating its grains from each other, by means of a finely powdered non-explosive substance. Attempts have several times been made in past years to apply to practical purposes the obvious fact, of which nobody acquainted with the nature of gunpowder could be ignorant, that, by interposing between the grains of powder a sufficient quantity of a finely divided material, which offers great resistance to the transmission of heat, the ignition of separate grains of the entire mass may be accomplished without risk of inflaming contiguous grains. In 1835, Piobert made a series of experiments with the view to apply this fact practically to reduce the explosiveness of gunpowder, and similar experiments of an extensive character were carried on by a Russian chemist, Fadéiff, between 1841 and 1844. These experimenters found that the object in view might be attained by diluting gunpowder with any one of its components; they also employed very fine sand (a substance closely allied in its physical characters to the powdered glass which Mr. Gale now proposes to use); but the preference appears to have been given to a particular form of carbon. It was not attempted altogether to prevent the burning of a mass of gunpowder when a spark or flame reached any portion, but to reduce the rapidity of combustion so greatly as to prevent tho occurrence of a violent explosion. No more than this is accomplished by the employment of powdered glass in the proportions directed by Mr. Gale. Indeed, as the quantity of diluent required to give to different kinds of gunpowder the character of equally slow-burning materials, increases with the explosiveness of the particular powder and with the size of its grain, the proportion of powdered glass with which the gunpowder employed in rifled cannon would have to be mixed to render it only slow-burning, would be about double the quantity required for almost altogether preventing the ignition of fine-grain powder, or of the comparatively weak blasting powder with which Mr. Gale's public experiments appear generally to have been instituted. Although a sufficient dilution of gunpowder may secure such comparative safety to the neighbourhoods of large magazines, or to the crews of merchant-vessels in which gunpowder (for blasting purposes, &c.) is transported, as to compensate fully for the inconvenience attending the great increase of volume of the powder, there is no doubt that such a treatment of gunpowder actually issued for military and naval service would be attended by more than one serious obstacle—such as the tendency of the powder, unless very largely diluted, to separate from the glass, during transport by land or sea, to so considerable an extent as very greatly to diminish the degree of security originally aimed at; the very great addition which would have to be made to the arrangements for carrying the necessary ammunition in active service; the necessity for introducing, in the field or on board ship, the operations of separating the powder from the glass and transferring it to cartridges and shells (which, whatever sifting and other arrangements were adopted, would be time-taking and very dangerous), instead of preserving the ammunition ready for immediate use; and, above all, the incalculable mischief which would inevitably result from the establishment, in the minds of the soldier and sailor, of an erroneous feeling of security in dealing with gunpowder, which, however harmless it may for a time be rendered, must finally be handled by the men in its explosive form. The extremely rare occurrence of accidents with gunpowder, on board ship or in active land-service, is mainly due to the strictest enforcement of precautionary regulations, some of which may appear at first sight exaggerated or almost absurd, but which combine to maintain a consciousness of danger and a consequent vigilance indispensable to safety.

One of the most remarkable materials recently employed to replace gunpowder as a destructive agent is nitro-glycerine. This substance was discovered by Sobrero in 1847, and is produced by adding glycerine in successive small quantities to a mixture of one volume of nitric acid of sp. gr. 1·43, and two volumes of sulphuric acid of sp. gr. 1·83. The acid is cooled artificially during the addition of glycerine, and the mixture is afterwards poured into water, when an amber-coloured oily fluid separates, which is insoluble in water, and possesses no odour, but has a sweet, pungent flavour, and is very poisonous, a minute quantity placed upon the tongue producing violent headache which lasts for several hours.

The liquid has a specific gravity of 1·6, and solidifies at about 5° C. (40° F.); if flame is applied, nitro-glycerine simply burns; and if placed upon paper or metal, and held over a source of heat, it explodes feebly after a short time, burning with a smoky flame. If paper moistened with it be sharply struck, a somewhat violent detonation is produced. Alfred Nobel, a Swedish engineer, was the first to attempt the application of nitro-glycerine as an explosive agent, in 1864.

Some experiments were, in the first instance, made with gunpowder, the grains of which had been saturated with nitro-glycerine. This powder burnt much as usual, but with a brighter flame, in open air. When confined in shells or blast-holes, greater effects were, however, produced with it than with ordinary gunpowder; its destructive action is described as having been from three to six times greater than that of powder. The liquid could not be employed as a blasting agent in the ordinary manner, as the application of flame to it from a common fuze would not cause it to explode. But Mr. Nobel has succeeded, by employing a special description of fuze, in applying the liquid alone as a very powerful destructive agent. The charge of nitro-glycerine having been introduced, in a suitable case, into the blast-hole, a fuze, to the extremity of which is attached a small charge of gunpowder, is fixed immediately over the liquid. The concussion produced by the exploding powder upon ignition of the fuze effects the explosion of the nitro-glycerine.

The destructive action of this material is estimated, by those who have made experiments in Sweden and Germany, as about ten times that of an equal weight of gunpowder. Therefore, although its cost is about seven times that of blasting-powder, its use is stated to be attended with great economy, more especially in hard rocks, a considerable saving being effected by its means in the labour of the miners, and in the time occupied in performing a given amount of work, as much fewer and smaller blast-holes are required than when gunpowder is employed. The material appears to have recently received considerable application in some parts of Germany and in Sweden; but, in England, its employment has been confined to one set of experiments instituted in Cornwall last summer, upon which occasion a wrought-iron block, weighing about three hundredweight, was rent into fragments by the explosion of a charge of less than one ounce of nitro-glycerine placed in a central cavity.

Nitro-glycerine appears, therefore, to possess very important advantages over gunpowder as a blasting and destructive agent, but the attempts to introduce it as a substitute for gunpowder have already been attended by most disastrous results, ascribable in part to some of its properties and the evident instability of the commercial product, but principally to the thoughtlessness of those interested in its application, who appear to have been induced, either by undue confidence in its permanence and comparative safety, or from less excusable motives, to leave the masters of ships, or others who had to deal with the transport of the material, in ignorance of its dangerous character.

The precise causes of the fearful explosions of nitro-glycerine which occurred at Aspinwall and San Francisco will, in all probability, never be ascertained; but they are likely to have been due, at any rate indirectly, to the spontaneous decomposition of the substance, induced or accelerated by the elevated temperature of the atmosphere in those parts of the ships where it was stored. Instances are on record in which the violent rupture of closed vessels containing commercial nitro-glycerine has been occasioned by the accumulation of gases generated by its gradual decomposition; and it is at any rate not improbable that a similar result, favoured by the warmth of the atmosphere, and eventually determined by some accidental agitation of the contents of the package of nitro-glycerine, was the cause of those lamentable accidents. The great difficulties attending the purification of nitro-glycerine upon a practical scale, and the uncertainty, as regards stability, of the material even when purified (leaving out of consideration its very poisonous character and its extreme sensitiveness to explosion by percussion when in the solid form), appear to present insurmountable obstacles to its safe application as a substitute for gunpowder.

(To be continued.)

ACADEMY OF SCIENCES.

June 25.

M. Terreil presented "*An Analysis of a Piece of Rock forming a Part of the New Island of Santorin,*" the composition of which approaches that of soda felspar:—

Silica . . .	68·39	oxygen	36·19	
Alumina . .	15·07	,,	7·04	8·31
Peroxide of iron.	4·26	,,	1·27	
Protoxide of iron	3·83	,,	0·85	3·15
Lime . . .	3·19	,,	0·91	
Magnesia . .	0·70	,,	0·28	
Soda . .	3·86	,,	0·99	
Potash . .	0·73	,,	0·12	
Lithia . .	traces			
Nitrogenised organic matter .	traces			
	100·03			

The traces of lithia were shown by the spectroscope, which revealed no trace of cæsium or rubidium.

M. L. Lartet presented a paper "*On the Deposits of Bitumen in Judea, and on the Asphalte of the Dead Sea.*" Travellers and geologists have been at a loss to account for the origin of the masses of asphalte, sometimes of considerable size, found floating on the water of the Dead Sea. M. Lartet believes in the existence of a series of hot springs which rise through bituminous limestone and bring up the asphalte.

Several papers besides the one mentioned above, on the wonderful volcanic phenomena still in progress around the island of Santorin, were presented; one, by M. da Corogna, related to "*the influence of the volcanic emanations on the health of men and plants.*" It can be easily imagined that a large quantity of ashes and of sulphuretted hydrogen thrown into the air might produce disagreeable effects, and we accordingly find that the population suffer more or less from conjunctivitis, bronchitis, and angina, and that the stomach and brain are somewhat affected. Plants also appear to suffer from the action of hydrochloric acid, but the sulphuretted hydrogen seems to have benefited the vines, which have suffered from the oidium for the last ten years.

Other letters mention the appearance of two new islands on the last days of May, which the German geologists on the spot have named the Isles of May.

A report on M. Fouque's *Researches on the Chemical Phenomena of Volcanoes*, by M. Charles St. Claire Deville, was also presented. We have noticed the principal results of the author's investigations as they appeared, and need not refer to them again here.

There is a vacancy for a corresponding member in the Chemical Section of the Academy, to fill which Dr. Frankland has been selected.

THE BRITISH ASSOCIATION OF GAS MANAGERS.

On the Combustion of Gas for Economic Purposes.

A Lecture delivered by Dr. LETHEBY.

(Continued from page 298.)

THE temperature of different combustibles is shown on the diagram below, and you will notice that the highest temperature produced by the various constituents of coal gas is that of acetylene, or the vapour of benzole when burned in oxygen, the heat of which exceeds 17,000° Fahr.; the lowest temperature of all the constituents is about 12,700° Fahr., the temperature of burning carbonic oxide.

On the same diagram I have tabulated the thermotic power of a great number of substances. It is expressed in the number of pounds of water raised 1° Fahr. by a pound of the substance, and when the body is capable of being converted into gas or vapour, I have also expressed it in the cubic foot at common temperatures and pressures. Hydrogen, you perceive, is the most powerful thermotic agent, and carbonic oxide is the weakest; a pound of the first of these gases will raise 62,030 lbs. of water 1°, whereas a pound of the latter will only heat about 4325 lbs. of water to that extent. Examined by the cubic foot, and considering that for every pound of water raised 1°, about 48 cubic feet of air are raised to the same extent, we may say the chief constituents of coal gas have this thermotic power:—

Pounds of Water and Cubic Feet of Air raised 1° Fahr. by a Cubic Foot of the Gas Burning in Air.

Cubic Foot of		Lbs. Water. raised 1° Fahr.	Cub. Ft. Air raised 1° Fahr.
Hydrogen . .	heats	329 .	. 15,837
Marsh gas . .	,, .	996 .	. 47,946
Olefiant gas . .	,,	1585 .	. 76,299
Propylene . .	,,	2376 .	. 114,378
Butylene . .	,,	3168 .	. 152,502
Acetylene . .	,,	1251 .	. 60,220
Benzole vapour .	,,	3860 .	. 185,814
Carbonic oxide gas	,,	320 .	. 15,403
Common coal gas .	,,	650 .	. 31,290
Cannel coal gas .	,,	760 .	. 36,585

From this we can determine the practical thermotic power of any of these agents. A cubic foot of common gas will heat 65 gallons of water 1°, or 6·5 gallons 10°, or 3·25 gallons 20°; so that a bath containing 250 gallons of water would require about 77 cubic feet of common gas, or 66 of cannel, to raise its temperature from 55° to 75°. In practice, however, this is rarely attained, because of the faulty construction of the heating apparatus. I find, indeed, that a bath in my own house, made by Phillips, of Skinner Street, takes nearly twice this proportion of gas to heat it, and being in a closed room the atmosphere is almost poisoned before the bath is ready; and the circulation of the hot water is so imperfect that the top layer becomes boiling hot before the bottom of the water is warm. This is a subject which requires attention, for it is open to much improvement.

Again, with regard to the boiling power of gas, although in good practice a cubic foot of gas should boil off about 4712 grains of water, or about 22 times its own weight,

Table of the Combustion, Temperature, and Explosive Power of Gases.

	Per lb. substance.			Pounds of Water heated 1° Fahr.			Temperature of Combustion.				Explosive Power.		Mechanical power per lb.
	Ox. used.	CO₂ produced.	Air vitiated.	Per lb. substance.	Per cubic foot substance.	Per lb. Ox. used.	Open flame. With Ox.	Open flame. With Air.	Closed Vessel. With Ox.	Closed Vessel. With air.	With Ox.	With Air.	Tons raised 1 ft. high.
	Cub. ft.	Cub. ft.	Cub. ft.	Lbs.	Lbs.	Lbs.	Deg.	Deg.	Deg.	Deg.	At.	At.	Tons.
Hydrogen . .	93·4	0·0	467	62030	329	7754	14510	5744	19035	7852	25·6	12·5	21390
Marsh gas . .	47·2	23·6	826	23513	996	5878	14130	4762	18351	6680	37·0	14·0	8108
Olefiant gas .	40·5	27·0	878	21344	1585	6225	16535	5217	21344	7200	42·9	15·1	7360
Propylene . .	40·5	27·0	878	21327	2376	6220	16522	5239	21327	7177	67·3	22·5	7360
Butylene . .	40·5	27·0	878	21327	3168	6220	16522	5232	21327	7177	85·8	30·2	7360
Acetylene . .	36·3	29·1	909	18197	1251	5914	17146	5142	22006	7009	37·9	17·6	6275
Benzole . .	36·3	29·1	909	18197	3860	5915	17146	5142	22006	7009	113·7	52·8	6275
Carbonic oxide .	6·7	13·5	371	4325	320	7569	12719	5358	16173	7225	21·8	11·7	1490
Bisulph. carbon	14·9	5·0	689	6120	1239	4845	15280	4314	20031	5917	30·2	11·6	2110
Sulph. hydrogen	16·7	0·0	630	7444	671	5271	13688	4388	17542	6026	28·3	12·7	2567
Cyanogen . .	14·5	14·5	435	6712	925	5142	13488	5028	17645	6167	35·6	17·8	2314
Common coal gas	37·5	17·6	618	21060	650	6816	14320	5228	18101	7001	29·2	14·6	7262
Cannel gas .	31·0	22·0	698	20140	760	6503	14826	5121	19046	7186	38·8	18·0	6945
Wood spirit .	25·3	11·8	422	9547	819	6363	11435	4641	14902	6347	40·3	15·3	3290
Alcohol . .	24·6	16·4	533	12929	1597	6195	13305	4831	17223	6629	46·4	16·1	4455
Ether . .	30·9	20·4	664	16249	3217	6158	14874	5150	19225	6953	58·6	19·0	5603
Camphine . .	38·9	27·8	880	19573	7134	5942	16271	5026	20953	6922	47·6	16·0	6750
Spermaceti .	37·0	25·2	815	17589	...	6088	14599	4413	...	...	...	...	6065
Wax . .	37·7	25·6	829	15809	...	4995	12921	4122	...	...	...	...	5451
Stearic acid .	34·6	24·0	783	17050	...	6061	15885	4818	...	...	...	...	5880
Stearin . .	34·4	14·2	527	18001	...	6143	15815	5095	...	...	...	...	6207
Paraffin . .	40·5	27·0	878	21327	...	6220	16522	5239	...	...	...	...	7354
Paraffin oil .	40·5	27·0	878	21327	...	6220	16522	5239	..	...	...	...	7354
Rape oil . .	38·7	24·3	801	17752	...	6123	15830	5087	...	...	...	...	6121
Sperm oil . .	38·7	24·3	801	17230	...	6088	15363	4937	...	...	...	...	5941
Carbon . .	31·0	31·5	943	14544	...	5447	18329	3026	...	...	..	...	5015

yet this is not often attained, for in an open vessel we rarely evaporate more than 2866 grains of water, or about 13 times its weight. •

But the heat of the burning gas is more surely applied to the warming of rooms; for, as you will see by the table, a cubic foot of common gas will heat an apartment containing 3129 cubic feet of air 10°, and the same quantity of cannel gas will heat 3658 cubic feet to the same extent. Other illuminating agents will, however, light for light, heat the atmosphere, and vitiate it to a larger extent. This is seen in the table which I brought under your notice at the last lecture.

Heating and Vitiating Effects of Different Illuminating Agents when Burning so as to give the Light of 12 Sperm Candles.

	Lbs. Water raised 1° Fahr.	Oxygen consumed, Cub. Ft.	Carb. Acid produced, Cub. Ft.	Air vitiated. Cub. Ft.
Cannel gas .	1950	3·30	2·01	50·2
Common gas .	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	5·77	131·7
Wax . .	3831	8·41	5·90	149·5
Steario . .	3747	8·82	6·25	156·2
Tallow . .	5054	12·00	8·73	218·3

The vitiating effect is calculated on the actual loss of oxygen, and on the power which 4 per cent. of carbonic acid has on the vital qualities of the atmosphere; and, although the results indicate that there should be less discomfort in a room lighted with coal gas than with any other illuminating agent, yet common experience is altogether in the opposite direction. The explanation of this is to be found not only in the fact that gas is used more lavishly than other agents, but also that in burning it produces a larger proportion of aqueous vapour, which becoming diffused into the surrounding atmosphere occasions great discomfort. Professor Tyndall has shown that the molecules of aqueous vapour are endowed with a remarkable power of absorbing the radiant heat of burning gas, and by thus becoming warm they create a sense of oppression; and, again, when the warm atmosphere of a room is overcharged with moisture, it checks the action of vaporous or insensible perspiration, and this also causes distress. In all cases, therefore, where gas is largely used in rooms, provision should be made for the quick removal of the products of combustion.

When the heat of gas is required for warming a room, its radiant power should be increased by allowing it to ignite some solid substance, for the radiant heat of a non-luminous flame is very insignificant. I have here a Bunsen's burner, which gives with this gas the highest temperature of combustion, but the amount of heat which radiates from it is very small—smaller indeed than is the case when the gas is burnt in the ordinary way, when every atom of ignited carbon becomes a centre of radiation. The proportion of radiant heat from the same flame under different circumstances is very variable. From Bunsen's burner it is only 12, from the same gas burnt as a luminous flame it is 30, and with a spiral of platinum in it it is 85. The introduction of solid matter into a non-luminous flame of high temperature changes its character altogether, and from the heat of convexion it becomes heat of radiation. No doubt the quality of the vibrations is greatly changed, and they pass from the large and comparatively slow undulations of obscure heat to the small and quick vibrations of light; and the more this is effected, the greater and greater becomes the intensity of the radiant heat. Professor Tyndall found that the following were the quantities of radiant heat from a platinum spiral, at different degrees of luminosity:

		Degrees of Heat radiated.
Platinum spiral	Feebly red . . .	19
,, ,,	Dull red . . .	25
,, ,,	Full red . . .	62
,, ,,	Orange red . . .	88
,, ,,	Yellow red . . .	158
,, ,,	Yellow white . .	200
,, ,,	Blue white . . .	276
,, ,,	Intense white . .	440

So that, when we wish to economise the radiant heat of burning gas, it is best to use it with some solid body, as fragments of pumice or pieces of asbestos.

The last point to which I would refer is the available or convertible motive power of burning gas.

The calculations of Dr. Mayer, of Heilbron, and the experimental inquiries of Mr. Joule, of Manchester, show that the mechanical power of heat is 772 lbs., raised a foot high for the heat necessary to raise the temperature of a pound of water 1° Fahr. A cubic foot of hydrogen in burning has therefore the mechanical power of (329 × 772 =) 253,988 lbs.; and the same quantity of common gas has the power of (650 × 772 =) 501,800 lbs.; while the power of a cubic foot of cannel gas is (760 × 772 =) 586,720 lbs., raised a foot high. But, if the same quantity of these gases is exploded with air or oxygen in a closed chamber, the mechanical power is somewhat different. I have here tabulated the expansive force of such a mode of combustion, and I may say that the calculations are deduced from the temperatures of combustion and from the volumes of the products—allowance having been made for the specific heats of the several products. It would seem, therefore, that the explosive powers of the several constituents of coal gas, when mixed with their proper proportions of air or oxygen, are as follows:—

Explosive Power of Mixed Gases.

	Mixed with Air. (Ats.)	Mixed with Ox (Ats.)
Hydrogen . .	12·5 . .	25·6
Marsh gas . .	14·0 . .	37·0
Olefiant gas . .	15·1 . .	42·9
Propylene gas . .	22·5 . .	67·3
Butylene gas . .	30·2 . .	85 8
Carbonic oxide . .	11·7 . .	21·8
Common gas . .	14·6 . .	29·2
Cannel gas . .	18·0 . .	38 8

These are the theoretical pressures exerted upon the sides of the containing vessel when these several gases are exploded with their proper proportions of air or oxygen; but as the explosion is never instantaneous, but proceeds from particle to particle, and therefore occupies time, and as the walls of the vessel always cool the products of the exploded gas to a great degree, this theoretical value is never obtained in practice, the highest pressure in the exploding chamber of a gas-engine being only 75 lbs. on the square inch, or five atmospheres. The power of this has been determined experimentally by Mr. Evans, who informs me that with a cubic foot of a mixture of nine air and one gas he has propelled a wooden shot (three inches by four) 50 yards; and he ascertained that the same effect was produced with an ounce of gunpowder. The motive power, therefore, of the exploding mixed gas is considerable.

In the gas-engines of Lenoir it has been found that the best proportions of air and gas are eight volumes of air to one of common gas; theoretically the best proportion for London (13-candle) gas is 5·6 volumes of air to one gas. A larger portion of air is required for cannel gas, as 11 to 1; but in practice it is found that cannel gas does not produce so good an effect as common gas. The time of the explosion is about the 27th part of a second, and the temperature of it is about 2474° Fahr. instead of from 5128° to 7000°—the calculated temperatures for open and closed chambers.

The machines which are used for practically employing this power are all modifications of the original engine of Lenoir. They consist of a cylinder with a double-action piston, receiving the mixed gas alternately on either side of the piston. The arrangement is such that in the movement of the piston the air and gas, in proper proportions (8 to 1), are drawn into the cylinder by a suitable side valve, and when the piston has made half a stroke it shuts off the valve; at that moment the mixed gas is fired in the cylinder by means of an electric spark from a Ruhmkorff's coil passing between the points of two wires in the cylinder. One of these wires is insulated by traversing a rod of porcelain fixed in the cylinder, and, being in connexion with a make-and-break contrivance, called a distributor, attached to the fly-wheel of the engine, it receives the charge of electricity, and so fires the mixed gas at the right moment. The expansion caused by the explosion and heat of combustion drives the piston through the rest of the stroke, and it generally ends with a good deal of unutilised pressure. In one case I find that the indicator recorded an initial pressure of 75 lbs. on the inch at the moment of explosion, and a final pressure of 25 lbs. The loss of power in this case must have been considerable, for not only is there the loss of the difference (12·5 lbs.) between the calculated pressure 37·5 lbs. (75+2), and the real (25), but there is also the total loss of the unavailable final pressure. A part of this loss is no doubt due to leakage, and to the cooling effect of the walls of the cylinder, for the temperature has been observed to fall from 2474° Fahr. at the moment of explosion to 1438° at the end of the stroke—the calculated temperature being 2156°; indeed the management of the temperature is one of the difficulties of the engine, for the cylinder has to be cooled by a stream of water. Improvements will no doubt be made in the construction of the engines, and especially in the utilisation of the residual power, and this must be done by shutting off the valve and firing the gas earlier in the stroke. This has already been done to some extent in America with engines of half-horse power, as with cylinders of 4¾ inch diameter by 8¾ inch stroke; and this with 185 revolutions or 370 explosions in a minute raises 16,280 lbs. one foot high in a minute. In France and in this country much larger engines are made, as from 1 to 3 horse power.

The quantity of gas used in the working of the engine is rather variable. In the American engine, already alluded to, it took 105 cubic feet of gas an hour to work an engine of half-horse power, and a one-horse engine in London takes about 185 cubic feet of London gas—say it is 200 cubic feet—per horse power. This is 1,980,000 lbs. a foot high; whereas the theoretical power of 200 feet is more than 100 millions of pounds.

The advantages of the engine are very great, for it takes up but little room, it is very clean, it works with great regularity, it requires little or no attention, and it costs nothing for fuel when it is not at work.

One thing I ought to mention in speaking of the explosive power of mixed gas, and that is the effect of using mixtures in improper proportions. Sir Humphrey Davy found, in his experiments with marsh gas, that there was but one proportion of air and gas which gave the maximum effect, and that was a mixture of 1 of gas and 7·5 of air (theoretically it should be 1 to 9·5). When the proportions are reduced in either direction the mixture becomes less and less explosive, until with 1 gas and 15 air, or with equal volumes of gas and air, the mixture ceases to explode.

In the case of coal gas, although the theoretical proportions for London gas are 1 of common gas* to 5·6 of air, and 1 of cannel gas to 7·4 of air, yet the best results are obtained with 1 of the former to 8 of air, and 1 of the latter to 11. On either side of this proportion the mixture rapidly becomes less and less explosive.

The effect of mixing other gases with explosive mixtures has been well studied by Davy and others; taking, for example, an explosive mixture of 2 volumes of hydrogen and 1 of oxygen, it is found that 1 of nitrogen to 6 of the gas, or 1 of carbonic acid to 7 of it, will stop its explosion.

Lastly, the temperature at which these gases are fixed is a matter of considerable importance. Davy found that he could not set fire to marsh gas (the firedump), or to an explosive mixture of it with air, by using the strongest heat of glowing charcoal. He even blew a mixture of the gas upon glowing charcoal until he got it at a maximum heat without firing it; nor can it be fired by the sparks from flint and steel. Not so, however, with hydrogen, or olefiant gas or carbonic oxide, all of which are fired by the sparks and by glowing charcoal—perhaps the igniting temperature is about 3900° Fahr.; and the vapour of bisulphide of carbon is fired at as low a temperature as 300° Fahr. These facts are deserving of attention, for they show that gas leaking from the mains may be fired by a spark from a pick, or from the chipping of a hole in the pipe in laying a service.

And now, gentlemen, we have gone over the question of the phenomena of gaseous combustion, and of the manner in which gas is to be most profitably and most economically used for illuminating purposes. We have also examined the thermotic powers of coal gas, and I hope if I have the opportunity of meeting you again, I shall be able to bring under your notice one other question of interest to gas engineers, and that is the profitable utilisation of the waste products of gas-works.

NOTICES OF BOOKS.

A Companion to the British Pharmacopœia: comparing the Strength of the Various Preparations with those of the London, Edinburgh, and Dublin, United States, and other Foreign Pharmacopœias, with Practical Hints on the Art of Prescribing. By Peter Squire, F.L.S., Chemist on the Establishment of the Queen, &c., &c. Third Edition. London: Churchill and Sons. 1866.

We must heartily congratulate Mr. Squire on the appearance of this, the third, edition of a book which we pronounced to be the best of the many published as companions and guides to the British Pharmacopœia. We can only repeat what we said of the second edition, that the author has made the best book still better. Very considerable additions, and those of very useful matter, have been made to this edition. Since the publication of the last a new Prussian Pharmacopœia has been issued, and the portions of the work in which the last Prussian Pharmacopœia was quoted have been carefully corrected to the most recent edition.

It is impossible to notice the additions which have been made; they occur on every page. But we may say that we have not observed one that does not add to the value of the work. Many of them are devoted to non-officinal preparations, and the pharmaceutist will well understand that

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* Average Composition of London Gas by Volume.

	Common Gas.	Cannel Gas.
Hydrogen	46·0	27·7
Light carburetted hydrogen	39·5	50·0
Olefiant, &c.	3·8	13·0
Carbonic oxide	7·5	6·8
Carbonic acid	0·7	0·1
Aqueous vapour	2·0	2·0
Nitrogen	0·5	0·4
	100·0	100·0

these, made by an author with unusually good sources of information at command, will contain the best information on recent progress in pharmacy.

The book, too, may be equally commended to the notice of medical men; for the practical hints on prescribing scattered about the pages show an excellent knowledge of the uses of medicines, as well as of their incompatibilities. In short, this is the best work of the kind we know both for pharmaceutist and prescriber.

Annales de Chimie et de Physique. June, 1866.

We have in this journal the second part of M. Kolb's "*Theoretical Study of Leblanc's Process,*" in which the author examines the changes which take place during the digestion and lixiviation of black ash. There is much useful information for the manufacturer in the tables in which the author shows the influence of the proportion of water in the results of the digestion, as well as the duration of the digestion, and also the influence of temperature on the result, and we are sorry that the large space they occupy will prevent us from giving the whole series. In a future number, however, we shall give the most important features of them. The tables show that in a cold concentrated liquor, and in the presence of a little caustic soda, no reaction takes place between the sulphide of calcium and the carbonate of soda in the course of a short digestion. Hence the object of the manufacturer must be to lixiviate with as little water and at as low a temperature as possible. The great want, the author suggests, is an apparatus which shall effect the exhaustion of the ash in a few hours with a small quantity of cold water.

There is another original memoir by M. Joseph Boussingault, "*On the Manufacture of Kirschenwasser,*" which is of no interest to English chemists.

NOTICES OF PATENTS.

We have on several occasions urged the advisability of appointing scientific examiners to investigate the claims of an invention to novelty, upon which alone we have argued the grant of the protection of a patent should depend, time alone being able to decide on the utility. Among the recently-published specifications we find two or three inventions (?) which well illustrate the necessity for such an examination. It is true that in most of these instances only a provisional protection has been obtained, and the inventors therefore have only had the privilege of paying five pounds to the Government, and their agents' fees. Why their patents have not been completed we have no means of knowing, but we may feel tolerably certain that it was simply because they doubted their chances of making money by them. The Attorney-General, we dare say, would have raised no obstacle if the inventors had been ready with their fees.

The first of these specifications we may notice is the following:—

"Generating Oxygen Gas.

"*Provisional Specification left by Hermann Beigel at the Office of the Commissioners of Patents, with his Petition, on July* 6, 1865.

"I, Hermann Beigel, of Finsbury Square, in the County of Middlesex, do hereby declare the nature of the said invention for 'Improvements in the Means of Obtaining or Producing Oxygen, applicable to various Useful Purposes,' to be as follows:—

"This invention relates to certain improvements in the means or method of producing or generating oxygen gas, applicable to a variety of useful purposes, the process being cheaper than any other hitherto in use for the purpose.

"I propose by this invention to take a concentrated or saturated solution of chloride of lime, to about 100 pounds of which I add about half an ounce of oxide or salt of nickel or cobalt, the result of this admixture at a temperature of about 80 degrees Reaumur being that chloride of lime is decomposed into chloride of calcium and oxygen, the oxygen being eliminated and set free from the lime; and if the process is effected in a closed vessel, a tube or pipe will conduct the gas as required.

"I also propose to mix the ingredients in the dry state, and to eliminate the oxygen from the lime by the addition of water, so that the powder may be packed and rendered easily portable and ready for use. In this process there is no danger, as is the case in some others where great heat is employed or compounds are used which are liable to explosion; pure oxygen is obtained, there is no difficulty in working, great quantities of oxygen can be quickly produced, and the facility of production affords a more general means of application. The process should be conducted with warm water, or water at a temperature of about 90 degrees, to urge the elimination. The oxygen gas may be used to aerate or oxygenate water and other liquids, to purify air in hospitals, mines, ships, and elsewhere, in which cases an open vessel may be employed. But for inhalation or aerating waters the process should be conducted in a closed vessel. The gas is also applicable to the generation of light for lighthouses and other situations where signals are required. By adding fresh quantities of chloride of lime, the generation of oxygen may be continued without the addition of cobalt or nickel, which undergo no change during the process."

The date of this specification, it will be seen, is July 6, 1865. But the readers of the Chemical News will, perhaps, remember that in our journal for May 19, 1865, there was a notice of the *Annalen der Chemie und Pharmacie* for April which contained an account of this very process by the true inventor Fleitmann; and the Chemical News of the following week contained a full translation of the paper. The specification has nothing on the face of it to show that the invention was "a communication," and we are therefore left to the conclusion that Mr. Hermann Beigel claimed it as his own. The mixing of the dry ingredients, perhaps, was Mr. Hermann Beigel's invention; but the process is beyond all doubt Fleitmann's, and by what right Mr. Beigel presumed to take it to the Patent Office we are quite at a loss to conceive.

We pass to another specification of a process for the production of oxygen:—

"*Provisional Specification left by Hector Auguste Dufrené at the Office of the Commissioners of Patents, with his Petition, on July* 11, 1865.—*A communication from Monsieur Charles Tellier, residing at Passy, Paris, in the Empire of France.*

"I, Hector Auguste Dufrené, do hereby declare the nature of the said invention for 'An Improved Process for Obtaining Oxygen' to be as follows—that is to say:—

"The object of the invention is to employ oxygen for industrial purposes, and, as it does not exist in a commercial state, to obtain it economically. To attain this object I produce the following reactions:—When a current of dried chlorhydric acid and air is passed over pumice-stone at a red heat in a suitable apparatus, decomposition of the acid takes place. The hydrogen unites with the oxygen of the air to form water, and azote and chlorine, which may be easily separated, can be collected. When on the contrary a mixture of chlorine and water steam is passed through a tube heated to red heat, decomposition again takes place, but in this instance the hydrogen combines with the chlorine, and oxygen is set at liberty. The furnaces employed for these operations may vary in form according to circumstances; I do not therefore lay claim to any kind of furnace which may be employed.

"It will be easily understood from the preceding reactions that a very large quantity of azote is eliminated in the operations. To utilise this gas I pass it over iron in a spongious state heated to a red heat, by which the azote is absorbed. In these conditions I cause hydrogen to be brought on the combination of azote and iron thus formed; the decomposition is immediate, and the large quantity of ammonia so produced causes the reduction of the price of oxygen. This gas being thus produced I apply it principally to the production of heat and light by burning in this gas several substances, but especially metals. I propose also to take advantage of the excessive heat resulting from this combustion to melt iron, and apply it either for moulding, or for preparing moulds in which iron can be run in and cast, and also for preparing ingots for the forge. I can also burn in this gas sulphurous cast iron, and obtain pure oxide easily reducible. Zinc produces a greater heat than iron, and in certain cases it should be preferred, especially in that which concerns light, which will give the best results, in consequence of the solid particles produced by its combination with oxygen. The oxide formed in both cases is reduced by the ordinary means."

M. Dufrené, it will be seen, is more candid than Mr. Beigel. He ascribes the invention to the fertile brain of M. Tellier, but what right has even the last-named gentleman to patent the decomposition of steam in contact with chlorine?

There is something highly amusing in this specification. Supposing for a moment such a patent valid, claims for half a dozen different things might be founded upon it. The chemistry also is remarkable. The elimination of azote in the reaction of chlorine on steam is scarcely worthy of M. Tellier; but as all this gentleman's thoughts are directed to the production and utilisation of ammonia the confusion is not surprising.

We need not detain our readers longer over these *inventions*; and we only quote them because we know of nothing in our present patent law to hinder the actual completion of such patents.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

1493. J. D. Whelpley and J. J. Sterer, Boston, Mass., U.S.A., "An improved process and apparatus for obtaining metals and saleable products from ores and minerals, adapted particularly to the reduction of sulphurets."—May 29, 1866.

1522. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the deodorising of crude rock or mineral oil, and in the preparation of lubricating oil therefrom."—A communication from J. Mott and G. Cowles, Lindsay, Canada West.—May 31, 1866.

1555. C. A. McEvoy, Bedford Square, Middlesex, "Improvements in shells, and in fuses used with shells.—June 5, 1866.

1559. W. Lawrence, Cornwall Road, Paddington, Middlesex, "Improvements in the manufacture of malt, and in apparatus for drying malt and hops."

1560. W. Lawrence, Cornwall Road, Paddington, Middlesex, "Improvements in the manufacture of and apparatus for the treatment of worts."—June 6, 1866.

Notices to Proceed.

582. J. L. Pulvermacher, Oxford Street, Middlesex, "Improvements in means and apparatus for producing and applying galvanic currents."—Petition recorded February 24, 1866.

603. H. Robertson, Motherwell, Lanarkshire, N.B., "Improvements in the manufacture of oil and other products from bituminous substances, and in the machinery or apparatus employed therein, which improvements, or parts thereof, are also applicable to the manufacture of white lead or other pigments."—February 27, 1866.

615. H. A. Dufrené, Rue de la Fidélité, Paris, "Improvements and new applications in the manufacture of beer and alcoholic liquids."—A communication from C. Tellier, Rue Boulainvilliers, Passy, Paris.—Feb. 28, 1866.

667. J. Gray, Glasgow, N.B., "Improved preparations for acting upon sea water, or upon hard or impure water, in order to render such water more suitable for use in boilers and otherwise."—March 5, 1866.

MISCELLANEOUS.

The New Pharmacopœia.—The following Report was presented by the Pharmacopœia Committee at the recent sitting of the Medical Council:—

"The Pharmacopœia Committee have to report that since the date of their last Report Messrs. Redwood and Warington have continued to be engaged in the duty assigned to them, and they have so far completed their work that the whole of the matter, with the exception of the Appendix, is now in type. The Committee have reason to hope that the volume will be ready for circulation, in proof, amongst the members of Council in three months from the present time. Under these circumstances the Committee beg leave to direct the attention of the Council to the resolution adopted at the meeting of last year (Minutes, vol. iii., p. 285), as follows:—

"'That it is desirable to have a proof copy of the new Pharmacopœia in the hands of the members of the General Medical Council at least one month before the meeting of the General Medical Council, at which the opinion of the Medical Council is to be given relative to its being published, in order to afford to each member of Council the opportunity of making such suggestions to the Committee as may appear desirable.'

"As the Committee anticipate that the work will be ready some considerable time before the next ordinary general meeting of the Council, the Committee would wish to receive such further directions as the Council may feel it necessary to give them on this subject. The Committee, before concluding their Report, desire, in reference to an impression which seems to prevail that some unnecessary delay has taken place in the production of the Pharmacopœia, to assure the Council that no time has been spent in the work which was not necessary.

"The Committee beg to inform the Council that they have not hitherto had occasion to draw upon the fund placed at their disposal by order of the Council. (Minutes, vol. iii., p. 285.)

"May 21, 1866." "R. Christison, Chairman.

The Chemical Society and the Pharmacopœia.—The following letter respecting the notation to be adopted in the new Pharmacopœia was sent to the Medical Council by the Chemical Society:—

"*To the President of the General Council of Medical Education and Registration.*

"Burlington House, March 19, 1866.

"Sir,—The President and Council of the Chemical Society venture to call the attention of the Medical Council to the system of chemical notation adopted in the British Pharmacopœia; and, as they are informed that a new edition of that Pharmacopœia is in course of preparation, they entertain a hope that it may not be an inopportune moment to urge upon the Medical Council the desirableness of considering whether, in the forthcoming edition of the work, the use of chemical symbols could not be advantageously dispensed with altogether. In the few cases which may seem specially to call for the use of such formulæ, a percentage representation of the composition of the body would, it appears, supply all the necessary data.

"The grounds on which the President and Council of the Chemical Society have been induced to suggest this course are these:—

"The system of notation at present adopted in the British Pharmacopœia is constructed in conformity with views which are rapidly disappearing from chemical teaching in this country.

"The Pharmacopœia is necessarily the text-book on which the examinations of students of medicine and pharmacy in pharmaceutical chemistry are based. It appears, therefore, extremely desirable that no work shall be put forth on official authority, such as that of the Medical Council, which shall be at variance with the views propounded by many of the most active experimental leaders and principal teachers of chemical science, or which shall oblige the teacher to adopt a double numerical system in his exposition of the facts of chemical science to his pupils—a course which is always a source of embarrassment both to professor and learner.

"It is obvious that the adoption of a plan such as the one now suggested does not necessitate any expression of opinion on the part of the Medical Council upon a subject which is still under discussion. At the same time it will relieve the Council from the inconvenience of appearing pledged to the maintenance of doctrines which are no longer believed to be correct by many of the most competent to form an opinion on the subject.

"The President and Council of the Chemical Society trust that the importance of the subject will sufficiently explain their anxiety to bring this matter under the consideration of the Medical Council.

"Wm. Allen Miller,
"President of the Chemical Society."

Some discussion on the subject followed the reading of this communication, and eventually the following resolution was passed by the Council:—

"That it be an instruction to the Pharmacopœia Committee to give for each therapeutic compound, of definite constitution, occurring in the forthcoming edition of the Pharmacopœia, two formulæ—the first being that in ordinary use at present, the second being one constructed in accordance with the more recent views of what is called the 'unitary system.'"

Analysis of the Metropolitan Waters for June, by Professor Frankland, F.R.S., of the Royal College of Chemistry:—

Companies.	Number of houses supplied in May, 1866.	Average daily supply of water in gallons during the month of May, 1866. (See Note.)	Solid matter in 100,000 parts of the waters.	Organic and other volatile matter included in column 4.	Amount of oxygen required for oxidation of organic matter.	Total hardness.
Thames.						
Chelsea	26,463	7,385,800	25·25	0·85	·0360	16·5
West Middlesex	35,707	8,397,709	24·81	0·97	·0360	16·2
Southwark and Vauxhall	73,809	12,175,000	24·74	0·93	·0420	15·7
Grand Junction	25,636	8,855,729	24·82	0·91	·0368	16·2
Lambeth	36,008	8,904,800	26·63	1·01†	·0424	16·8
Other Sources.						
Kent	32,766	6,025,420	39·28	1·50	·0076	25·4
New River	111,958	23,092,000	21·55	0·91	·0252	13·7
Ditto (after filtration through animal charcoal)	—	—	19·57	0·30	·0072	9·5
East London	88,340	18,357,000	26·22	1·26	·0264	15·7
South Essex	750	160,000	38·52	1·66	·0080	23·1

Note.—The water includes the supply for manufactures and for various purposes other than domestic consumption. This return, as compared with that for the previous mouth, shows an increase of 267 houses and an increase of 3,688,005 gallons of water supplied daily.

The table may be read thus:—100,000 pounds of the Chelsea water contained 25·25 lb. of solid matter, of which 0·85 lb. of organic and other volatile matters was driven off by incineration. 0·0360 lb. of oxygen was required to oxidise the organic matter in the said quantity of Chelsea water. Of the solid matter 16·5 lb. were carbonate of lime or its equivalent of hardening salts.*

The fourth column of this table contains the amount of solid matter left on evaporation and desiccation at 120 deg. C.—130 deg. C. (248 deg. F.—266 deg. F.)

The results are recorded in 100,000 parts. By moving the decimal point one place to the right the above figures express in milligrammes the quantities contained in one kilogramme of the several waters. The whole of the waters were free from turbidity when drawn from the companies' mains.

Composition and Quality of the Metropolitan Waters in June, 1866.—The following are the Returns of the Metropolitan Association of Medical Officers of Health:—

Names of Water Companies.	Total solid matter per gallon.	Loss by ignition.*	Oxidisable organic matter.†	Hardness.	
				Before boiling.	After boiling
Thames Water Companies.	Grains.	Grns.	Grains.	Degs.	Degs.
Grand Junction	18·05	0·67	0·62	13·5	3·0
West Middlesex	17·02	0·71	0·40	13·0	3·0
Southwark & Vauxhall	18·12	0·68	0·62	13·5	4·0
Chelsea	17·73	0·74	0·48	13·5	3·5
Lambeth	18·60	0·80	0·72	13·5	3·0
Other Companies.					
Kent	28·23	1·00	0·00	17·5	8·0
New River	16·06	0·56	0·14	12·0	3·0
East London	17·70	0·94	0·23	12·5	4·0

* The loss by ignition represents a variety of volatile matters, as well as organic matter, as ammoniacal salts, moisture, and the volatile constituents of nitrates and nitrites.

† The oxidisable organic matter is determined by a standard solution of permanganate of potash, the available oxygen of which is to the organic matter as 1 : 8; and the results are controlled by the examination of the colour of the water when seen through a glass tube two feet in length and two inches in diameter.

H. Letheby.

Royal Commission on the Coal Question.—The following appeared in Tuesday's *Gazette*:—"The Queen has been pleased to appoint the Most Noble George Douglas, Duke of Argyll, K.T.; Sir Roderick Impey Murchison, Bart., K.C.B.; Sir William George Armstrong, Knight, C.B.; Henry Hussey Vivian, Esq.; George Thomas Clark, Esq.; Joseph Dickinson, Esq.; George Elliot, Esq.; Thomas Emerson Forster, Esq.; John Geddes, Esq.; Robert Hunt, Esq.; John Beete Jukes, Esq.; John Hartley, Esq.; John Percy, Esq., Doctor of Medicine; Joseph Prestwich, Esq.; Andrew Crombie Ramsay, Esq.; and John Thomas Woodhouse, Esq., to be her Majesty's Commissioners to investigate the probable quantity of coal contained in the coal fields of the United Kingdom, and to report on the quantity of such coal which may be reasonably expected to be available for use: whether it is probable that coal exists, at workable depths, under the Permian New Red Sandstone, and other superincumbent strata; to inquire as to the quantity of coal at present consumed in the various branches of manufacture, for steam navigation, and for domestic purposes, as well as the quantity exported; and how far, and to what extent, such consumption and export may be expected to increase; and whether there is reason to believe that coal is wasted, either by bad working or by carelessness or neglect of proper appliances for its economical consumption."

ANSWERS TO CORRESPONDENTS.

W. L. R. writes:—"Can you or any of your readers kindly inform me what quantity of sulphuric acid 1750 can practicably be made from one ton of Irish ore containing 30 per cent. of sulphur?"—We have no time to make the calculations for the theoretical quantity. Perhaps some reader may like to amuse himself with the question.

A Colour Maker.—We do not know of a book on the naphthaline and phenyle colours, but "Die Entwickelung der Anilin-Industrie," by Dr. Max Vogel, appears to be a good practical work on the aniline colours.

J. R. P.—The last series are only published in the *Transactions* of the Belgian Academy at present, but we shall commence immediately a tolerably full translation. The first series will be found in the fourth volume of the Chemical News.

Books Received.—"The Negro and Jamaica," by Commander Bedford Pim, R.N.; "Lessons in Elementary Chemistry," by H. E. Roscoe, B.A., F.R.S.

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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 of hardening salts, 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 seven, and then moving the decimal point one place to the left.

† By mistake, this number was given as 2·14 in the Report of the Registrar-General.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

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

PART III.

CONNEXION BETWEEN ORGANIC AND INORGANIC CHEMISTRY.

SECTION I.—*Atomicity as a Means of Classification.*

(*Continued from vol.* xiii., *page* 302.)

THE reasoning which we have applied to atomicity establishes a solid relationship between organic and inorganic chemistry. Struck with the fact that the atoms of carbon, hydrogen, and oxygen could be heaped up in organic compounds so as to form very complex molecules, chemists were of opinion that this peculiarity impressed a special stamp upon the combinations of carbon. But it is not so, and it is easy to show that the property in question is displayed in other polyatomic elements. This accounts for the complication of the combinations of silicium, which may be compared, on this point, to the combinations of carbon. Why, then, is the chemistry of silicium so different from that of carbon? It arises from these two circumstances—that, on the one hand, silicium forms with oxygen a fixed compound; and, on the other hand, that its affinity for hydrogen seems to be exhausted in a single combination, which cannot exist in presence of air, since it is spontaneously inflammable.

Without carbides of hydrogen there would be no organic chemistry; and if there existed silicides of hydrogen corresponding to the carbides, it is clear that the bodies derived from these silicides might be very numerous. But it is none the less true that the natural silicates often show great molecular complication, and may be compared, in this respect, to the organic compounds of carbon. And the reason of such a molecular complication is contained, as we will show, in the polyatomic nature of silicium and of certain of the metals which are united with this element in the silicates. Our investigations upon atomicity establish, between compounds otherwise very unlike in nature and properties, connexions in constitution or molecular structure which it is desirable to point out. They allow of convenient grouping together, and furnish, both for inorganic and organic chemistry, elements of classification that it would in future be impossible to neglect. Our task shall be further to develope these points.

A celebrated chemist has said*:—"Organic chemistry is the chemistry of the compound radicals." We know now that such radicals do not belong exclusively to organic combinations; but, as regards their power of combination, we know that they act as elements. We have then the right to compare, with respect to their atomicity, the radicals of organic chemistry, not only to the compound radicals but also to the simple elements of inorganic chemistry. As in organic chemistry we find monoatomic, diatomic, triatomic radicals, &c., so also in inorganic chemistry we find radicals and elements of different atomicity, and it is evident that inorganic and organic combinations containing radicals or elements of the same atomicity should present a certain analogy of structure, which might show itself by a certain analogy in their reactions. For simple as well as for compound bodies their atomicity is the principal means of classification. The natural families of metalloids established by M. Dumas† are groups of simple bodies of equal atomicity:—

Mon-atomic.	Diatomic.	Triatomic.	Tetratomic.	Triatomic and pentatomic.
Fluorine.	Oxygen.	Boron.	Carbon.	Nitrogen.
Chlorine.	Sulphur.		Silicium.	Phosphorus.
Bromine.	Selenium.			Arsenic.
Iodine.	Tellurium.			Antimony.

Similar groups might be formed among the metals, and these classifications are much better founded than the artificial relationships established between the metals by their degree of affinity for oxygen.

It must be allowed that, in a large number of cases, the classification formerly adopted by Thenard breaks the natural connexions established between the metals by the general composition of their combinations. It is thus, for example, with silver, which is monoatomic, and which should be placed along with the alkaline metals.

The following is this very natural group of monoatomic metals:—

Hydrogen.

Rubidium.
Cæsium.
Potassium.
Sodium.
Lithium.
Silver.

Thallium.

Lead should be classed with the diatomic metals barium, strontium, calcium. To this group would be joined the diatomic metals isomorphous with the magnesian series, magnesium, manganese, iron, zinc, &c. The tetratomic metals form a very natural group. It is convenient to place them after silicium. We have thus the following family:—

Carbon.
Silicium.

Zirconium.
Titanium.
Tin.
Tantalum.

Niobium.

But it must be added that in this attempt at classification, as in all attempts of this character, difficulties are encountered arising from the circumstance that among the metals, even more than among the metalloids, each element bears the impress of a strongly marked individuality. It shows certain points of contact with its neighbours with regard to some combinations, but seldom a complete analogy in every combination. Thus thallium, which in some points resembles the alkaline metals, differs from them in the property it possesses of forming a sesquichloride and a terchloride. Iron, which, when considered in the ferrous combinations, resembles manganese and zinc, should be classed with aluminium when it is considered in the ferric combinations. Copper, which shows a point of contact with the magnesian series in the cupric combinations, also, to a certain point, resembles mercury. The general composition of the cuprous and mercurous, cupric and mercuric oxides and chlorides is the same.

If from simple we pass to compound bodies, we shall see that the notion of atomicity allows us to establish

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* Liebig, "*Traité de Chimie Organique,*" vol. i., p. 1.

† Dumas, "*Traité de Chimie appliquée aux Arts,*" vol. i., p. lxxvii., 1828.

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very curious, and often very unexpected, relationships between certain inorganic and organic compounds.

SECTION II.—*Oxides, Hydrates, and Salts, Inorganic and Organic.*

Let us first take the oxides and the hydrates. We know that Berzelius likened the oxidised bodies of organic chemistry to the inorganic oxides and acids. He looked upon acetic acid as the teroxide of an acetyle radical (C_4H_6 in his notation), and compared it to sulphuric acid.

$$(C_4H_6).O_3 \text{ Acetic acid.}$$
$$S.O_3 \text{ Sulphuric acid.}$$

Comparing ether to oxide of potassium, he called it oxide of ethyl, and this name has remained to it, for the comparison was very reasonable. It has, in fact, been found that ether can enter into direct combination with the acids. Dr. Wetherill, in 1848, obtained sulphate of ethyl (sulphatic ether) by directly combining oxide of ethyl with anhydrous sulphuric acid. Afterwards M. Berthelot prepared other compound ethers by combining ether directly with the acids.

Thus oxide of ethyl and its homologues were found to resemble oxides not merely by the symbolic representation of their composition, but also by a certain analogy of properties. But it must be owned that this analogy was not of a very striking nature, the affinities of oxide of ethyl being very far from equalling those of the mineral oxides. This is not the case with the oxide of ethylene, whose reactions are much more energetic, and which is able to enter into direct combination, not only with the acids, but also with water and ammonia, like certain metallic oxides. Oxide of ethylene

$$(\text{Ꞓ}_2H_4)''\Theta$$

contains the diatomic radical ethylene, and we can compare it to the oxides formed by the diatomic metals. We are thus led to establish the following parallel between the oxides of inorganic and those of organic chemistry:—

Monatomic oxides.	Diatomic oxides.	Triatomic oxides.	Tetratomic oxides.
$\left.\begin{matrix}K\\K\end{matrix}\right\}\Theta$ Oxide of potassium.	$Ca''\Theta$ Oxide of calcium.	$\left.\begin{matrix}Sb'''\\Sb'''\end{matrix}\right\}\Theta_3$ Oxide of antimony.	iv. $Zr\Theta_2$ Oxide of zirconium.
$\left.\begin{matrix}Na\\Na\end{matrix}\right\}\Theta$ Oxide of sodium.	$Zn''\Theta$ Oxide of zinc.	$\left.\begin{matrix}Bi'''\\Bi'''\end{matrix}\right\}\Theta_3$ Oxide of bismuth.	iv. $Sn\Theta_2$ Stannic acid.
$\left.\begin{matrix}Ag\\Ag\end{matrix}\right\}\Theta$ Oxide of silver.	$Cu''\Theta$ Oxide of copper.	——	iv. $Ti\Theta_2$ Titanic acid.
——	——	$\left.\begin{matrix}(\text{Ꞓ}_3H_5)'''\\(\text{Ꞓ}_3H_5)'''\end{matrix}\right\}\Theta_3$ Oxide of glyceryle.	iv. $Nb\Theta_2$ Niobic acid.
$\left.\begin{matrix}(\text{Ꞓ}H_3)'\\(\text{Ꞓ}H_3)'\end{matrix}\right\}\Theta$ Oxide of methyl.	$(\text{Ꞓ}_2H_4)''\Theta$ Oxide of ethylene.		iv. TaO_2 Tantalic acid.
$\left.\begin{matrix}(\text{Ꞓ}_2H_5)'\\(\text{Ꞓ}_2H_5)'\end{matrix}\right\}\Theta$ Oxide of ethyl.	$(\text{Ꞓ}_3H_6)''\Theta$ Oxide of propylene.		
$\left.\begin{matrix}(\text{Ꞓ}_3H_5)'\\(\text{Ꞓ}_3H_5)'\end{matrix}\right\}\Theta$ Oxide of allyle.	$(\text{Ꞓ}_5H_{10})'\Theta$ Oxide of amylene.		

Thus, as we have above remarked, oxide of ethylene combines directly with water to form glycol or hydrate of oxide of ethylene. This reaction is similar to the direct hydration of lime, and leads us to compare glycol to hydrated lime.

$$\underset{\text{Oxide of ethylene.}}{(\text{Ꞓ}_2H_4)''\Theta} + H_2\Theta = \underset{\text{Hydrate of ethylene.}}{\left.\begin{matrix}(\text{Ꞓ}_2H_4)''\\H_2\end{matrix}\right\}\Theta_2}$$

$$\underset{\text{Oxide of calcium.}}{Ca\Theta} + H_2\Theta = \underset{\text{Hydrate of calcium.}}{\left.\begin{matrix}Ca''\\H_2\end{matrix}\right\}\Theta_2}$$

Alcohol itself has long been compared to hydrate of potassium, although no one has yet succeeded in obtaining it by directly combining the elements of water with oxide of ethyl. But the resemblance in question is founded on the analogy of the reactions which acids exercise both upon hydrate of potassium and upon alcohol or hydrate of ethyl. Here are some examples of these reactions:—

$$\underset{\text{Hydrate of potassium.}}{\left.\begin{matrix}K\\H\end{matrix}\right\}\Theta} + \underset{\text{Nitric acid.}}{\left.\begin{matrix}N\Theta_2\\H\end{matrix}\right\}\Theta} = \left.\begin{matrix}H\\H\end{matrix}\right\}\Theta + \underset{\text{Nitrate of potassium.}}{\left.\begin{matrix}N\Theta_2\\K\end{matrix}\right\}\Theta}$$

$$\underset{\text{Hydrate of ethyl.}}{\left.\begin{matrix}\text{Ꞓ}_2H_5\\H\end{matrix}\right\}\Theta} + \underset{\text{Nitric acid.}}{\left.\begin{matrix}N\Theta_2\\H\end{matrix}\right\}\Theta} = \left.\begin{matrix}H\\H\end{matrix}\right\}\Theta + \underset{\text{Nitrate of ethyl.}}{\left.\begin{matrix}N\Theta_2\\\text{Ꞓ}_2H_5\end{matrix}\right\}\Theta}$$

$$\underset{\text{Hydrate of potassium.}}{\left.\begin{matrix}K\\H\end{matrix}\right\}\Theta} + \underset{\text{Hydrochloric acid.}}{\left.\begin{matrix}H\\Cl\end{matrix}\right\}} = \left.\begin{matrix}H\\H\end{matrix}\right\}\Theta + \underset{\text{Chloride of potassium.}}{\left.\begin{matrix}K\\Cl\end{matrix}\right\}}$$

$$\underset{\text{Hydrate of ethyl.}}{\left.\begin{matrix}\text{Ꞓ}_2H_5\\H\end{matrix}\right\}\Theta} + \underset{\text{Hydrochloric acid.}}{\left.\begin{matrix}H\\Cl\end{matrix}\right\}} = \left.\begin{matrix}H\\H\end{matrix}\right\}\Theta + \underset{\text{Chloride of ethyl.}}{\left.\begin{matrix}\text{Ꞓ}_2H_5\\Cl\end{matrix}\right\}}$$

The same relations exist between the inorganic and the organic hydrates which contain polyatomic radicals. We may therefore establish the following parallel:—

Monatomic hydrates.	Diatomic hydrates.	Triatomic hydrates.
$\left.\begin{matrix}K'\\H\end{matrix}\right\}\Theta$ Hydrate of potassium.	$\left.\begin{matrix}Mg''\\H_2\end{matrix}\right\}\Theta_2$ Hydrate of magnesium (brucite).	$\left.\begin{matrix}Bi'''\\H_3\end{matrix}\right\}\Theta_3$ Hydrate of bismuth.
$\left.\begin{matrix}(\text{Ꞓ}_2H_5)'\\H\end{matrix}\right\}\Theta$ Hydrate of ethyl.	$\left.\begin{matrix}(\text{Ꞓ}_2H_4)''\\H_2\end{matrix}\right\}\Theta_2$ Hydrate of ethylene (glycol).	$\left.\begin{matrix}(\text{Ꞓ}_3H_5)'''\\H_3\end{matrix}\right\}\Theta_3$ Hydrate of glyceryle (glycerine).

Tetratomic hydrates.	Hexatomic hydrates.
iv. $\left.\begin{matrix}Sn\\H_4\end{matrix}\right\}\Theta_4$ Stannic hydrate.	vi. $\left.\begin{matrix}[Fe_2]\\H_6\end{matrix}\right\}\Theta_6$ Ferric hydrate.
iv. $\left.\begin{matrix}(\text{Ꞓ}_4H_6)\\H_4\end{matrix}\right\}\Theta_4$ Erythrite.	vi. $\left.\begin{matrix}[\text{Ꞓ}_6H_8]\\H_6\end{matrix}\right\}\Theta_6$ Mannite.

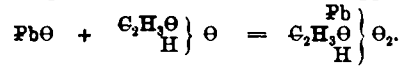
Ethers may be compared to salts. This is evident from their mode of formation, as shown by the preceding equations. It is also proved by certain of their reactions. Thus the action of potash upon ethers may be compared to the action of potash upon salts. When ethers composed of alcohol, glycol, or glycerine are treated with potash, the corresponding hydrates are set free, as hydrate of copper is set free when potash acts upon a salt of copper. And further, MM. Friedel and Crafts have recently proved that an alcohol, when heated with an ether of another alcohol, sets free a certain quantity of the latter, as potash sets free hydrate of copper in a solution of the sulphate. I do not think it advisable to insist upon those analogies which are not evident and recognised by all chemists. I merely wish to compare some ethers of glycol to certain salts.

We may form ethers of glycol by combining directly oxide of ethylene with acids. Thus, by the action of acetic acid upon oxide of ethylene, we may easily obtain two ethers, which are formed by virtue of the following reactions:—

$$\underset{\text{Oxide of ethylene.}}{\text{Ꞓ}_2H_4\Theta} + \underset{\text{Acetic acid.}}{\left.\begin{matrix}\text{Ꞓ}_2H_3\Theta\\H\end{matrix}\right\}\Theta} = \underset{\text{Monacetic glycol.}}{\left.\begin{matrix}\text{Ꞓ}_2H_4\\\text{Ꞓ}_2H_3\Theta\\H\end{matrix}\right\}\Theta_2}$$

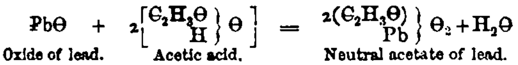
$$\underset{\text{Oxide of ethylene.}}{\text{Ꞓ}_2H_2\Theta} + 2\underset{\text{Acetic acid.}}{\left[\left.\begin{matrix}\text{Ꞓ}_2H_3\Theta\\H\end{matrix}\right\}\Theta\right]} = \underset{\text{Diacetic glycol.}}{\left.\begin{matrix}\text{Ꞓ}_2H_4\\2(\text{Ꞓ}_2H_3\Theta)\end{matrix}\right\}\Theta_2} + H_2\Theta.$$

These reactions correspond in all points to those of acetic acid upon oxide of lead or oxide of copper—



$$Pb\Theta \;+\; \left.\begin{matrix}C_2H_3\Theta\\ H\end{matrix}\right\}\Theta \;=\; \left.\begin{matrix}Pb\\ C_2H_3\Theta\\ H\end{matrix}\right\}\Theta_2.$$

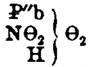
Oxide of lead. Acetic acid. Bibasic acetate of lead.



$$Pb\Theta \;+\; 2\left[\left.\begin{matrix}C_2H_3\Theta\\ H\end{matrix}\right\}\Theta\right] \;=\; \left.\begin{matrix}2(C_2H_3\Theta)\\ Pb\end{matrix}\right\}\Theta_2+H_2\Theta$$

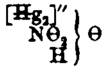
Oxide of lead. Acetic acid. Neutral acetate of lead.

Certain basic nitrates have a similar composition—



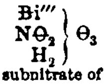
$$\left.\begin{matrix}P''b\\ N\Theta_2\\ H\end{matrix}\right\}\Theta_2$$

Basic nitrate of lead of M. Pelouse.



$$\left.\begin{matrix}[Hg_2]''\\ N\Theta_2\\ H\end{matrix}\right\}\Theta_2$$

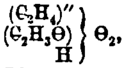
Mercurous mononitrate (colourless soluble rhomboidal prisms: Gerhardt).



$$\left.\begin{matrix}Bi'''\\ N\Theta_2\\ H_2\end{matrix}\right\}\Theta_3$$

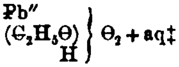
Soluble subnitrate of bismuth.

The neutral acetates of lead and of copper correspond to the ethylenic diacetate; the bibasic acetates of lead and of copper correspond to the ethylenic monacetate—



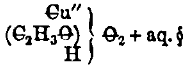
$$\left.\begin{matrix}(C_2H_4)''\\ (C_2H_3\Theta)\\ H\end{matrix}\right\}\Theta_2,$$

Ethylenic monacetate.



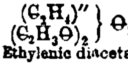
$$\left.\begin{matrix}Pb''\\ (C_2H_5\Theta)\\ H\end{matrix}\right\}\Theta_2+\text{aq}‡$$

Plumbic monacetate.



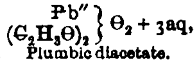
$$\left.\begin{matrix}Cu''\\ (C_2H_3\Theta)\\ H\end{matrix}\right\}\Theta_2+\text{aq}.§$$

Cupric monacetate.



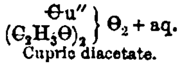
$$\left.\begin{matrix}(C_2H_4)''\\ (C_2H_3\Theta)_2\end{matrix}\right\}\Theta_2,$$

Ethylenic diacetate.



$$\left.\begin{matrix}Pb''\\ (C_2H_3\Theta)_2\end{matrix}\right\}\Theta_2+3\text{aq},$$

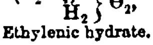
Plumbic diacetate.



$$\left.\begin{matrix}Cu''\\ (C_2H_3\Theta)_2\end{matrix}\right\}\Theta_2+\text{aq}.$$

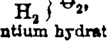
Cupric diacetate.

MM. Maxwell Simpson and Lourenço have described some mixed ethylenic ethers which contain 2 radicals of different acids, each of these radicals replacing 1 atom of the hydrogen in hydrate of ethylene (glycol). Thus there exists an ethylenic acetobutyrate, and this ether may be compared to the barium and strontium acetonitrates which have been described by M. C. de Hauer.‖



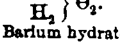
$$\left.\begin{matrix}(C_2H_4)''\\ H_2\end{matrix}\right\}\Theta_2,$$

Ethylenic hydrate.



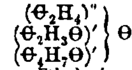
$$\left.\begin{matrix}Sr''\\ H_2\end{matrix}\right\}\Theta_2,$$

Strontium hydrate.



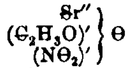
$$\left.\begin{matrix}Ba''\\ H_2\end{matrix}\right\}\Theta_2.$$

Barium hydrate.



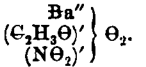
$$\left.\begin{matrix}(\Theta_2H_4)''\\ (\Theta_2H_3\Theta)'\\ (\Theta_4H_7\Theta)'\end{matrix}\right\}\Theta_2,$$

Ethylenic acetobutyrate.



$$\left.\begin{matrix}Sr''\\ (C_2H_3O)'\\ (N\Theta_2)'\end{matrix}\right\}\Theta$$

Strontium acetonitrate.

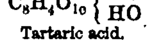


$$\left.\begin{matrix}Ba''\\ (C_2H_3\Theta)'\\ (N\Theta_2)'\end{matrix}\right\}\Theta_2.$$

Barium acetonitrate.

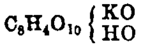
We must here remark that the existence of the strontium and barium acetonitrates supplies an argument in favour of the diatomicity of strontium and barium of the same value as that which Liebig has drawn from the existence of Rochelle salt in favour of the bibasicity of tartaric acid. We know that the composition of tartaric acid was formerly represented by the formula $C_4H_2O_5,HO$, and that it was considered as monobasic. M. Liebig was the first who proposed to double this formula and to consider tartaric acid as containing 2 equivalents of basic water.¶

In cream of tartar, said he, a single equivalent of water is replaced by potash. In Rochelle salt the first is replaced by potash, the second by soda.



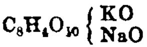
$$C_8H_4O_{10}\left\{\begin{matrix}HO\\ HO\end{matrix}\right.$$

Tartaric acid.



$$C_8H_4O_{10}\left\{\begin{matrix}KO\\ HO\end{matrix}\right.$$

Acid tartrate of potash.



$$C_8H_4O_{10}\left\{\begin{matrix}KO\\ NaO\end{matrix}\right.$$

Anhydrous Rochelle salt.

Thus the existence of the acid tartrates and of the bibasic tartrates led M. Liebig to double the molecular weight and the formula of tartaric acid. In the same way the existence of salts of strontium and barium with two acids may cause the atomic weights of strontium and barium to be doubled.

On Peroxide of Hydrogen and Ozone (Second Part),
by M. C. WELTZIEN.*

(Continued from page 2.)

In the action of peroxide of hydrogen on alkaline hydrates, hydrated peroxides are also formed, but these decompose into water, hydrated protoxides, and oxygen, just as the peroxides of these metals decompose in contact with water—an action in the course of which a little peroxide of hydrogen is inversely produced:—

$$2HK[\Theta+2H_2]\Theta_2 = 2HK\Theta_2+2H_2\Theta,$$

and

$$2HK\Theta_2 = 2HK\Theta+\Theta_2.$$

This action accounts for the instability of peroxide of hydrogen in the presence of alkalies. Its stability in the presence of acids is accounted for by the fact that these neutralise the basic hydrates which may be present, and not, as many chemists believe, on the supposition that the acids form a compound with the peroxide.

Carbonic and boracic acids do not render the peroxide stable, because the alkaline carbonates and borates have an alkaline reaction.

In all the reactions of the peroxide which give rise to an alkaline hydrate—as, for example, in the action of thallium, of the iodide, permanganate, and ferrocyanide of potassium—the decomposition of the peroxide, which is usually attributed to catalytic action, is really the result of the action of the hydrate. Other metallic hydrates and peroxides act in the same way, alternately reducing and oxidising. Thus the action of thallic hydrate on peroxide of hydrogen results partly from a reduction and partly from the action of the thallous hydrate formed on the peroxide.

The action of ferric hydrate on oxygenated water is certainly due to an analogous transformation.

In Fleitmann's process for obtaining oxygen, the solution of chloride of lime acts like peroxide of hydrogen. By the action of peroxide of cobalt protoxide is at first formed, and then there is a new formation of peroxide.

$$CaCl_2[\Theta_2+2Co]\Theta_2=CaCl_2+2Co\Theta_2\Theta_2$$
$$CaCl_2[\Theta_2+2Co]\Theta_2=CaCl_2+2Co\Theta_2.$$

The action of peroxide of hydrogen on iron and its salts is always accompanied by the formation of ferric compounds—

$$2feI_2+3H_2\Theta_2=H_6Fe\Theta_6+2I_2.$$

The most delicate test for peroxide of hydrogen is chromic acid, which gives a blue compound, soluble in ether, and decomposable into oxygen and oxide of chromium. This, according to Barreswil, is perchromic acid, formed according to the equation—

$$2cr\Theta_3+H_2\Theta_2=cr_2\Theta_7+H_2\Theta†$$
$$cr_2\Theta_7=Cr\Theta_3+2\Theta_2.$$

---

‡ $Aq=H_2\Theta$, formula in equivalents $=C_4H_3\Theta_3,2PbO+3HO$.

§ Formula in equivalents $=C_4H_3O_3,2CuO+3HO$.

‖ *Journal für praktische Chemie*, vol. lxxv., p. 431.

¶ *Annalen der Chemie und Pharmacie*, vol. xxvi., p. 154.

* Abstract from *Bulletin de la Société Chimique, &c.*, May, 1866, p. 322.

† $cr=53$ $Cr=106$.

Aschoff and Brodie have both studied this reaction the latter expressing the final result by the equation—

$$2\mathrm{cr}\Theta_3 + 6H_2\Theta_2 = \bar{\mathrm{C}}\mathrm{r}\Theta_3 + 6H_2\Theta + 9\Theta,$$

observing, at the same time, that the reaction probably passes through several stages.

The author, however, thinks it probable that, as expressed above, the blue compound is formed by the addition of one molecule of peroxide of hydrogen to two molecules of chromic acid, so producing perchromic acid, properly so called, and not the anhydride.

$$2\mathrm{cr}\Theta_3 + H_2\Theta_2 = H_2\mathrm{cr}_2\Theta_8.!$$

TECHNICAL CHEMISTRY.

A Theoretical Study of the Manufacture of Soda by Leblanc's Process, by M. J. Kolb.[*] (*Second Part.*)

In the former part of this study, which will be found in places indicated below, the author gave an account of the reactions by which crude soda, black ash or ball soda is produced; and showed that it is essentially a mixture of carbonate of soda with varying proportions of lime and sulphide of calcium. He now goes on to show what changes take place when the black ash comes in contact with water in the digestion and lixiviation.

When ball soda is drawn from the furnace, and while cooling in the air, a decided odour of ammonia is evolved. This the author believes to be owing to the oxidation and decomposition by moist air of the cyanide of sodium formed on the surface of the balls. There is always, he states, a small amount of cyanides present in black ash, owing, as the author shows, to the presence of nitrogenised matter in the coal. In contact with air the cyanide decomposes and carbonate of ammonia is formed, which is volatilised by the heat of the ash.

He next passes on to examine what happens when black ash is exposed to the air for a certain time, describing separately the action of oxygen, of carbonic acid, and of moisture. All the experiments to be hereafter detailed were made upon one and the same ash, carefully made for the express purpose, the percentage composition of which, when drawn from the furnace and cooled protected from the air, was as follows:—

$NaO.CO_2$	47·79
NaO,SO_3	0·92
NaCl	1·85
$NaOSiO_2$	1·52
$NaOAl_2O_3$	1·44
CaS	29·96
CaO	9·68
CaO,CO_2	5·92
Fe_2O_3	1·21
Coal	1·20
Traces of sulphide of sodium, bisulphides and cyanides, loss and matters not estimated	1·51

One hundred grammes of this ash was treated with a litre of water at 15°, and digested for twenty-four hours. The filtered liquid gave—

$NaOCO_2$	38·56
NaO	3·30
NaS	0·25
$NaOSO_3$	0·92

Exposed to air perfectly dry and deprived of carbonic acid for a month, 100 grammes of the ash reduced to powder and then well spread out weighed, at the end of the month, 100·40 grammes. Treated with water as above, the solution gave—

$NaOCO_2$	34·70
NaO	5·70
NaS	0·25

Another sample of 100 grammes exposed for a month to a current of dry air in a stove heated to 100° increased in weight to 100·31, and the solution obtained as above gave—

$NaOCO_2$	34·60
NaO	5·70
NaS	0·30

The same ash heated to redness in the air for four hours increased in weight from 100 grammes to 108·6 grammes, and the analysis, made as before, gave—

$NaOCO_2$	19·00
NaO	5·10
NaS	0·30
$NaOSO_3$	24·30

This action of heated air on black ash has already been observed by Pelouze, who has remarked that the sulphide of calcium is rapidly oxidised to sulphate, especially in the presence of an alkaline carbonate. The treatment with water then causes the following change:—

$$CaOSO_3 + NaOCO_2 = CaOCO_2 + NaOSO_3.$$

The black ash so roasted becomes yellowish, the coal being completely burnt, and the colour being communicated by peroxide of iron.

To ascertain the influence of carbonic acid on the ash, 100 grammes in fine powder were well spread out in an atmosphere of the dry gas, which was frequently renewed. No alteration in weight had taken place at the end of a month, and the analysis showed—

$NaOCO_2$	36·80
NaO	4·45
NaS	0·38

Contrary to the author's expectation, the dry carbonic acid had acted neither on the lime nor the sulphide of calcium, equally dry. Astonished at the result, he then exposed perfectly anhydrous lime to a current of dry carbonic acid, and proved that no absorption or change of weight took place. When, however, but a little moisture is present in the gas and in the lime, absorption takes place rapidly, and the transformation to carbonate is soon complete.

M. Kolb next submitted the same ash to an atmosphere of moist carbonic acid. The absorption was at first energetic, and after some days, whenever the gas was renewed, that removed was found to have sulphuretted hydrogen with it. Under this treatment the 100 grammes of ash in a month became 132 grammes. The solution it gave was of a deep lemon colour; and the results of the analysis were—

$NaOCO_2$	32·50
NaO	0·00
NaS	6·05
NaS_2	4·12

The following changes had taken place:—The moist carbonic acid first of all carbonated the lime (this explains the absence of caustic soda); then its action was transferred to the sulphide of calcium, which it transformed to carbonate of lime, setting free some sulphydric acid: $CaS + HO + CO_2 = CaO,CO_2 + HS$.

Only a part of the sulphydric acid is disengaged; another part unites with sulphide of calcium to form a sulphydrate of the sulphide — $CaS + HS = CaS,HS$.

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[*] Abstract from *Annales de Chimie et de Physique*, June, 1866, p. 135. For abstracts of the former part of the author's memoir see Chem. News, vol. xiii., pp. 140, 162.

The latter in the presence of water becomes bisulphide of sodium.

Lastly, 100 grammes of the same ash were exposed for a month to air at 15°, saturated with moisture, but deprived of carbonic acid. At the end of the month the weight had increased to 157·40 grammes. The analysis gave—

$NaOCO_2$ . .	28·70	$NaOSO_3$ . .	6·27
NaO . .	6·92	$NaOS_2O_2$. .	traces
NaS. . .	0·30		

In this case we observe an oxidation shown by the presence of sulphate of soda. At the ordinary temperature the sulphides of calcium and sodium are both oxidised, but in a different manner. In the case of sulphide of sodium the oxidation is rapid but incomplete; it stops at the formation of hyposulphite, which remains unchanged under ordinary atmospheric conditions. With sulphide of calcium the oxidation is slower. Hyposulphite is also formed, but this is soon converted into sulphate of lime, which exchanges acids with the carbonate of soda in the presence of water.

Such is the cause of the presence of hyposulphites in crude sodas; they could not be formed in the furnace, where, indeed, they would be immediately decomposed. It is not surprising, then, that a well-made ash—that is to say, one not containing sulphide of sodium—should give no trace of hyposulphites even after long exposure to moist air, while 2 or 3 per cent. of hyposulphites may be found in over-roasted ash, which is rich in sulphide of sodium.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, July 5.

Prof. W. A. Miller, *M.D., F.R.S., President, in the Chair.*

This being an extraordinary meeting of the Society, there were no steps taken towards the election of candidates.

The new *Standard Metres* upon glazed porcelain were exhibited and described by Mr. James Yates, M.A., F.R.S. These have been made in accordance with the suggestions offered at a meeting of the Society in December last,* and consisted of plates of white glazed porcelain about forty inches long and five-eighths of an inch in thickness, their surfaces being divided and marked by different processes, and with variously coloured pigments. One metre was true to the $\frac{1}{5000}$th part of its length, and was very conspicuously divided throughout with thick black lines. Another scale showed the yard and metre more accurately in immediate proximity, and coloured red and blue respectively; whilst a third scale showed the effect of leaving a clear space between the graduations of the metre and yard. They were all neatly mounted in mahogany frames, and ready for fixing as mural tablets. Their manufacture had been undertaken by Mr. L. P. Casella, of Hatton Garden, who, with regard to the nature of the material, had adopted the recommendation of Professor Frankland, and it was found that when properly baked in the first instance the porcelain suffered no further contraction in the after process of firing the coloured glaze.

Mr. Casella gave some further particulars respecting the manufacture of the scales, and

Dr. **Frankland** suggested that the edges—in fact, all surfaces—of the porcelain plates should be protected by glaze, for he had observed in one of Sir Benjamin Brodie's garden thermometers an instance of the disintegration of glazed porcelain by frost.

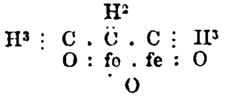
Mr. David Forbes, having paid particular attention and made a great number of experiments upon the glazing of porcelain, hesitated to believe that this material would resist the action of frost. He never saw any description of glazed ware which withstood exposure to a Norwegian climate; the best samples were those of thin substance in which the glaze applied to both surfaces almost met in the centre. The speaker advocated the use of a perfectly vitrified, instead of a semi-vitrified, material, and recommended opal-coated glass, which could hardly be distinguished from white porcelain.

After further observations from Sir Benjamin Brodie, Dr. Frankland, Mr. Brayley, and others, Mr. Yates, and with him Lord Wrottesley, as President of the Weights and Measures Committee of the British Association, acknowledged the aid rendered by the Chemical Society in offering suggestions as to the material best suited to the manufacture of their new metrical standards.

Professor A. W. Williamson then gave a brief discourse "*On the Constitution and Representation of Organic Compounds*," in which he described a new mode of exhibiting rational formulæ by the help of dots or points to indicate the value of the atomicities. The author reviewed the systems of notation in common use, particularly alluding to the string of beads (or "sausages," as they have been humorously termed) of Kekulé; to the system of rakes—thus, $\underline{|\;\;|\;\;|\;\;|}$; to the use of brackets, including the substances combined with the carbon written in a column: and, lastly, to the spheres with arms, or poles, introduced by Dr. Crum Brown. The author claimed for his new system the advantages of greater simplicity, and the power of representing a compound by a specific picture, without at the same time hazarding any hypothesis as to the mode of arrangement of the atoms in a molecule. It was, however, like all other pictorial systems, open to the objection that the atoms must be represented in a statical condition, and always shown on the same plane. It must be granted likewise that the use of the dot for another purpose by Berzelius, and lately by Dr. Debus, is not an insuperable difficulty. Professor Williamson then gave a clear exposition of his proposal, and wrote a great number of examples showing the application of his formulæ upon the black board. Amongst them were the following:—

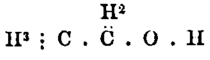
Hydrogen	$H . H$
Oxygen	$O : O$
Nitrogen	$N \vdots N$
Carbon	$C \,\text{⁞}\, C$
Phosphorus	$\begin{array}{c} P : P \\ \dot{P} : \dot{P} \end{array}$
Acetylene	$H . C \vdots C . H$
Olefiant gas	$H^2 : C : C : H^2$
Ethylic hydride	$H^3 \vdots C . C \vdots H^3$
Ferric chloride	$Cl^3 \vdots fe . fe \vdots Cl^3$.

The speaker then referred to a number of examples which required for their representation more than one line, and it was immaterial whether the outstanding constituent was shown above or below, thus—

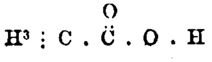


Propylic hydride $H^3 \vdots C . \overset{H^2}{\ddot{C}} . C \vdots H^3$

Ferric oxide $O : \underset{\overset{\cdot}{O}}{fe} . fe : O$



Alcohol $H^3 \vdots C . \overset{H^2}{\ddot{C}} . O . H$



Acetic acid $H^3 \vdots C . \overset{O}{\ddot{C}} . O . H$

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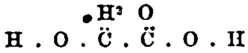
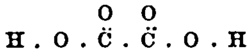
* *Vide* Chemical News, vol. xii., p. 305.

Glycollic acid 

$$H . O . \overset{\bullet H^2}{\ddot{C}} . \overset{O}{\ddot{C}} . O . H$$

Oxalic acid 

$$H . O . \overset{O}{\ddot{C}} . \overset{O}{\ddot{C}} . O . H$$

The formulæ of several isomeric bodies of the three-carbon series were then represented, particularly those of acetone, aldehyde, allylic alcohol, and methyl-ethyl ether; and the Lecturer proceeded to show the manner in which replacements could be effected, taking for illustration benzol, and producing from it kreosote, pyrogallic acid, and toluol. With regard to the sign of atomicity or equivalence in these formulæ, Dr. Williamson first endeavoured to use lines instead of points, but he considered them objectionable, inasmuch as they were likely to be mistaken for the signs of equality and minus.

The President considered some of the formulæ to be unnecessarily protracted, and made inquiry respecting the modes of abbreviation. In his opinion the new formulæ did assert the constitution as well as the composition of a molecule.

Dr. Frankland explained the system (of brackets) which he was in the habit of using, and showed the abbreviations of which it was capable; thus he would not hesitate to write $CMeH_3$, $CMe''H_2$, &c., and the water-residue hydroxyl thus, Ho. There were defects in the graphic formulæ both of Kekulé and Crum Brown, and in Dr. Williamson's symbol notation there was the liability of mistaking points (often ill-formed in manuscript) for figures.

Dr. Debus cleared himself from the imputation of having employed dots in his formulæ in two different senses; their position on or above the line was sufficiently indicated, thus—

Alcohol $CH_3 . CH_2\dot{H}$.

Sir Benjamin Brodie wished for a clearer explanation of the meaning of the point, and to know by what process of reasoning the author had arrived at a knowledge of the internal constitution of his molecules. The growth of a formula in any simple case ought to have been shown.

Dr. Odling contrasted the various systems of notation used by the previous speakers, and objected to the principle of employing an old symbol under a new signification.

Dr. Williamson replied to the several objections, and, in answer to Sir B. Brodie, quoted the successive removal of hydrogen atoms from the marsh-gas molecule. Abbreviations were allowable, and he would often contract one half of the formula and leave it intact, whilst the other half was undergoing change. The same substance might therefore be differently expressed according to the nature of the reaction about to be defined.

At this stage of the proceedings the President vacated the chair, which was then filled by Sir Benjamin Brodie.

Mr. W. Thorp then read a paper "*On the Reduction of the Oxides of Nitrogen by Metallic Copper in Organic Analysis.*" The experiments made by the author were directed to the removal of sources of error in the determination of nitrogen by volume, as in Dumas' method, and were conducted with the superior means of heating afforded by Hofmann's gas-combustion furnace. Copper wire was flattened to a ribbon of about 3·5 mm. in width, and made into spirals fitting one within another. A length of about 200 mm. was then oxidised, and subsequently reduced in the usual manner, and through the tube containing the copper was passed first carbonic acid and afterwards the mixture of this gas with nitric oxide to be experimented upon. If the flow of gas be moderated to 2 c.c. per minute and the heat maintained at bright redness, nothing but nitrogen was collected in the gas receiver filled with potash and standing over mercury. Other results were obtained at lower temperatures, when it was found that 4, 5, and even 10 per cent. of the nitric oxide escaped decomposition. Aqueous vapour adds somewhat to the difficulties of the method, but the author concludes that it is only necessary to maintain the heat at bright redness and to pass the gas slowly to ensure the evolution of the whole of the nitrogen in the elementary form.

Dr. Frankland referred to the practical difficulties encountered in former attempts to decompose the whole of the nitric oxide when the charcoal furnace was used.

The Secretary then read a "*Note on the Hydrocarbons contained in Crude Benzol,*" by Mr. C. Schorlemmer. By acting with bromine upon crude benzol, boiling between 80°–82° C., digesting with sodium and fractionating, the author obtained a mixture of hydrocarbons which by a second treatment with bromine furnished amongst other products the compound $C_6H_{10}Br_2$. By adding an excess of bromine to this liquid, long, white, needle-shaped crystals gradually separated out, which after washing with alcohol proved to have the composition $C_6H_{10}Br_4$. These crystals melt at 112° C., and distil without decomposition at 318° C. From these results the author infers that crude benzol contains, besides members of the olefine series, the hydrocarbon C_6H_{10}, which may be identical with the "hexoylene" of M. Caventou, which boils at 80°—85° C. For the preparation of a very pure sample of benzol Mr. Schorlemmer recommends that the crude mixture of hydrocarbons should be treated with bromine, and subsequently with potash, before rectification. Such a product furnishes a nearly colourless nitrobenzol, and dissolves in concentrated sulphuric acid almost without coloration.

Another communication, entitled "*Note on Ethyl-Hexyl Ether,*" by the same author, was read by the Secretary. When acting upon chloride of hexyl with alcoholic potash, Cahours and Pelouze discovered that the hexylene—the main product of the reaction—was mixed with other substances. One of these latter has been identified by Mr. Schorlemmer, and proved to have the composition $C_8H_{18}O$. This body is assumed to be the ethyl-hexyl ether, and may be viewed thus—

$$\left.\begin{matrix} C_2H_5 \\ C_6H_{13} \end{matrix}\right\} O.$$

A vote of thanks was passed to the respective authors, and at a late hour the meeting was adjourned until November.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, May 4, 1866.

Sir Henry Holland, *Bart., M.D., D.C.L., F.R.S., President, in the Chair.*

On Recent Progress in the History of proposed Substitutes for Gunpowder, by Professor F. A. Abel, *F.R.S., V.P.C.S., Chemist to the War Department.*

(*Continued from page 6.*)

The conversion of purified lignin or wood fibre into an explosive substance of the same nature as gun-cotton, was accomplished by chemists soon after Schönbein's discovery of gun-cotton was made known. Finely divided wood, or sawdust, may, by treatment with suitable agents, be to a very considerable extent purified of substances foreign to cellulose; and if then submitted to careful digestion in a mixture of the strongest nitric and sulphuric acids, and properly purified, it furnishes a highly explosive material similar to the most explosive gun-cotton, and possessed apparently of considerable stability. Captain Schultze, a Prussian artillery officer, who was entrusted by his government a few years ago with the investigation of gun-cotton, appears to have come to the conclusion that finely-divided wood offered greater prospect of conversion into a controllable explosive agent than cotton wool. The ultimate result of his investigations has been the production of a "gun-sawdust," the explosive properties of which depend in great measure upon its impregnation with a considerable proportion of an oxidising agent, either saltpetre or a mixture of that salt and nitrate of barium. The wood, having been reduced to a tolerably uniform state of division, is submitted by Captain Schultze to purifying processes for the separation of resinous and other substances from the lignin, and the product is converted by digestion in a mixture of sulphuric and nitric acids into a very feebly explosive material, which leaves a considerable carbonaceous residue when burnt. This product after purification is impregnated with a sufficient proportion of nitrates to give it rapidly explosive power, the oxidation of the carbon being now almost complete. The objects which appear to be aimed at by Captain Schultze in following this method of manufacturing a wood-gunpowder, are, the production of a more gradually explosive material than is obtained by the most perfect action of nitric acid upon wood-fibre, and the possibility of preserving the material in a slightly explosive and therefore comparatively harmless form until it is required for use, when it may be soon rendered powerfully explosive by impregnation with the nitrates. It is asserted that this powder is considerably more powerful than gunpowder as a mining agent; and that, by its employment in mines, the operators are enabled to return to work sooner than when gunpowder is used, because there is little or no smoke produced by its explosion. The latter is an undoubted advantage which Schultze's powder shares with gun-cotton. Advantages are also claimed for this material when employed in firearms, and it is possible that, when applied to sporting purposes, it may compete successfully with gunpowder in this direction also; but its behaviour as an explosive, and the peculiarities of its structure, afford little promise of its advantageous employment in arms for military and naval purposes.

Important progress has been made in the history and the practical application of gun-cotton since its study was resumed in this country about three years ago. Very considerable quantities of the material have been manufactured at the works of Messrs. Prentice at Stowmarket, and at the Government Gunpowder Works at Waltham Abbey; its application to mining and artillery purposes, and to small arms, has been, and is still, the subject of systematic experiment, conducted by the Government Committee on Gun-cotton; its employment as a blasting agent is steadily increasing in several important English mining districts; and considerable, though not uniform, success has already attended the employment of gun-cotton cartridges for sporting purposes.

The system of manufacture of gun-cotton, as perfected by Baron Von Lenk, has undergone but trifling modifications in its employment in this country. It has been made the subject of careful investigation by Mr. Abel, and the results furnished by many experimental manufacturing operations and an examination of the products have shown that the process of converting cotton into the most explosive form of pyroxilin or gun-cotton, and of purifying the material, have been so greatly perfected by Von Lenk as to render a strict adherence to his simple and precise instructions alone necessary to ensure the preparation of very uniform products, which exhibit in their composition a very much closer approximation to purity than those obtained in the earlier days of the history of gun-cotton.

Although the conclusions arrived at by the many chemists who investigated the composition of gun-cotton, soon after Schönbein's discovery, varied very considerably, the constitution has been very generally regarded as definitely established by the researches of Hadow, published in 1854. According to that chemist, the most explosive gun-cotton has the composition expressed by the formula $C_6H_7N_3O_{11}$ (which was first assigned to the substance by W. Crum, in 1847), and may be regarded as cellulose, in which three atoms of hydrogen are replaced by three molecules of peroxide of nitrogen. The name *trinitro-cellulose* has therefore been assigned to gun-cotton, its constitution being expressed by the formula—

$$C_6\left\{\begin{matrix}H_7\\ 3NO_2\end{matrix}\right\}O_5.$$

Hadow's conclusions have since been confirmed by other chemists, more especially by Redtenbacher, Schrötter, and Schneider, who have analysed specimens of gun-cotton prepared under Von Lenk's directions. But a report upon the Austrian gun-cotton was published in 1864 by Pelouze and Maury, in which the formula $C_{24}H_{36}O_{18},5N_2O_5$ is assigned to the product of Von Lenk's process; the conclusions of those chemists being founded partly upon some analytical results, and partly upon the increase of weight which they found cotton to sustain when submitted to treatment with the mixed acids. They found the greatest increase in weight to be 78 per cent.—a number slightly in excess of that which would correspond to the requirements of the formula which they adopt.

An experimental inquiry into the composition of gun-cotton, as obtained by Von Lenk's process, has been instituted by Mr. Abel; and the very numerous analytical and synthetical results which he has obtained confirm the correctness of the formula assigned by Crum and Hadow to the most explosive gun-cotton, and demonstrate satisfactorily that the products obtained by following strictly the instructions given by Von Lenk are invariably trinitro-cellulose, in a condition as nearly approaching purity as a manufacturing operation can be expected to furnish.

The most explosive gun-cotton is perfectly insoluble in mixtures of ether and alcohol; but by varying the proportions and strength of the acids employed for the conversion of cotton, products of less explosive character are obtained, which are more or less freely soluble in ether and alcohol (furnishing the well-known material collodion). If, therefore, in manufacturing gun-cotton, the conditions essential to the production of insoluble pyroxilin are not strictly fulfilled, the uniformity of the product will suffer.

The ordinary products of manufacture are never altogether free from soluble gun-cotton; but the proportion present is small and very uniform, amounting to about 1·5 per cent. They contain, besides, a small quantity (about 0·5 per cent.) of matter soluble in alcohol alone, and possessed of acid characters, which is evidently produced by the action of nitric acid upon such small quantities of resinous or other matters foreign to pure cellulose as are not completely removed from the cotton fibre by the purification which it receives.

There appears good reason to believe that this impurity in gun-cotton is of comparatively unstable character, and that the great proneness to spontaneous decomposition which has been observed by Pelouze and Maury, De Luca, and others, in some specimens of gun-cotton, is to be ascribed in great measure to the existence in those specimens of comparatively large proportions of those unstable by-products.

One hundred parts of carefully-purified cotton wool have been found by Mr. Abel to furnish from 181·8 to 182·5 parts of gun-cotton. The increase which perfectly pure cellulose should sustain by absolutely complete conversion into a substance of the formula $C_6H_7N_3O_{11}$ (trinitro-cellulose) is 83·3; the above results are therefore strong confirmations of the correctness of this generally-accepted view of the composition of gun-cotton. In carrying out the actual manufacturing process as prescribed by Von Lenk, somewhat lower results are obtained, because of impurities existing in the cotton employed, and of loss of product during its purification.

Very extensive experiments are in progress at Woolwich, with the view of examining fully into the extent of liability to change of gun-cotton when preserved in store, or exposed for prolonged periods to light and to degrees of heat ranging between the ordinary atmospheric temperatures and that of boiling water. The results hitherto arrived at, though they have shown that, under severe conditions, gun-cotton is liable to decompose, have not confirmed the conclusions arrived at by the French chemists with regard to the great instability of the material. Thus De Luca states that all specimens exposed by him to sunlight decomposed either on the first day or within a few days. But at Woolwich no single instance of such rapid decomposition of gun-cotton, made by the present process, has been noticed. A very gradual and slight development of gas occurs after a time when the substance is exposed to sunlight; but the quantity which has been collected from specimens exposed at Woolwich to direct day- and sun-light for two years and a half is very small, and the gun-cotton has in all instances preserved its original appearance. Pelouze and Maury state that gun-cotton always decomposes perfectly within a few days, by exposure to temperatures of 55°—60° C. (130°—140° F.), and they lay great stress upon the explosion of a specimen directly it was introduced into a vessel heated to 47° C. (116·6° F.). But at Woolwich a specimen of ordinary product which has been exposed now for twelve months to 65° C. (150° F.) has evolved only a small quantity of gas, and retains its original appearance perfectly. Several specimens, after having been exposed for some hours to a temperature of 90° C. (194° F.), during which period some nitrous vapours were in all instances evolved, have since been exposed to light in closed vessels for about twenty months, and still retain their original appearance and explosive characters. Several large ammunition cases, closely packed with gun-cotton, have been preserved for six months in a chamber, the temperature of which was maintained for three months at 49° C. (120° F.), and afterwards at 54°—55° C. (130° F.), arrangements having been made for periodically registering the temperature within the boxes, which were kept closed. In no instance has the latter temperature risen to an extent to indicate serious chemical change, *i.e.*, it has always been below the temperature of the air in the chamber. These few examples of results already obtained are given to show that the behaviour of gun-cotton manufactured in England by Von Lenk's process does not, as yet, at all justify the condemnation which the material has recently received in France.

One most important point in connection with the preservation of gun-cotton appears to have been lost sight of by the French experimenters. The material may be most perfectly preserved, apparently for any period, either by immersion in water, or, still more simply, by being impregnated with just sufficient moisture to render it perfectly uninflammable. In this condition gun-cotton is much safer than gunpowder can be rendered, even by mixture with very large proportions of incombustible materials. It may be transported with quite as much safety as the unconverted cotton; indeed, it appears to be very much less prone to gradual decay, if preserved for very long periods in a damp condition, than cotton or other vegetable substances. Many specimens of gun-cotton, preserved for several months in a very damp chamber, together with paper, cotton fabrics, and wood, retained their strength of fibre and all their original properties, and had no signs even of mildew upon them, while the paper fabrics in immediate contact with them had completely rotted away, and the wood was covered with fungi.

Considerable progress has been made in the manipulation of gun-cotton, with the object of modifying its explosive action. The rapidity with which gun-cotton burns in open air admits of ready and very considerable variation by applying the simple expedients of winding, twisting, or plaiting gun-cotton yarn of different sizes. But although a mass of gun-cotton may be made to burn in a comparatively gradual manner by being very tightly wound, a charge of the material in that form acts quite as destructively when exploded in the bore of a gun as an equal charge consisting of the yarn wound very loosely, because the pressure of gas established by the first ignition of the charge renders the compact packing of the gun-cotton powerless to resist the instantaneous penetration of flame between the separate layers of the material. The assertion that a power had been acquired of controlling the explosive action of gun-cotton in a firearm by simply varying the compactness with which the material was twisted or wound, has therefore proved quite erroneous. There are, however, two methods of reducing the rapidity of explosion of gun-cotton, which are much more likely to furnish successful results. The one consists in diluting the material by its admixture either with a less explosive variety of gun-cotton or with some inexplosive substance, such, for instance, as the cotton in its original form. The latter mode of dilution has recently been applied by Messrs. Prentice to the construction of cartridges for sporting purposes, and they describe the results already arrived at as very promising. The second method of controlling the explosion of gun-cotton consists in consolidating the material by pressure into compact homogeneous masses, and in confining the first ignition of such compressed gun-cotton in the bore of the gun to certain surfaces. The gun-cotton fibre in the form of yarn or plait may be compressed into very compact masses by being rammed into strong cylinders of pasteboard or other suitable material; but much more perfectly homogeneous and solid masses are produced, independently of cylinders or other cases, by a method which Mr. Abel has recently elaborated, and which consists in reducing the gun-cotton fibre to a fine state of division or pulp, as in the process of paper-making, and in converting this pulp by pressure into solid masses of any suitable form or density.

This method of operating affords also special facilities for combining both methods, dilution and compression, of reducing the explosive violence of gun-cotton. The material is, in fact, operated upon by this system, in a manner exactly corresponding to the processes by which the explosive action of gunpowder is regulated to so remarkable an extent. Some results, which are admitted by the most sceptical as encouraging, have already been arrived at in the systematic course of experiments which are in progress with the object of applying the methods of regulation pointed out to the reduction of gun-cotton to a safe form for artillery purposes. Its arrangement in a form suitable for small arms is a much less difficult problem, which may be considered as approaching a perfect solution. For employment in shells and for military mines, both land and submarine, the compressed or solid form of gun-cotton presents special advantages, on account of the great compactness which may be imparted to it; a given weight arranged so as to ignite instantaneously under pressure (*i. e.*, in strong vessels), may be made to occupy the same space as an equal weight of gunpowder, whereas the forms of gun-cotton hitherto applied to these purposes occupy about three times the space of gunpowder.

Beautiful pyrotechnic effects may be readily produced by means of gun-cotton, though the absence of smoke, which, in some of its applications (especially in mines), would constitute an important advantage, detracts from some of the effects which may be obtained with pyrotechnic compositions. On the other hand, gun-cotton fireworks may be displayed indoors without inconvenience.

There appears at present no reason to doubt that the application of gun-cotton with great advantage to at least some of the more important purposes for which gunpowder is used, will ere long be fully established, and that this interesting explosive agent is destined to occupy a permanent and prominent position among the most important products of chemical industry.

ACADEMY OF SCIENCES.—*July 2.*

M. Becquerel presented a memoir "*On the Formation of Various Compounds, and particularly Silicates, by Slow Reactions.*" The extract from this memoir published gives us but little information of interest or novelty. The general method by which he forms silicates is by saturating a porous body with one solution, which will react slowly on another solution in which the porous body is placed. Thus he saturated a lump of chalk with a solution of nitrate of copper, and then immersed it in a solution of silicate of potash. The result, in course of time, was the formation of silicate of lime, and carbonate and nitrate of potash. By using in a similar way aluminate of potash, the author obtained prismatic crystals of aluminate of lime. A double silicate of lime and potash was obtained by causing a solution of silicate of potash to run for a lengthened period over a plate of gypsum. Part of the memoir is devoted to a notice of some reductions which take place under the influence of electricity. This offers nothing of interest. The following method of producing basic chromate of lead is new to us. The yellow chromate is made into a paste with water, spread on a plate of zinc, and covered with a glass plate. The zinc reacts on the chromate, removing one equivalent of chromic acid and leaving the vermilion-coloured basic chromate.

M. Aug. Cahours presented a note "*On Vapour Densities.*" Where is the necessity, the author asks, for believing that the molecules of all bodies must give absolutely four volumes of vapour? Why may not one vapour correspond to eight volumes, while another is represented by four volumes? Must we really admit the fact of dissociation in all cases of eight volumes? M. Cahours, whose labours on this subject have extended over many years, believes that a volatile compound in a state of vapour only exists in one grouping representing four or eight volumes; it might, he thinks, represent two or six volumes, but this mode of grouping is still unknown to us. He does not believe in three or six volumes. M. H. St. Claire Deville made some remarks after M. Cahours. He believes that the vapour volume may vary with the temperature, and appears to think it too early yet to dogmatise on the subject. We may perhaps take another opportunity of presenting the reasoning of both these gentlemen more fully.

M. Nicklés presented a second note "*On New Solvents of Gold,*" in which he showed that iodine under pressure, or even under the influence of light, will dissolve gold-leaf. The sesqui-iodide and sesqui-bromide of iron also act as solvents.

M. de Charcourtois communicated a note "*On the Natural and Artificial Production of the Diamond.*" The author believes that the diamond is formed in consequence of the decomposition of hydrocarbons, just as free sulphur results from the decomposition of hydro-sulphuretted emanations. The hydrogen in these cases combines with oxygen, leaving the other element free. Many methods of producing diamonds have been thought of, but no one has yet thought of imitating the process followed by Nature, which the author suggests may be done as follows:—Submit a very slow current of marsh-gas or a hydrocarbon vapour accompanied by the vapour of water to a very mild oxidising action in a mass of sand containing traces of putrescible matter—flour, for example. The author is not slow to point out that this very process has been going on under our noses for a good many years past, and he suggests that diamonds, or at least diamond-dust, may be found in the black earth that surrounds the gas-pipes where they leak under our streets.

Dr. Frankland was elected a corresponding member of the Academy by twenty-nine out of thirty-five votes.

Bismuth Test for Glucose.—MM. Francqui and Vyvere prepare the test as follows:—Nitrate of bismuth is first precipitated by a considerable excess of potash; the mixture is then moderately heated, and tartaric acid added until the precipitate is dissolved, when the re-agent is ready. A few drops of this test boiled with diabetic urine gives a black deposit of metallic bismuth.

NOTICES OF BOOKS.

Journal de Pharmacie et de Chimie. June, 1866.

The above-named journal contains two or three articles which we have not had the opportunity of noticing before. One is entitled "*Chemical Researches on the Brain,*" by M. A. E. Bourgoin, which gives the results of well-executed experiments performed under the direction of M. Berthelot. Perhaps the most important result the author has arrived at is the fact that *cerebrine*, or cerebric acid, does not contain phosphorus. In what combination this element does exist in cerebral matter the author does not explain. He tells us, however, that it is found in much larger quantity in the grey matter than in the white; that the amount found in the brain may vary within rather extensive limits, but that the average proportion present amounts to 2 per cent. of the dried cerebral matter. The amount of water present is about 73·5 per cent. of the white substance and 83 per cent. of the grey. The author seems to doubt whether there is any relation between the amount of the phosphorus present in a brain and the intelligence of the individual it belonged to. He seems to think that phosphorus may become concentrated, so to say, in a brain, for that one in which he found the largest quantity belonged to an individual who died of phthisis, and it might be that the properly called fatty matters exempt from phosphorus may be absorbed at a greater rate than the principles which contain the phosphorus. The amount of nitrogen in a brain also appears to vary considerably; the grey matter contains most, but the average amount in the dried grey and white substances taken together appears to be about 7 per cent. The general examination appears to indicate the presence of several albuminoid principles which require a fuller examination.

The next paper we may notice, and which we shall shortly give in detail, relates to the "*Employment of Magnesium in Toxicological Examinations.*" The paper by M. Roussin, read before the Pharmaceutical Society of Paris, shows that this metal may advantageously replace zinc in toxicological examinations for metals. Magnesium has the double advantage of rapidly and completely precipitating poisonous metals without the danger of introducing any other poisonous substance. Arsenic and antimony are not precipitated, but will be found of course in the gas disengaged and the liquid remaining. The author destroys organic matter by the usual methods, concentrates the acid liquor, and then introduces plates of magnesium as long as any deposit is formed. This precipitate is washed and examined by the usual method for metals. If the operation be conducted in a Marsh's apparatus, the gases may at the same time be examined for arsenic and antimony.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

1207. A. V. Newton, Chancery Lane, "Improvements in the manufacture of steel."—A communication from E. L. Bonreisler, Philadelphia, Penn., U.S.A.—Petition recorded April 28, 1866.

1256. P. Spence, Manchester, "Improvements in the separation of certain metals from their ores, and in the production of sulphide of ammonium to be used in the process, which sulphide is also applicable to other purposes for which that salt is required."—May 3, 1866.

1537. A. Paraf, Manchester, "Improvements in dyeing, printing, and other operations based on chemical reactions."—A communication from M. Paraf, Tuval, Thann, France.—June 2, 1866.

1564. A. Parkes, Birmingham, "Improvements in the manufacture of compounds in the nature of kamptulicon."—June 6, 1866.

1232. J. Thomas, Battersea, Surrey, and A. Prince, Trafalgar Square, Charing Cross, Middlesex, "Improvements in reverberatory blast and other furnaces for smelting ores, and in the means of extracting the precious metals therefrom."—Petition recorded May 1, 1866.

1594. T. J. Leigh, Lansdowne Cottages, Denmark Street, Camberwell, Surrey, "Improvements in the method of burning coals (whether large or small coals), coal dust, coke, coke dust, charcoal, wood, and other combustible substances, as also hydrocarbons and gases, and in the arrangement of the furnaces applicable thereto."—June 12, 1866.

1615. G. D. Malam, Halifax, Yorkshire, "The purifying of ammoniacal liquor by an improved process, and the application of such purified ammoniacal liquor to the purifying of coal gas."

1623. W. Knaggs, Euston Grove, Euston Square, Middlesex, "Improvements in the manufacture of sugar, and in the apparatus employed therein."

1625. V. Gallet, Lavausseau de Benassais, Vienne, France, "Improvements in the manufacture of cast steel."—June 14, 1866.

1626. L. A. de Milly, Rue de Calais, Paris, "A new process in the treatment of concrete fatty acids for the manufacture of candles called 'stearine candles.'"

1628. B. F. Stevens, Henrietta Street, Covent Garden, Middlesex, "A new or improved method of treating permanent inflammable gases, whereby greater heat is obtained therefrom."—A communication from S. Stevens, New York, U.S.A.—June 15, 1866.

1637. G. L. Léclanché, Rue Gaillon, Paris, "Improvements in voltaic piles."—June 16, 1865.

1639. J. E. T. Woods, Camberwell Grove, Surrey, "Improvements in the manufacture of pigments."

1640. W. B. Patrick, Mincing Lane, London, "Improvements in the treatment of animal charcoal used by sugar refiners or others, in order to its re-use."—June 18, 1866.

1642. A. Paraf, Manchester, "Improvements in fixing colouring matters on textile fabrics, yarns, or other materials."—June 19, 1866.

1654 D. A. Fyffe, Glammis, Forfarshire, N.B., "Improvements in the manufacture of pulp."

1657. J. Möller, Shaftesbury Villas, Hornsey Rise, Middlesex, "Improvements in obtaining and preparing colouring matter for printing, dyeing, and other purposes."—June 20, 1866.

1697. J. Young, jun., Limefield, Midlothian, N.B., "Improvements in apparatus for the treatment of hydrocarbon oils."

1703. W. R. Lake, Southampton Buildings, Chancery Lane, "Improvements in the manufacture of white lead."—A communication from W. Bell, T. M. Fell, and A. G. Fell, New York, U.S.A.—June 26, 1866.

1707. H. Medlock, Tavistock Square, Middlesex, and W. Bailey, Wolverhampton, "Improvements in preserving animal substances."

1710. W. R. Lake, Southampton Buildings, Chancery Lane, "Improvements in the mode of distilling or separating volatile products from oils and other fluids."—A communication from H. L. Smith, Gambier, Ohio, U.S.A.—June 27, 1866.

NOTICES TO PROCEED.

513. J. Kidd, Battersea Rise, Surrey, "Improvements in carburetting low pressure superheated steam, air, or coal gas for lighting and heating purposes, for generating steam or hydrocarbon vapour, and in apparatus employed therein."—Petition recorded February 17, 1866.

545. J. D. Brunton, Leighton Crescent, Kentish Town, Middlesex, "Improvements in the manufacture of peat fuel, and in the machinery employed therein."

550. C. de Cæsaris, Bermondsey, "Improvements in preparing hides and skins for tanning." February 22, 1866.

565. R. Milburn, jun., Tulse Hill, Brixton, and W. H. Baxter, Elm Cottage, Brixton Hill, Surrey, "Improvements in the treatment of brewers' and distillers' grains."—February 23, 1866.

606. W. E. Newton, Chancery Lane, "An improved process of, and apparatus for, distilling petroleum and other liquid substances."—A communication from J. P. Vincent, J. S. Richards, O. Noble, C. H. Lovelin, and H. Rawle, Erie, Pennsylvania; and L. S. Fales, New York, U.S.A.—February 28, 1866.

921. J. Davis, Sussex Road, Southsea, Hants, "An improved method of preventing the putrefactive decomposition of vegetable and animal substances, and utilising the same for agricultural purposes."

922. J. Davis, Sussex Road, Southsea, Hants, "Improvements in obtaining caustic alkalies to be used as disinfectants and decarbonisers, and the means by which the same are to be applied, as also for applying the gases liberated in the process to the conversion of iron into steel, and for the manufacture of manures."—March 31, 1866.

1649. G. T. Bousfield, Loughborough Park, Brixton, Surrey, "An improved process of utilising waste vulcanised india-rubber, and manufacturing hard rubber therefrom."—A communication from C. McBurney, Roxbury, Norfolk, Mass., U.S.A.—June 19, 1866.

CORRESPONDENCE.

Amount of Sulphuric Acid obtainable from Pyrites.

To the Editor of the CHEMICAL NEWS.

SIR,—I beg to give the following results in answer to the inquiry of "W. L. R." in your last number:—1 ton of Irish pyrites at 30 per cent. sulphur should make theoretically 1 ton 1 cwt. 3 qrs. $23\frac{403}{835}$ lbs. of acid at 1750 strength.

On account of a slight loss of gas being almost inevitable while in chambers and a small percentage of sulphur being left in burnt residue, I find the practicable quantity one is able to obtain from 1 ton of pyrites is as follows:—18 cwts. 1 qr. 5 lbs. to 18 cwt. 2 qrs. Hoping this may be satisfactory to "W. L. R.," I am, &c.

A PRACTICAL CHEMIST.

July 9, 1866.

MISCELLANEOUS.

Chemical Society.—We have been requested to insert the following addendum to our report of the meeting of the Chemical Society on the 21st ult.:—

Mr. NEWLANDS inquired whether Dr. Debus considered it possible, in accordance with the views which he had just brought before the Society, for two hydrocarbons to exist having the formula C_2H_6, alluding, of course, to the disputed identity of methyl and hydride of ethyl. Also, after mentioning the fact that the two atoms of carbon might in ethylic hydride be considered as united by one affinity, in olefiant gas by two affinities, in acetylene by three affinities, and, lastly, in the molecule of free carbon by four affinities, Mr. Newlands inquired whether Dr. Debus considered it necessary to admit the existence of bivalent carbon in carbonic oxide.

Dr. DEBUS replied that, according to the present state of his information on the subject, it was only possible for one hydrocarbon to exist having the formula C_2H_6. He also stated that he thought it was necessary to admit the existence of biatomic carbon in carbonic oxide.

Mr. NEWLANDS then proposed to represent the anomalous constitution of carbonic oxide by adopting for it a doubled formula; but

Dr. Williamson reminded him that the density of the compound in question would not accord with this otherwise very convenient proposal.

Death from an Experiment.—Mr. Toynbee, the well-known aurist, was found dead in his consulting-room last Saturday afternoon. There can be no doubt that the unfortunate gentleman killed himself accidentally by inhaling the mixed vapours of chloroform and prussic acid. The evidence of Dr. Markham, at the inquest, details the circumstances under which the deceased was found. He said:—"I found the deceased on the sofa perfectly dead. There was some cotton wool on the table close by, and witness's attention was attracted by a smell of chloroform in the room. The cotton wool smelt strongly of chloroform. Dr. Leared happened to come in at that time, and they both tried artificial respiration for half an hour without the least hope of restoring life. There was not the slightest sign.—By the Coroner: There were papers on two chairs, and a watch upon one set of the papers. On the first set there was a slip which referred to an experiment apparently tried on Thursday last—viz., 'The effect of inhalation of the vapour of chloroform for singing in the ears, so as to be forced to the tympanum, either by being taken in by the breath through a towel or a sponge, producing a beneficial sensation of warmth.' The second paper was an experiment on 'The effect of chloroform combined with hydrocyanic acid.' This was not clipped, apparently waiting for a result. Close to his hand, on the chair, were two bottles which had been obtained at Bell's that afternoon. The one contained rectified ether, which had not been opened. The second was a little more than half full of hydrocyanic acid. He did not detect any smell of hydrocyanic acid, for that acid would evaporate very quickly. There was also a machine made of india-rubber lying on the chair used for injecting ether or other vapours, and afterwards was found, underneath the sofa, just as his hand—that of a dead man's—would fall, a six-ounce bottle, completely empty, which had contained chloroform, but was dry and free from smell. The stopper was not in. From his experience he should say the appearances were quite consistent with death from the effects of chloroform, but it was not possible to say that there was a combination of hydrocyanic acid with the chloroform, owing to the advanced state of decomposition of the body, both being so volatile that they speedily evaporated in an ordinary temperature. In answer to further inquiries, he said he had made a post-mortem examination, but not an analysis, as he did not consider it necessary. In fact, there were no contents in the stomach to analyse, and not the remotest smell of the acid, which must have been present had it been taken in quantity into the system. He believed that the death was due to chloroform, but what effect the prussic acid would produce in combination with the chloroform in vapour he could not tell. Witness here produced a letter written by deceased to Dr. Gibson on the 6th inst., in which was expressed an opinion that Clover's apparatus for inhaling the vapour of hydrocyanic acid could be safely applied to the tympanum. This was explained by stating that the vapour was inhaled to the back of the throat, and, by holding the mouth and nostrils, was forced into the cavities of the ears, thus removing the singing and other nervous sensibility. The Coroner: In fact, he must have forgotten his lungs, being so wrapped up in what he was doing to the ear. Witness: Yes; he forgot that the vapour was getting into his chest."

Scientific Gossip.—We read in *Les Mondes* that the exclusive right to use Mr. Wilde's machine in France has been purchased by the Alliance Company. This company, we learn, made a proposal to establish an electric light on board the *Great Eastern* while laying the Atlantic cable. The light was to be equal to 125 standard gas-lights, and was to be supplied for the small charge of 240*l.* for the three months. At a lower sum the company offered two machines, one to be placed at the fore, and the other at the after, part of the great ship. We are sorry that the offer was rejected by the Telegraph Company.——Speaking of the uncertainty of the electric light in lighthouses, our valuable contemporary, the *Journal of Gas-lighting*, asks why gas is not supplied to many. There can be no doubt that in many situations this can be easily done, and the illuminating power of the gas increased by naphthalising and other means, according as circumstances may require. We hope this valuable suggestion of our contemporary will not be lost sight of by the Board of Trade and the Lighthouse Boards.——The Emperor of the French has directed M. Bobœuf to furnish him with a report on the use of phenate of soda as a disinfectant in connexion with the army and navy. M. Bobœuf has supplied Garibaldi's army with 100 litres of his disinfectant.——The French Association for the Advancement of Science assembled at Marseilles on the 18th of last month. So far as we can gather from the meagre reports at present supplied, the proceeding offered nothing of particular interest. At one of the sittings a new instrument called a *liquomètre* was exhibited. It is intended for estimating the amount of alcohol in wines, and is based on the principle of capillary action. It consists essentially of a very fine graduated tube. The instrument is said also to give separate indications of the amount of tartar and extractive matter.

Sodium Amalgam.—A paragraph has lately appeared in several papers mentioning that a case marked "sodium" had been thrown overboard from a vessel on which it had been shipped and had violently exploded; also that it was believed to contain, not "sodium," but the new "sodium amalgam" now used for gold and silver extraction. In relation thereto, Messrs. Johnson, Matthey, and Co., of Hatton Garden, who are the manufacturers of these patent amalgams, state that the case in question could have contained "sodium" only, as with the amalgam there is not the slightest danger of explosion or of damage of any kind either by contact with fire or water. It can be shipped with as perfect safety as quicksilver itself. This notification will remove a misapprehension that has already created some difficulty in shipping abroad a material of incalculable value to gold and silver miners, the manufacture of which where most required is impracticable.—*Times.*

Sodium Amalgam.—The New York *Tribune* of June 5 says:—"'Sodium amalgam' is the name of a new explosive compound of California origin. The explosive power of one ounce of this material is said to be equal to that of twenty-five pounds of gunpowder." These three lines contain just three gross errors. Firstly, sodium amalgam is *not* an "explosive compound;" secondly, it is *not* of "California origin;" and thirdly, the explosive power of one ounce of the metal "sodium"—which is the only material in sodium amalgam that of itself is explosive—is *not* "equal to that of twenty-five pounds of gunpowder."—*American Journal of Mining.*

British Association for the Advancement of Science.—The thirty-sixth meeting will be held at Nottingham, commencing August 22, 1866. The opening address will be delivered in the Theatre, on Wednesday, August 22, by W. R. Grove, Esq., M.A., Q.C., F.R.S., &c., President elect. Two *soirées* will be held at the Exhibition Building, Shakespeare Street on the evenings of Thursday the 23rd, and Tuesday the 28th of August. An evening lecture will be delivered at the Theatre, on Friday, the 24th, and one on Monday, the 27th of August, at eight o'clock. One of the lectures will be delivered by J. D. Hooker, Esq., M.D., F.R.S., V.P., L.S., F.G.S. Excursions of scientific interest will take place on Saturday, the 25th, to the Midland Railway Works at Derby, Eastwood, Riddings, Cinder Hill, Annesley, and Newstead Abbey; and on Thursday, the 30th, to the Derwent and Wye Valleys and Charnwood Forest. The two latter will be respectively under the management of the Derbyshire and Leicestershire Committees. Luncheon has been kindly offered to members of the Association at the above places, by the following noblemen and gentlemen:—The Duke of Devonshire; the Duke of Rutland; W. F. Webb, Esq.; William Perry Herrick, Esq.; Ambrose L. Phillipps de Lisle, Esq.; Messrs. Barber and Walker; J. Oakes, Esq.; Thomas North, Esq.; W. Worswick, Esq.; the Directors of the Midland Railway Company; the Mayor and Corporation of Derby; the Midland Scientific Association, &c.

The Hot Air Burner.—Dr. Letheby has written to the *Journal of Gas Lighting* as follows:—"I am afraid I unwittingly did injustice to Dr. Frankland, when, in my lecture 'On the Combustion of Gas for Economic Purposes,' I spoke of the hot-air burner as having been 'originally designed by Mr. Bowditch, and somewhat modified by Dr. Frankland;'* for it appears, from information which I have received from Dr. Frankland, that he never heard of Mr. Bowditch's invention until he saw the account of it in my lecture. I am, therefore, anxious to set the matter right, and to say how I came to mistake the facts. In the year 1853 or 1854 I received from Mr. Bowditch one of his hot-air burners; and in the summer of 1855 I wrote a description of it for a work I was then preparing, 'On the Chemistry of Artificial Light.' The work was hastily written, and was published anonymously in 1856, by Messrs. Orr and Co., in their 'Circle of the Sciences.'† At page 27 of the work I thus described the invention: 'The Rev. Mr. Bowditch, of Wakefield, has contrived an apparatus whereby this (the heating of the air) may be effected in the case of common gas. He places a disc of metal, or a cup of glass, having a hole in its centre, upon the screw which receives the burner. This disc or cup is made the means of supporting an outer glass, and thus of directing the air down over the surface of the hot chimney before it enters the flame from below. It is stated that the light is increased about 25 per cent. by this arrangement.' In the early part of 1861, I saw for the first time the account of Dr. Frankland's double-cylinder gas burner; and as the drawing of it was somewhat different from the drawing which I had given of Mr. Bowditch's contrivance, I erroneously thought that it was a modification of Mr. Bowditch's. This error I am anxious to correct, by saying that there cannot be a doubt of Dr. Frankland having originated the invention, without any knowledge of what Mr. Bowditch had done, for he informs me that he showed it to many friends at Manchester early in the year 1854, and that he has described it in his lectures at Owens College, Manchester, and at St. Bartholomew's Hospital, and at the London, and the Royal Institution of London for years past. It would seem, therefore, that the arrangement was designed about the same time by both Dr. Frankland and Mr. Bowditch, and that the invention was original in each case."

Preservation of Lemons.—A correspondent of the *Pharmaceutical Journal* (Mr. Mee) writes that lemons may be preserved by the very simple process of varnishing them with a solution of shellac in spirit of wine. Fresh lemon juice is thus obtainable at all seasons of the year; and if the peel be required for flavouring, the skin of shellac may be easily removed by simply kneading the elastic lemon in the hands.

Preparation of Oxygen.—The following is a process patented in France by MM. Maréchal and Tessie du Motay. The inventors decompose in a retort at an elevated temperature highly oxygenated salts, such as chromates and bichromates, manganates and permanganates, condensing aqueous vapour, and collecting the oxygen in a gasometer. The residue left in the retort is peroxidised again by the action of heat and a current of dry air. The inventors also propose to decompose sulphuric acid at a high temperature, fixing the sulphurous acid by means of magnesia. The sulphite of magnesia they decompose by heat, and convert the sulphurous into sulphuric acid in a leaden chamber to be decomposed again.—*Bulletin de la Société Chimique, &c.*, May, 1866, p. 398.

Use of Alum in Iron Safes.—A Vienna manufacturer makes fire-proof safes, in which a certain space is filled with powdered alum. When the heat reaches this, the water of crystallisation is driven off, by which a great absorption of heat is produced and the temperature of the interior of the safe kept proportionately low.—*Bulletin de la Société Chimique*, p. 400.—[This process has been long adopted in England. Ammonia alum is used for the purpose.]

Preparation of Hydriodic Acid and Iodides.—Pettenkofer gives the following modification of Liebig's process:—Using the same proportions, he takes the 15 grammes of phosphorus with 360 grs. of water at 60° or 70° C., and first adds 30 grammes of the iodine, and agitates well. The hydriodic acid formed is decanted upon the unused iodine (210 grammes). A portion of this dissolves in the hydriodic acid, and the solution is poured back upon the phosphorus and shaken until it is decolorised. This plan is repeated two or three times until all the iodine is dissolved and only a little amorphous phosphorus left. The hydriodic acid is then distilled off. The syrupy residue contains phosphoric and phosphorous acid, which, by treatment with nitric acid containing a little nitrous vapour, is easily converted into syrupy phosphoric acid. The hydriodic acid may be employed in the preparation of iodides. Its density will be about 1·39. By neutralising with bicarbonate of potash, crystals of pure iodide of potassium will be obtained.—*Annal. der Chem. und Pharm.*, cxxviii, p. 57.

Preparation of Bones for Manure.—Illienkof, a Russian chemist, gives the following process, which, it is said, has received the approbation of Liebig:—The author mixes 4000 kilos. of ground bones with 4000 kilos. of wood ashes containing 10 per cent. of carbonate of potash, and adds 600 kilos. of quick lime. This mixture he places in a tank or fosse with water sufficient to make the whole moist. In a short time the bony matter is completely disaggregated by the caustic potash, and the pasty mass formed is then taken from the tank, dried, mixed with an equal weight of mould, and is then ready to be distributed. We can easily believe that a preparation of this kind is a far better manure than superphosphate.

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. XIII. 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., II., and VII. are out of print. All the others are kept in stock. Vol. XIV. commenced on July 7, and will be complete in 26 numbers.

W. H. D.—Received too late for insertion this week.

Mr. Rodwell's article will appear next week

C. C.—Send a specimen to the Editor.

D. H.—We commence a tolerably full abstract to-day, and shall give the tabular results in detail. Respecting the corrections, we will communicate with the editor of the work in question.

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* Chemical News, last volume, p. 296.

† Dr. Letheby takes this opportunity of making it known that the edition of this work now in course of publication is issued against his wishes and consent.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On Certain Reasons for Doubling or otherwise Multiplying Chemical Formulæ, by JOHN A. R. NEWLANDS, *F.C.S.*

IN a paper "*On the Constancy of Quantivalence*" (CHEMICAL NEWS, May 18, 1866), I showed how certain cases in which elements appear to depart from their usual quantivalence may be rendered non-exceptional by the simple process of doubling the formulæ of their compounds. Thus I proposed to look upon carbonic oxide as C_2O_2, the two atoms of carbon interchanging two affinities, &c. I also mentioned at the same time that "if we double the formula of carbonic oxide, we must also double those of water, ammonia, and in fact all, or nearly all, others, in order to preserve the relations between their volumes in the gaseous state."

When I afterwards (June 21) made a similar proposition during a discussion which took place at the conclusion of Dr. Debus' lecture at the Chemical Society, Dr. Williamson admitted it to be "a very convenient proposal," but stated "that the density of carbonic oxide would not accord with it." To this I replied by saying that I would at the same time double the formulæ of hydrochloric acid, water, etc. The present communication is simply a sketch of certain reasons why the formulæ usually assigned to these and other bodies should be doubled or otherwise multiplied.

1. **Argument drawn from Probabilities or Chances.**—Admitting that there is an equal number of atoms of hydrogen and of chlorine in the molecule of hydrochloric acid, we have no proof what the absolute number really is. This may be any conceivable sum from one to infinity, and therefore the statement that the hydrochloric acid molecule contains only one atom of hydrogen and one of chlorine is a mere assertion; it is only one possibility out of millions of possibilities, and consequently there are millions of chances to one that it is wrong. The same may be said regarding the formulæ of water, ammonia, and marsh gas. To obviate this objection to the present formulæ, we may attach an x to the various symbols, as representing the unknown constant indicating the number of atoms contained in the various formulæ; thus hydrochloric acid would be $HxClx$, water would be H_2xOx, ammonia H_3xNx, and marsh gas H_4xCx. The value of x being uniform, the above formulæ would simply indicate (without making any assertion whatever as to the absolute number of atoms in the several molecules) that the number of atoms of hydrogen contained in the molecule of water was twice as great, in that of ammonia thrice as great, and in that of marsh gas four times as great, as the number contained in the molecule of hydrochloric acid.

2. **Argument from Geometrical Considerations.**—We may regard the atoms of bodies in the gaseous condition as so many infinitesimally small points, or centres of force, distributed through space, not filling it, but merely occupying it, or indicating its boundaries, so as to exclude, under particular conditions, certain kinds of matter from entering therein. Now, if we consider what will be the lowest number of atoms required for occupying, or pointing off, so to speak, a portion of space having three dimensions, four will appear to be the lowest that can be taken. Thus, we may imagine the form of a four-sided pyramid to be indicated by four points, one being placed at each of the four corners. We may therefore conclude that the molecule of hydrochloric acid contains at least two atoms of hydrogen and two of chlorine. It is, indeed, almost inconceivable that the single atoms of hydrogen and of chlorine usually supposed to exist in the molecule of hydrochloric acid could be capable of occupying the same space as the three atoms of hydrogen and one of nitrogen in the molecule of ammonia.

3. **Argument from the Nature of Elementary Molecules.**—If we admit that the molecules of all elements contain at least two atoms, we must consider the molecule of cadmium as CdCd, and that of mercury as HgHg; the corresponding volumes of hydrochloric acid, water, ammonia, and marsh gas, would be formulated thus: H_2Cl_2, H_4O_2, H_6N_2, and H_8C_2.

4 **Argument from Certain Abnormal Vapour Densities.**—Instead of regarding tho four volumes occupied by chloride of ammonium and pentachloride of phosphorus as due to dissociation, we may look upon them as representing the true state of affairs, and double other formulæ to make them correspond to the same volume. Thus we may suppose that nitrogen and phosphorus are really quinquivalent, as in NH_4Cl and PCl_5, and that in ammonia, an equal volume of which would contain N_2H_6, the two atoms of nitrogen interchange two affinities, and therefore, when united, are only capable of fixing six atoms of hydrogen. In like manner, the two atoms of phosphorus in P_2Cl_6 may be considered as interchanging two affinities, the phosphorus thereby becoming apparently trivalent.

5. **Argument from Certain Proposals for Classifying the Elements.**—The elements have been divided by Dr. Odling and others into two classes—viz., perissads and artiads, or elements of uneven and those of even quantivalence. Now, this distinction is not of a very satisfactory character, and it disappears if we double the formulæ, as then all the elements become united with an even number of atoms.

6. **Argument from Exceptions to the Constancy of Quantivalence.**—This has been already alluded to, and we have seen how those who maintain the constancy of quantivalence are compelled at the same time to double many, if not all, chemical formulæ.

In conclusion, I may say that I would on no account employ the doubled or multiplied formulæ for any save a special purpose, such as showing how exceptions to an otherwise general law may be removed. In fact, for all ordinary purposes the simpler the formulæ we employ the better, and those at present in use, such as HCl, are as simple as they could possibly be.

Laboratory, 19, Great St. Helen's, July 17.

Note on the Discovery of Oxygen and of Sodium, by GEORGE F. RODWELL, *F.C.S.*

WITHIN the last six months two extracts, containing some rather remarkable assertions, have been inserted in this journal—the one from a Manchester paper, which informs us that oxygen was discovered by Swedenborg half a century before Priestley; the other a communication to the *Mining Journal*, from a Mr. John Calvert, who endeavours to prove that sodium was known to the ancients.

Now there is not a particle of reliable evidence in support of either statement.

It is scarcely worth alluding to the claims of Swedenborg, founded as they are upon a very obscure and unintelligible passage from the works of a man who, in the eighteenth century, wrote in a style worthy of the most cabalistic writers of the tenth and two following centuries, who possessed much of their spirit of secresy and concealment, and assumed much of their jargon. Moreover, these claims are unsupported by experimental evidence. We are quite unable to comprehend by what contortion of the meaning of the principal passage quoted, Swedenborg can be supposed to allude to oxygen. "Air," he writes, "consists superficially of fifth finites, and within it are enclosed the first and second elementaries." And again:—"The fifth finites have entered into the surface of the aërial particle, and the first and second elementaries into the internal space." There is no possible reason for assuming that by the meaningless term *fifth finites* oxygen gas is alluded to, and if there were any evidence at first sight it would speedily be nullified by the fact that Swedenborg afterwards speaks of *crystals* of this matter. It is useless to pursue the subject further; the only evidence in support of the supposition is so utterly shallow that it is not worthy of criticism, for it carries with it its own refutation.

Then as regards the discovery of sodium. Mr. Calvert, in order to support his assertion, quotes a passage from Roger Bacon's "Ars Omnia," in which, among other things, it is stated that salt can be transmuted into a metal which, in its turn, can transmute other metals into gold. Now, there is no proof that sodium was procured before the nineteenth century, and no direct evidence upon which to found such an assertion; there is no account in the works of any old writer of its preparation, or of the distinctive properties of any metal even approaching it in character. The statement that the "metal of salt" can transmute other metals into gold, at once settles the question, and proves that no reliance can be placed upon the assertion. We may state, *en passant*, that if any one of the old chemists was more likely than another to have discovered sodium it was Glauber, who worked more with salt chemically than perhaps any of his predecessors; he also attributed to it the most extravagant virtues, maintaining that it was first created, and that the elements were evolved from it.

The statements of the alchemical writers must be received with great caution, and the chances of their probability must be carefully weighed in the mind before any credence is given to them. We give below an example of the matter contained in these works; and as the statement supposed to refer to the discovery of sodium is taken from the writings of Roger Bacon, we have taken the following from the old translation of the treatise "*De Mirabili Potestate Artis et Naturæ,*" one of the most famous compositions of the same author:—"There may be made instruments of navigation without men to row in them; as huge shippes to brooke the sea only with one man to steere them, which shall sail far more swiftly than if they were full of men. And chariots that shall move with an unspeakable force without any creature to stirr them. . . . Moreover, instruments may be made wherewith men may walk on the bottom of the sea or rivers without bodily danger . . . . and it is certaine that there is an instrument to flie with, which I never sawe, nor know any man that hath seen it, but I full wel know by name the learned man that invented the same. . . . The Queen of Tormery in Great Britany seeking after a white hart, lighted upon an ointment wherewith the keeper of the forest had anointed his whole body, the soles of his feet only excepted; he lived three hundred years without corruption, save that he was troubled with gout in the feet. And we have observed many countrymen in our days who without the counsel and advice of physicians have lived a hundred and three score years or thereabouts."

We conceive it is fair reasoning to maintain that if one statement is to be accepted literally, other statements of the same author given under like conditions have a right to be similarly treated; if therefore we admit that the passage quoted by Mr. Calvert proves the discovery of sodium at an early date, we must also admit that the above extract proves that the steam engine (or some other powerful motive machine not dependent upon animal force), diving apparatus, a machine to enable a man to fly, and a means of prolonging life far beyond the natural term, were known to the ancients. But here we arrive at a palpable absurdity; hence on this evidence alone (even supposing we did not possess the crushing evidence conveyed in the statement that the "metal of salt" transmutes other metals into gold), we have good ground for ignoring the very dubious passage quoted by Mr. Calvert, and we are compelled to admit, that, like the greater number of assertions in the same work, it is unintelligible and unexplainable. Q.E.D.

To take an individual passage from an obscurely written work, and to found upon it the claims of its author to some great discovery attributed to a much later period, is a very pernicious practice, and can lead to no good result. It has been thus in both the cases discussed above. Nevertheless, if there is a particle of sound evidence in favour of an assumed discovery, let it by all means be brought forward, for in the discussion to which it leads the real discoverer is likely to be found. As Mr. Mill very justly observes, "However unwillingly a person who has a strong opinion may admit the possibility that his opinion may be false, he ought to be moved by the consideration that however true it may be, if it is not fully, frequently, and fearlessly discussed, it will be held as a dead dogma, not as a living truth." That which applies to the opinion of an individual, obviously applies equally to the one opinion of a distinct community.

The man who assumes on good mental evidence, or who even partially proves by actual experiment, the existence of a something unknown before, is never recognised by the world as its discoverer. If such were the case, Lucretius was the discoverer of carbonic acid, Kunckel of ammoniacal gas, Majow of oxygen and nitrogen, and Paracelsus of hydrogen. It is the man who proves absolutely by some conclusive series of experiments that the something possesses properties distinct from all known entities—it is this man who is recognised as the true discoverer. The Copernican theory of the earth's mobility was a "dead dogma" until Galileo made it a "living truth;" and the same principle has obtained throughout the whole history of science.

The attribution of a discovery to a man who lived prior to the universally recognised discoverer, is a dangerous and difficult matter, and should never be attempted except with extreme caution, and upon the soundest and most reliable evidence. That evidence should be rigidly tested by the works of contemporary authors; the entire writings of the assumed discoverer should be carefully studied; and the train of thought which led to the discovery should be followed in its minutest ramifications. The historian of science should endeavour to grasp the precise mode of thought of the man of whom he writes, to think as he thought, to view phenomena in the light of the age in which he lived, and thus to reason on them as he reasoned. He must specially beware of coming too hastily to a conclusion, for let him bear in mind that an opinion universally accepted, has not been received by mankind without much inquiry as to its value, and much discriminative examination of its validity.

PHARMACY, TOXICOLOGY, &c.

Facts relating to Magnesium: its Action on Metallic Solutions, and its Application to Toxicological Researches, by M. Z. Roussin.[*]

Every chemist is aware how uncertain, and how often at variance with the theory as well as the principles of the established classification, is the precipitation of a metal contained in a saline solution by a metal apparently more oxidisable. Whether secondary reactions, the presence of water, the nature of the acid, or the conductibility of the solution complicate a reaction which *a priori* seems so simple, it is certain that several metals have hitherto resisted precipitation in a metallic state by the contact of another metal with their aqueous solutions.

We refer more particularly to cobalt, nickel, iron, zinc, manganese, chromium, &c.

Experiment has shown that magnesium precipitates in a metallic state some of the above metals, which until then had resisted all attempts of this kind.

Slightly acidulated solutions of proto- and sesqui-salts of iron, of zinc, of protoxide of cobalt and of nickel, placed in contact with pure magnesium, cause an escape of hydrogen, and precipitation, in a metallic state, of the metals of these solutions.

All these metals freed by washing from saline liquid, dried and then compressed, possess great metallic brilliancy, and entirely dissolve in acids. Iron, cobalt, and nickel so obtained are highly magnetic; zinc takes the form of a large spongy mass, which the least compression renders brilliant.

Magnesium precipitates equally silver, gold, platinum, bismuth, tin, mercury, copper, lead, cadmium, and thallium.

Aluminium is not precipitated in a metallic state from its saline solutions.

Salts of chromium and of manganese form deposits by their contact with plates of magnesium, which have the characteristics of oxides of these substances, and which we reserve for further study.[†]

Arsenic and antimony are not precipitated from their acid solutions by contact with magnesium; they combine with the hydrogen gas which is formed in this reaction, and pass off as arseniuretted or antimoniuretted hydrogen.

Magnesium very readily decomposes water; in a very weak solution of common salt, of sal ammoniac, of some acid, &c., the metal will be oxidised, and a considerable disengagement of hydrogen take place. This gas is extremely pure, for the magnesium contains no silicium.

The foregoing qualities encouraged the hope that a substitution of magnesium for zinc in ordinary piles would offer a great electro-motive force. Direct experiment confirms this theoretical inference. A small plate of magnesium, 0·1 gr. in weight, placed beside a plate of copper in a small tube of glass of six centimetres cube, filled with acidulated water, produced in nearly ten minutes an electro-magnetic appearance, and illuminated a Geisler tube 10 cent. long. If magnesium should ever become cheap, this would decidedly be the best way of producing electricity.

The preceding facts appear to us above all to give a special interest to toxicological researches on metallic poisons. A few words on the subject are necessary to give a clear idea of the importance of this new application of magnesium. In all true chemical researches respecting the diagnosis and extraction of compound metallic poisons, the experimentalist, after having destroyed the viscus, or any other organic matter under his analysis, at last finds a greater or less proportion of either a saline or an acid liquid, in which he has to discover and determine the minute proportions of poisonous metal. Whatever the agent used in the destruction of organic matter—whether sulphuric acid, chlorine, aqua regia, or nitric acid—the ultimate liquid is always very complex. Over and above the poisonous substance which it may contain, there is always a great deal of soda, lime, magnesia, phosphoric acid, hydrochloric acid, &c., &c.; and also in most cases, whether colourless or slightly coloured, it contains some strictly organic substances, which are the necessary result of the action on such energetic agents as chlorine, aqua regia, and nitric acid.

In most cases it is possible to find and to separate the metal which determines the poisoning by a methodic use of such tests as hydrosulphuric acid, hydrosulphate of ammonia, &c. But not only do these processes, even in the hands of the most experienced chemists, offer but a limited sensibility, and are sometimes powerless merely from the effect of the complexity of the liquid under analysis, but they necessitate the sacrifice of a great quantity of the liquid in the indispensable preliminary researches. The use of the pile recommended by eminent toxicologists in isolating and precipitating poisonous metals contained in these liquids, has always given us incomplete results, and experience teaches us in this case that if the theory is favourable the practice leaves much to be desired.

Every chemist knows how rapid and complete in some cases is the precipitation of one metal by another in saline solutions. Several toxicologists, struck by the precision of this mode of precipitation and its ease of execution, have proposed its use in the toxicological researches of certain metals. We will limit our examples to the precipitation of arsenic by copper (Reinsch's process), of mercury by tin or by copper, of copper by iron or by zinc, of antimony by tin, &c. These different experiments present two serious difficulties, to mention which will justify our remarks:—

1. The search for every poisonous metal requires a distinct operation and the employment of a different metal for precipitation; hence the necessity for numerous manipulations, and the considerable loss of the matters used in the experiments which these successive analyses necessitate.

2. The introduction into the liquids under analysis of metals either poisonous themselves, such as copper and zinc, or expensive ones, such as tin, presents grave dangers, and it may in some cases render the operation

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[*] *Journal de Pharmacie et de Chimie*, iii, 413.

[†] I have recently observed that a sodium amalgam shaken up with acidulous salts of chromium and manganese changes to an amalgam of chromium and manganese. The last two amalgams, purified by washing in acidulated water, then distilled in a current of hydrogen, leave the pure metals in the form of a pulverulent sponge. The amalgam of manganese is opalescent and crystalline; that of chromium is more fluid and less variable at the ordinary temperature. If the latter is heated in a small porcelain capsule in the air, the vapours of mercury mechanically carry away particles of chromium, which produce, whilst burning in a darkened room, a singular scintillation which ends in the sudden incandescence of the rest of the metallic chromium.—Z. R.

impossible even to the expert chemist if the poisoning is not precisely determined by the metal employed as the agent of precipitation, and which is partly dissolved in the liquids under analysis.

Were there a metal completely destitute of poisonous properties which the chemist might fearlessly introduce in excess into his liquids, and which had the property of precipitating all the metals whose salts are used by poisoners or which might occasion accidents, there is no doubt but that such a metal would enormously facilitate the researches of legal chemistry. Now it seems to us that magnesium offers all these advantages, and may thus be of the greatest service.

There are now prepared and offered to commerce great quantities of nearly pure magnesium. The original materials and the processes of its manufacture quite drive out of its composition the poisonous metals most dreaded by chemists—copper, lead, mercury, antimony, arsenic, zinc, &c. It is drawn into long slight ribbons well fitted for the delicate experiments of the laboratory; it keeps equally well in a dry or moist atmosphere, and placed in a corked bottle it is safe from any alteration; its low equivalent displaces the ordinary poisonous metals by relatively small proportions of the precipitating metal. Magnesium and its compounds present no danger; it is one of the metals normally contained in the tissues and fluids of the animal economy, and the introduction of them into liquids to be analysed does not cause the least difficulty. The silicium which was found in the first samples manufactured is now seldom seen; and it is easy to understand that the presence of some thousandths or hundredths of silicium or of soda would be no hindrance in the toxicological researches under discussion. Let us add (although the consideration is of small importance in such serious analyses) that the price of magnesium is now very moderate, and it will no doubt become still more so, should the demand increase. A rapid sketch of the reactions produced by the contact of a plate of magnesium with the different acidulous metallic solutions does away with any necessity for entering into the details of the specially toxicological operation. We will merely give a summary.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday Evening, June 1.

The Opalescence of the Atmosphere. By Dr. H. E. Roscoe, *F.R.S., Professor of Chemistry at Owens College, Manchester.*

Ladies and Gentlemen,—By the investigations of Professor Tyndall, so ably expounded here at the commencement of this session, you have become acquainted with some of the interesting relations which he has discovered respecting the phenomena of absorption and distribution of the heating rays. These rays are, as you are aware, situated at and beyond the red end of the coloured beam of light which we term the spectrum. Situated at and beyond the blue or most refrangible end of the spectrum, are other rays which, although they do not possess the same heating power which the red and the ultra-red rays exhibit, play a not less important part in the phenomena of nature. These rays, by their rapid vibrations, are capable of producing amongst the atoms of which matter is composed that deep-seated change to which we give the name of chemical action, and hence these rays have been termed the chemically active rays. Although it is not in my power to lay before you either so completely or so eloquently the relations of these chemical rays as you have had the relations of their lower vibrating brethren at the red end presented to you, yet one or two points have lately come under my notice with respect to the distribution of these chemically active rays in the atmosphere which may not prove uninteresting.

Let me, in the first place, show you that beyond the blue we have rays which we cannot see, but which are capable of being rendered visible by the action of fluorescent bodies—bodies which, when exposed to this invisible blue light, have the power of absorbing it and giving off light of a lower degree of refrangibility. In this way we can render the ultra-blue rays visible. This I shall now endeavour to show you. (A ray of light from the electric lamp was passed through coloured glass and caused to fall on the white screen.) Here, you see, we have by means of this coloured cobalt glass absorbed or cut off all the rays but these very deep violet rays. These and the non-visible rays beyond will be rendered more visible to you when we allow them to fall on a piece of quinine paper. You observe here the immense difference of luminosity between those portions of light which I throw on the quinine paper and those portions which fall on the ordinary screen. This is because a large number of rays which are ordinarily invisible to the eye, and which we do not see when they fall on the screen, are now rendered visible to the eye by the action of the quinine paper. These are the chemically active rays. If we were to expose a photographic plate to the action of these rays, we should obtain a picture. We should be able to get chemical action in these blue and ultra-blue rays which we could not get in any other way.

Now allow me to show you in another way that we do thus get chemical action from the blue rays which we do not get from the red. I have here the means of producing a strong red light, and means of producing an equally strong blue light; and I hope to be able to show you that the red light will not produce chemical action, but that the blue light will. I will burn a piece of phosphorus in a red globe containing oxygen, and then I will afterwards burn a piece of phosphorus in a blue globe containing oxygen. Here I have a little bulb containing a mixture of chlorine and hydrogen, upon which the red rays will not act, and upon which the blue rays will act. We have a very bright red light, but my little bulb containing the mixed chlorine and hydrogen does not explode. I next burn a piece of phosphorus in the blue globe of oxygen, and on exposing the bulb to the blue light it instantly explodes. (The action of the blue light exploded the bulb containing the hydrogen and chlorine, as anticipated by the Lecturer.)

On a previous occasion (May 22, 1864) I explained in this place a method by which the intensity of these chemically active rays can be measured, and their distribution on various points of the earth's surface be determined. I will not trouble you this evening with a description of the method which I employ for this purpose. I will only say that it is founded upon two facts. The first is that the measurement is made by the determination of the tint attained upon sensitive photographic paper when exposed to the action of the light. When I speak this evening of the chemically active rays, you will be good enough to understand that I mean all those rays wherever they may lie in that bright-coloured band, whether in the blue, beyond the blue, or elsewhere—all those rays which have the power of blackening the paper sensitised with chloride of silver. And then we must know, in the second place, that we can prepare a paper which is of a perfectly constant degree of sensitiveness. This can be done. We must also know the relation that exists between the intensity of the acting light and the tint produced. That we have also learned; and thus we are now in a position to measure the intensity of the chemically active light falling from the total heavens, or directly from the sun, under every changing circumstance of time, position of the sun, condition of the heavens, and position as regards latitude and longitude of situation. The observations can be made by means of the little apparatus which I hold in my hand, and the whole arrangement can be packed up in a small box and carried from place to place, and the observations can be very readily made—indeed, those needed for a whole day can be made in a few minutes. (See "Bakerian Lecture," *Phil. Trans.*, p. 605. 1865.)

In the first place, then, I will direct your attention this evening to the results of a series of measurements which have been made, through the kindness of Mr. Balfour Stewart, at the Kew Observatory, by Mr. Baker. The results of these observations for the last year I have tabulated on a long curve, which I have hung round the room. This gives the curve of the daily mean chemical intensity of total daylight at Kew Observatory from April, 1865, to April, 1866. I should say that the observations are made at various stated intervals during the day, and then by a very simple process of integration, the value of these various determinations made during the day can be summed up, so that we get for each particular day a number which gives us the amount of chemical intensity acting during the day, if our measurements have been made correctly and in sufficient number.

In the first place, then, on joining the numbers thus obtained for each particular day, we get this remarkably varying curve which gives us the daily mean from April 1, 1865, to March 31, 1866. The general features of this curve will be noticed—the gradual rise from the shortest day up towards the summer and backwards towards the autumn, according to the varying altitude of the sun. It will be at once seen from this curve that the greatest amount of chemical action did not take place on the longest day, or in the months in which the days are longest—namely, June and July; but, on the contrary, May and September of last year were the brightest months chemically, September being the maximum. And thus we see how very much the character of the weather, the cloudiness of the atmosphere, and so on, influence the amount of chemical action which falls upon any given spot. I have here the numbers giving the monthly means for these particular months derived from the numbers from which this curve has been constructed. You will observe here that the month in which there was the greatest amount of chemical action last year was September—of course I am speaking of Kew. The month of July was more intense than the month of June. I have here given the numbers for spring, summer, autumn, and winter.

Daily Mean Chemical Intensities of Total Daylight measured at Kew Observatory, April, 1865, to April, 1866.

For April, 1865 .	81·2	For October, 1865 .	29·2
„ May „ .	97·0	„ November „ .	12·8
„ June „ .	76·9	„ December „ .	6·9
„ July „ .	100·6	„ January, 1866 .	13·4
„ August „ .	82·5	„ February „ .	24·2
„ Sept. „ .	110·2	„ March „ .	32·2

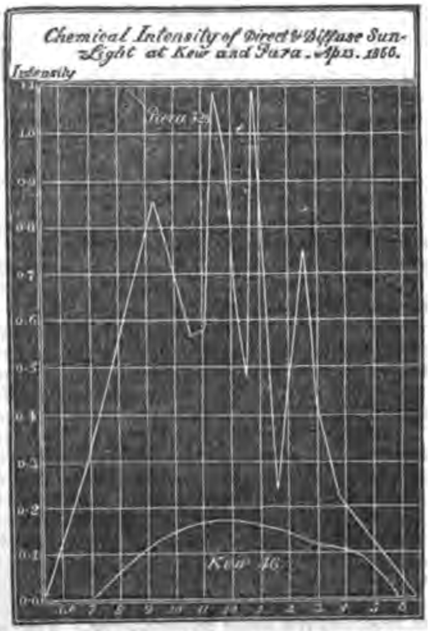
In Spring.	In Summer.	In Autumn.	In Winter.
45·9	91·5	73·9	11·0

(Light of the intensity 1, acting for 24 hours, taken as 1000.)

You observe how the amount increases from dark December which is 6·9, up to July which is 100, and to September which is 110.

If we examine the curves of chemical intensity as measured at Manchester on the longest day, or the autumnal equinox, and on the shortest day, or the winter solstice, we see that the increase of chemical action from December, during the first half of the rise, is not nearly so great as the increase in the latter half—that is to say, the increase from December to March, or the decrease from September to December, is much less than the increase from March to June, or the decrease from June to September. Now this difference is more than can be explained by the absorption exerted by a colourless atmosphere, and I think that we must look for an explanation of this fact to a property of the atmosphere which has been, indeed, noticed and spoken of before, but to which I wish this evening to direct your attention, and to which I have ventured to give the name of the "*opalescence of the atmosphere.*"

It has frequently been stated that amongst the snowy peaks of the Alps and in the glaring sun of the tropics the intensity of the chemically active light is less than we find in our own latitude. It has been stated that photographers in the Alps have had to expose their plates in order to obtain photographic pictures for a very much longer time than is the case in gloomy England or on the level of the sea, and that persons who went to Mexico have even been unable to get a photographic picture at all, and have had recourse to their sketch-books. Now, this extraordinary statement certainly required some definite proof, and I was fortunate enough to be able some few months ago to send my assistant, Mr. T. E. Thorpe, to the Brazils, through the kindness of Messrs. Alfred Booth and Co., of Liverpool. He took with him one of these apparatus for the purpose of making experiments for me on this and some other subjects. He has lately sent me from Para some of his results, which I am glad to be able to show you this evening. They are the first determinations of chemical intensity, the first measurements of light, which have been made relatively in our latitudes and under the equator. You will observe the higher white curve gives the intensity of the chemically active light at Para, which is situated about a degree and a quarter south of the equator on one of the southern mouths of the Amazon, and the lower curve gives the chemical intensity as observed at Kew Observatory on the same day. In the first place, I would call your attention to the enormous difference which exists in the intensity of the chemical action at these two positions.



Relative Chemical Intensity at Para and Kew.

	Kew.	Para.	Ratio.
April 4, 1866 .	19·7	260·0	13·1
„ „ .	9·3	320·0	34·4
„ „ .	45·7	326·0	7·1

You will notice, to begin with, the very great variation in the chemical light. You will observe how the curve at Pará ascends very rapidly in the morning and more rapidly descends in the afternoon. Now, this time of the year—April, May, and June—is the rainy season at Pará, and on these particular days I see, from the description of the weather which has been sent with these results, that a large thunderstorm passed over, as is usual, every day from three to four o'clock, deluges of rain fell, and of course the chemical action was reduced to zero. Hence, then, we get these extraordinary curves and these extraordinary variations in the intensity. If we find out what the value of the whole of this curve is, we shall see that it is 260 for Pará, and if we find the value of this whole curve for Kew, we see that it is 19·7, so that the amount of chemical action at Pará was just seven times as great as it was at Kew. I should mention that at Kew observations are made only at certain stated times, and all we can do is to join the lines here, and thus we get a much more regular curve, and perhaps not quite an accurate curve, but it is as near as we can get it with only a few observations, whereas at Pará we have a great number of observations, and hence we get these very great variations in the curve which become evident to us. Whatever was wrong, therefore, for the photographers near the equator, and whatever prevented the success of their operations, it was certainly not a want of chemical action in the light. Probably, instead of exposing their plates about 1-50th of the time required in this country, they exposed them about fifty times too long, and thus the failure of their pictures may have resulted from their being over-exposed. At the end of the diagram you have a drawing, giving you the action at Heidelberg and at Manchester on the same day. This shows that even at Heidelberg and Manchester very great variations take place—exceedingly great variations—and you will also observe the much less intensity of the chemical light at Heidelberg than at Para, remembering that this Heidelberg curve is drawn to the same scale as these curves at Pará.

I would, however, this evening especially direct your attention to some experiments which appear in some degree to explain that much-vexed question concerning the blue colour of the sky and the red tints at sunrise and sunset. Since the time of Leonardo da Vinci this subject seems to have been a favourite ground of speculation amongst the meteorologists. Leonardo thought the blue colour of the heavens was due to a mixture of white sunlight with darkness from surrounding space. In this speculation he was afterwards supported by Goethe, who held certainly very remarkable views, as we all know, on the nature of colour. Newton explained the blue colour of the sky by the existence in the air of minute hollow vesicles of water. These vesicles were supposed to float about, and were generally invisible; but they would produce the result which we observe—namely, the blue colour of the heavens—inasmuch as by the phenomena of interference, as on a soap-bubble, the colours of thin plates would become perceptible; and according as the thickness of the walls of these vesicles increases, so would the colour change from blue to yellow, orange, and red, and by frequent reflections the various colours from sky-blue to sunset red could be explained. This theory has been since supported by the eminent German physicist, Clausius, who has calculated what the intensity of the light would be under the assumption of the existence of these small vesicles. Other physicists have given various explanations. Some have said that the varying colours of sunrise and sunset—especially the varying colours of different sunsets—are not due to any real colour that is present, but that it is an ocular deception caused by the presence of clouds which receive and repeat the colour. Other physicists, especially Brücke, have expressed their opinion that the atmosphere is filled with small solid particles which have the effect of producing that appearance in the atmosphere which we know as opalescence in certain minerals and finely divided substances; whilst Professor Forbes observed that aqueous vapour, or at any rate small particles of water, have the power, under certain circumstances, of allowing only the red rays to pass through. Thus, for instance, he noticed that, if he looked at the sun through a jet of steam escaping from a locomotive boiler, the sun appeared like a red ball as we see it in a fog; and hence he explained the colour of the sun by the existence of this water, whether it be in the form of vapour or in the form of finely divided particles.

Now, until we are acquainted with some quantitative results as to the relative intensities of light coming directly from the sun as sunshine, and of the light reflected from the heavens, it appears to me idle to think of explaining with certainty this very important and interesting, but very difficult, question. By means of the method which I have alluded to, it is possible easily to determine the intensity at any rate of that part of the light which we should expect to show great differences—namely, the most refrangible portions, to which, as I have said, the name of chemically active rays has been given. For this purpose it is necessary simply to expose a paper in this little instrument to total daylight—that is, to the direct sunlight as well as the diffuse light from the whole sky—and then to expose another piece of paper in the same instrument, but to bring a little black ball between the sun and the paper, so that a shadow is cast on the paper. The diameter of this ball, seen from the position of the sensitive paper, is only a very little greater than the apparent diameter of the sun, and hence very little of the light from the sky round the sun is taken away, but simply the direct sunlight; and in this way we get the diffuse light coming from all the heavens to act on the paper, and then if we subtract the light emitted by the whole heavens except the sun, from the total light, that, of course, will give us the light that the sun sends. I am speaking now, you will please to understand, of the chemical light.

The results which were thus obtained were certainly, to begin with, rather startling, as they show that the amount of chemically active light which comes as direct sunshine is very much less than one would suppose—very much less than the amount of *visible* sunshine, compared with the intensity of the visible light coming as diffuse light from the whole sky. Thus, for instance, at Manchester, which is not a very favourable place for observing the maximum effect of the chemical action of light, when the sun was 20° above the horizon, if 100 rays fell as diffused light from the whole heavens, only 10 fell as direct sunshine; or, in other words, of 100 chemical rays which fell altogether on this piece of paper at Manchester, only about 8, speaking roughly, came from the direct sunlight, although the sun cast a very dark shadow, and although the amount of visible light which came from the sun—I mean that which affects the eye—and the amount which came from the sky were in very different proportions. Thus, of 100 rays affecting the eye, 60 came from the sun and only 40 from the sky. Now, this result was borne out by further experiments—experiments which were made by my friend Mr. Baxendell, of Cheetham Hill, near Manchester, whose co-operation I have to acknowledge with great pleasure; by Dr. Wolkoff, at Heidelberg, who forwarded me some results he obtained there, through Professor Bunsen; by Mr. Baker, at the Kew Observatory; and by Mr. Thorpe, at Pará on the Amazon. The results bear out this same fact, that the relative amount of chemically active light which comes directly from the sun is very much less than the amount of visible light which comes direct. Thus, for instance, it was very frequently found at Manchester and Heidelberg, and at Kew, when the sun was shining brightly enough, although it was not very high perhaps, but when it was certainly at a height of 12° of altitude, bringing this little ball and casting a shadow on the paper made no difference chemically; or, in other words, the direct sunlight did not produce any chemical action. The sunlight had been entirely robbed of its chemical power in passing through the air. Now, this fact will be seen by examining the table which follows:—

Chemical Actions at Heidelberg.

Altitude.	Direct Sun.	Diffuse Light.
0° 34′	0·000	0·026
1 32	0·000	0·024
2 29	0·000	0·038
3 27	0·000	0·028
6 0	0·000	0·030
10 40	0·000	0·073
11 51	0·000	0·079
12 58	0·000	0·080

The following numbers show that if the sky sends down light of the intensity 1, then the direct sunlight has an intensity of only 0·106, or a little more than one-tenth; and even when we reach a height of 26° at Owens College, Manchester, the amount of chemically active light coming direct from the sun is very slightly increased. The same thing was observed at Cheetham Hill. I should mention that these observations were made on a cloudless day, when we had nothing but a bright, clear sky. Now, at Heidelberg, the same experiments were made on the top of a hill which, as those who have been to Heidelberg will know, is called the Königstuhl, and this hill is about 2000 feet above the sea's level, so that we have a great deal of the air—the densest part of the air—below us when we are on the top of this hill. Hence we find that the ratio of the direct to the indirect sunlight increases very much more rapidly—that is to say, when the sun's altitude reaches 40°, the sunshine there is as strong as the whole diffused light of the heavens.

Results of Observations at Heidelberg.

	Number of observations.	Range of altitude of sun.	Mean altitude of sun.	Intensity of sky or diffused daylight.	Intensity of direct sunlight.	Ratio of sun to sky.
Group 1	10	0° to 15°	7° 15′	·048	·002	0·041
2	19	15 — 30	24 43	·134	·066	0·472
3	31	30 — 45	34 34	·170	·136	0·800
4	22	45 — 60	53 37	·174	·263	1·511
5	17	above 60	62 30	·199	·319	1·603

Results of Observations at Cheetham Hill.

	Number of observations.		Mean altitude of sun.	Intensity of sky or diffused daylight.	Intensity of direct sunlight.	Ratio of sun to sky.
	Sky.	Sun.				
Group 1	23	24	19° 30′	·064	·012	0·187
2	22	22	25 31	·091	·019	0·208
3	18	17	34 8	·104	·026	0·250

Results of Observations at Owens College.

	Number of observations.		Mean altitude of sun.	Intensity of sky or diffused daylight.	Intensity of direct sunlight.	Ratio of sun to sky.
	Sky.	Sun.				
Group 1	33	34	17° 8′	·066	·007	0·106
2	20	24	26 38	·074	·008	0·108
3	4	5	54 12	·140	·043	0·308

Results of Observations at Kew.

	Number of observations.		Mean altitude of sun.	Intensity of sky.	Intensity of direct sunlight.	Ratio of sun to sky.
	Sky.	Sun.				
Group 1	18	18	12° 55	0·065	0·014	0·213
2	8	8	21 8	0·072	0·030	0·416
3	7	7	28 16	0·104	0·056	0·538
4	6	6	41 23	0·135	0·107	0·792

Results of Observations at Para, Brazils.

	Number of observations.		Altitude.	Diffuse intensity.	Intensity direct.	Ratio.
	Sky.	Sun.				
Group 1	20	20	42° 21′	·451	·168	·372
2	25	25	62 49	·552	·277	·501
3	25	25	77 20	·660	·267	·404

If we compare the numbers thus obtained by experiment with those calculated by Clausius on the theory of hollow vesicles impeding the passage of the rays, we shall notice a most remarkable difference between the experimental and calculated numbers—

Ratio of Chemical Intensities of Direct Sunlight to Diffuse Light.

Sun's altitude.	Calculated (Clausius).	Experiments.		
		Heidelberg.	Cheetham Hill.	Owens College.
20°	0·491	0·350	0·19	0·10
25	0·896	0·480	0·20	0·11
30	1·320	0·650	0·23	
35	1·690	0·820	0·26	
40	2·032	1·00	—	
50	2·634	1·37	—	
60	3·129	1·60	—	

whereas at Kew it is not so strong, and at Owens College it is very much lower indeed. If we come, lastly, to the results at Para, we find that there, very remarkably, the direct sunlight is comparatively very weak—that is to say, the ratio of the diffused to the direct sunlight is but small. At Pará, just under the equator, when the sun's altitude reached nearly 80°, the sunshine was really only half as strong as the diffused light of the whole sky. From these results you will conclude that these very high curves, showing the increased intensity under the equator, are due not so much to an increase of the chemical brightness of the direct sunlight as to the immense increase in the amount of diffused light.

Now, how can we explain this certainly very remarkable fact of the very small relative amount of chemical intensity which the sunshine exhibits? I think we may do this best, perhaps, by an experiment. I have here a very slightly milky liquid, very slightly opalescent; it contains a very small amount of sulphur in suspension. I have placed some of this water in this little glass vessel, and in this other glass vessel I have placed pure distilled water. Now I want to show you that this very slightly milky liquid will cut off the chemically active rays, so that I shall not be able to explode my little bulb of chlorine and hydrogen which I place behind this milky liquid. I will then move the bulb in front of this vessel containing the pure distilled water, and I think you will see that the chemically active rays of light will pass through the pure water, and we shall effect an explosion of the mixed gases in the bulb. (The experiment was performed as described.) The same thing may be seen if we take a piece of this magnesium wire and burn it at the back of this vessel containing the milky water. You will see that the light of this bright-burning magnesium appears red, or at any rate yellow, when we look at it through this medium containing the finely divided sulphur in suspension, whereas the light reflected by the same liquid is blue.

This is exactly the state of things in the atmosphere. There is something in the air which acts upon the sunlight exactly as that finely divided sulphur acts upon the light from the burning magnesium wire; and I hope I may be able to show you the effect of a larger quantity of this sulphur. Here, I am going to put a very small quantity of finely divided sulphur into this tube, and we will fill the tube with water. Now the tube is filled, I send a beam of light from the electric lamp through it, and here we have a deep red beam of light falling on the screen, exactly the colour of the sun seen through a dense London fog. You observe that this liquid is only very slightly opalescent, but we have got a comparatively long column of it, through which the light has to pass before reaching the screen. You may have a liquid so slightly milky or so slightly opalescent that it appears clear and transparent; but imagine a column of it many miles in length, and you will then understand how it is possible that the sun appears red when it sinks to the horizon or when it rises from the horizon. We will introduce a little more of the sulphur into the liquid in the tube. You see it has now become darker, and here we have a very fair red sun. The small particles of sulphur allow the red rays to pass, but they do not allow the chemical rays to pass. I have made experiments, which show that if by means of such finely divided sulphur I diminish the intensity of the visible light to one-third, I take out altogether the chemically active light. Every particle of this chemically active light is taken away by means of this yellow fog, and we get the blue rays reflected. This is exactly what happens in the atmosphere. Another illustration of this, certainly as good as the one I have shown you, is an opalescent glass. Here I have such a glass, and you see at once the difference between the light when I put on the opalescent cover, and the light when the cover is off. When the glass is put on, the flame appears quite red, but a great deal of white light is reflected from the little particles which are suspended in this glass. Those particles consist of phosphate of calcium, and they allow the red rays to pass, but the blue rays cannot pass through. This I will show you by means of the electric lamp. (The theatre was darkened, and a beam of electric light was passed through the opalescent glass, and received as a red image on the screen.) Here you see the effect of the light passing through this really white substance, consisting of finely divided particles—a substance which has the power, therefore, of allowing the red rays to pass, but of entirely cutting off the blue.

We cannot tell exactly what the substances are in the atmosphere which thus act as the opalescent body—I mean the substance which reflects the blue and transmits the red. But we do know that the atmosphere is full of small solid particles floating about. We see that this is so from a great variety of circumstances. We know that liquids which are exposed to the air gradually undergo fermentation. The presence of little sporules of vegetable matter floating about in the air causes the peculiar change which we call fermentation. We know, too, that we cannot leave a piece of metal or any other substance exposed to the air for an instant without that substance obtaining a trace of sodium, which is instantly rendered visible when the substance is exposed to the flame. We see these particles as motes dancing in the sunbeam, and in those grander paths of light shooting up into the air from a setting sun. If these sporules and particles of solid matter are floating about in the air, they will certainly cause this opalescence. This opalescence may, however, be due to the phenomenon observed by Forbes—the power of small globules of water to produce the same effect.

That the size of the particles through which the light passes has, at any rate, something to do with the question is very evident when we come to consider that very beautiful example of colour produced by finely divided substances about which this audience has frequently been interested—I mean those beautiful colours of ruby gold so ably investigated by Mr. Faraday. I have here some of the original ruby gold solution which was produced by Mr. Faraday some nine years ago. This has been standing in the laboratory downstairs, but it has not yet deposited its metallic gold. It has still its bright red colour, and this bright red colour is due to suspended particles of metallic gold, as has been most beautifully shown by Mr. Faraday. Nobody who has read his paper can doubt for a moment that the blue colour which we see here is caused by finely divided gold, which only allows blue light to pass through it. Here, again, we have a purple gold liquid, here we have a crimson gold liquid, and here we have a ruby gold liquid. In all these, metallic gold in different states of division is the cause of the colour, and in time—if not in eight years, perhaps in eight times eight years, or some still longer period—this ruby gold will sink down, and we shall have a colourless liquid left above it.

Now, to what is this variation of colour due? Is it not due to a variation in the size of the particles? Is it not possible that the variation in the size of the particles of matter present in the air may produce a change as distinct as we see here in the gold? for we read and we have evidence of the sun appearing even blue on several occasions; thus in the year 1831 the sun was seen blue over a large district of Europe and America, and it is a very remarkable fact that a singular fog was observed in that year, which I believe spread even as far as the shores of America. We can also get sulphur in a blue condition. If we precipitate the sulphur from a solution of sulphuretted hydrogen in water by means of iron perchloride, you will observe that at the moment when the sulphur is precipitated we have a splendid purplish-blue colour. This seems to be blue sulphur. Now, is this colour due to the particles being exceedingly small, and does the sulphur then allow only the blue light to pass and reflect the red? Here we have another example of a deep indigo blue, caused by something which at least appears to be sulphur. It is yellow sulphur, which is dissolved in colourless anhydrous sulphuric acid. We do not know what the colour is caused by unless it is the sulphur, for we are not aware that there is any combination which takes place, and it is a singular thing that we repeatedly find sulphur having this particular blue colour when it is exceedingly finely divided. Thus, for instance, if we take a solution of sulphuretted hydrogen in water, and heat it in a sealed tube up to 200° C., we get a deep blue liquid, and when this liquid cools, the particles of sulphur collect together, and it separates out in its ordinary state. It is a singular fact that tellurium and selenium also have the power of producing coloured liquids with fuming sulphuric acid. I have here an olive-green liquid, formed by adding selenium to sulphuric acid, and this splendid red colour is due to the presence of tellurium in the sulphuric acid. Tellurium itself, we know, is a black powder when not in this extreme state of division.

I feel that in proposing these questions I am entering upon debatable ground—that, namely, of the colours of natural bodies. It is therefore with diffidence that I bring forward these examples of coloured liquids as caused by finely suspended particles, and I do so only because they force themselves on my notice in the consideration of the plainer and now somewhat better understood phenomenon of the opalescence of the atmosphere.

The Lecturer, before retiring, called the attention of the audience to a new magnesium lamp constructed by Mr. Henry Larkin. The lamp was suspended from the ceiling of the theatre. Dr. Roscoe stated that the lamp made use of the magnesium in the form of a fine powder which was caused to drop from a tube through a jet of burning gas, upon which it took fire and emitted a brilliant light. The lamp had never before been exhibited in public.

ACADEMY OF SCIENCES.

July 9.

The proceedings of the Academy continue to have but little interest for chemists. At the last meeting, M. Pisani presented a note "*On a Black Spinelle.*" It forms one of the constituents of the lherzolite of Auvergne, and occurs generally in the shape of simple octahedra—sometimes, however, pyramidal. It is extremely hard, infusible, and not attacked by acids. It takes, moreover, a beautiful polish. An analysis led to the formula $(\dot{\text{M}}\text{gFe})\ (\ddot{\text{A}}\text{lFe})$.

M. Gripon presented a note "*On the Conducting Power of Mercury for Heat.*" Experiments made after Peclet's method showed that if the conducting power of silver = 100, that of mercury = 3·54. It stands therefore the last of the metals, and a little before marble and gas coke. The author mentions that in this case the conducting power for heat and for electricity are very different, the former being 3·54, the latter 1·80.

M. Ch. Mène sent the "*Analysis of a Copper Ore from Corsica,*" the accuracy of which, he said, he could guarantee. It is a peacock ore, and may be, M. Mène says, $FeS + 2CuS$, or $FeS_2 + Cu_2S$.

M. Maumené distributed at the meeting the third part of his memoir "*On the General Theory of the Exercise of Affinity,*" in which he demolishes, to his own satisfaction, the theory of chemical types and the principles of substitution. These, he says, are really one and the same idea, false in itself, and therefore incapable of leading to exact consequences. Affinity, he goes on to say, is not a distinct force, but the resultant of two forces or systems of forces—the attractive or cohesive forces, confounded under the name of cohesion; and the repelling force—heat, to which we might give the name *dishesion.*

NOTICES OF BOOKS.

Journal für praktische Chemie. Nos. 6 and 7. 1866.

No. 6 is almost entirely occupied with contributions by R. Hermann, among which we have an account of a series of researches undertaken to decide *whether or not norium exists.* Swanberg, in 1845, fancied that he had discovered that zirconia was a mixture of at least two different earths, and to one of these, which he obtained by fractional precipitation with oxalic acid, and to which he assigned a lower atomic weight than that of zirconia, he gave the name *Norerde*, or, as English chemists say, *Noria.* Few chemists have since then occupied themselves with this body. The supposed metallic base *Norium* is placed in the list of elements in most books on chemistry, but it has generally been regarded as a body of doubtful existence. All doubts have now been removed by Hermann, who has found differences in zirconia of various origins—mainly from ad-mixture of alumina—to account for the facts on which Swanberg based his fancied discovery. Hermann has investigated—1. *The specific gravity of zircon;* 2. *The specific gravity of zirconia;* 3. *The composition of the sulphate prepared from the precipitates obtained by the fractional precipitation of chloride of zirconium by oxalate of ammonia;* and 4. *The behaviour of this fractionated zirconia towards sulphate of potash.* Reviewing all his results, Hermann concludes that it may be safely asserted that Swanberg's norium does not exist.

The same author has next a series of papers "*On the Separation of Zirconia from Titanic Acid and some other Substances,*" including thoria, the cerium bases, yttria, and oxide of iron. Then follows a paper "*On the Composition of Tschewkinite,*" a rare mineral in which the author finds among commoner substances large percentages of titanic acid, thoria, oxides of cerium, lanthanum, and didymium, yttria, and some uranous oxide. We have next a paper "*On the Amount of Ilmenic Acid in Greenland Columbite,*" and last a note "*On Asperolite,*" a new mineral, essentially a hydrated silicate of copper. The series of papers named above form a most important contribution to the chemistry of the rarer earths and metals, and we shall return to them for the methods of separating some of these.

The rest of this number is principally occupied with a memoir by Dr. K. Haushofer, "*On the Composition of Glauconite.*" The remainder is made up of abstracts from the *Journal of the Chemical Society* and the *Proceedings of* the Royal Society.

No. 7 of the *Journal für praktische Chemie* contains a long memoir by Erdmann "*On the Nitrous Acid Compounds of Nickel and Cobalt,*" in which is described a great variety of compounds of nitrous acid with those metals and the alkalies and earths. A paper by Dr. A. Winckler, "*On the Colorimetric Determination of Cobalt and Nickel,*" separately and in solution together. The author's process and instruments are certainly ingenious, but they probably will not command much attention from practical chemists. The titles of the remaining papers of any importance and not from English sources are as follows:—"*On the Aldehydes of Butylic and Propylic Acids,*" by Michaelson; "*On the Compounds of Hydrochloric Glycide with Chlorinated and Anhydrous Acids,*" by Truchot; "*On a New Method of Distinguishing between Grape and Cane Sugar,*" by Nicklés (this process was given in our last volume); "*On Tyrosin,*" by L. Barth; "*On the Gases in Melted Steel and Cast Iron,*" by L. Cailletet, also noticed by us.

We may state here that for the future we shall, in accordance with the wishes of many readers, give the titles of all the more important papers in the principal foreign journals; while doing so we shall for the most part omit those papers taken from English journals and also the abstracts of those previously noticed in our pages.

Zeitschrift für analytische Chemie. Edited by Dr. C. Remigius Fresenius. Parts iii. and iv. for 1865.

Dr. Fresenius is not to be congratulated on the regularity with which he issues his journal. These parts, published together, which complete the volume for last year, have but lately reached us. They open with a long and valuable paper, by Dr. E. A. Van der Burg, "*On the Cinchona Alkaloids and the Determination of Nitrogen by the Soda-lime Process.*" In this paper the author reviews the processes of De Vrij and Rabourdin for the determination of the alkaloids in bark, giving his preference to the latter both for simplicity and accuracy. In the notice of the process of Will and Varrentrapp for the estimation of nitrogen in the form of ammonia, he shows that it is not to be relied on in the case of many organic bases, and notably the cinchona bases. The differences, indeed, in the results obtained by it are extraordinary, and suggest a fuller examination to decide on the value of the method in any case. The difficulty appears to be so to regulate the heat that the whole of the substance under examination shall be decomposed, but not volatilised; and again, that the ammonia produced shall not be decomposed. This is a very important matter, and we shall return to the paper for a longer abstract.

The next paper is "*On the Estimation of Kreatin in Muscles,*" by Felix Nawrocki, which offers nothing of interest to the general chemist.

A short paper, by A. Chizynski, follows, "*On the Separation of Lime and Magnesia.*" The author gets these bases into the form of sulphates, and then separates them by means of diluted alcohol, in which sulphate of magnesia is soluble and sulphate of lime insoluble. The results obtained by this method, he shows, are very accurate.

The next paper is by Dr. Julius Löwe, "*On the Properties and Composition of the Hydrate of Alumina precipitated from an Alkaline Solution.*" The author describes the precipitate formed in an alkaline solution on the addition of sal-ammoniac, and shows that it has the composition indicated by the formula $Al_2O_3,2HO$.

The same author has next a paper "*On the Quantitative Estimation of Alumina,*" in which he recommends a method which is probably generally adopted by analysts.

Another paper by the same author follows, "*On the Behaviour of Nitrate of Potash and Nitrate of Lead towards a Solution of Basic Acetate of Lead.*" The admixture of solutions of nitrate of potash and basic acetate of lead in slight excess produces a precipitate of $2PbO,NO_6,HO$. Nitrate of lead and acetate give the same compound.

A paper "*On the Solubility of Pure Compact Metallic Copper in Hydrochloric Acid in the Absence of Air*" is also by Dr. Löwe. The author shows that copper is slightly soluble in hydrochloric acid on long boiling, and points this fact out as a source of error in Fuchs' method of estimating iron.

The same industrious author has yet another paper "*On the Estimation of Tannin in Oak Bark,*" in which he confirms the statement of Berzelius that the extract of oak bark contains a considerable proportion of pectic acid. When, therefore, he estimates tannin, he treats the dried extract with alcohol in which pectic acid is insoluble. He then gets rid of the alcohol, redissolves in distilled water, and the tannin can now be determined by the usual methods.

A short note "*On Barium in Platinum,*" by K. Kraut, follows. The author has a piece of platinum wire which gives a green colour to the flame of a Bunsen's burner.

Several other papers in the journal remain to be noticed next week.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

1180. T. W. Tobin, Watson's Road, Wood Green, Middlesex, "Apparatus for effecting a solution of lime for the purpose of softening hard water."—Petition recorded April 27, 1866.

1348. A. V. Newton, Chancery Lane, "Improved apparatus for manufacturing illuminating gas." A communication from L. Stevens and N. C. Munson, Shirley, Mass., U.S.A.—May 10, 1866.

1610. W. H. Hall and J. Cooke, Birmingham, "Improvements in miners' safety lamps."—June 13, 1866.

1667. E. Hunt, St. Vincent Street, Glasgow, "Improvements in dissolving or treating rubber, gutta-percha, copal, and similar gums, or resins, and their compounds."—June 22, 1866.

1721. H. D. Plimsoll, Ampthill Square, Hampstead Road, Middlesex, "The application of a new material to the purpose of rendering gunpowder non-explosive."

1726. C. E. Brooman, Fleet Street, London, "Improvements in obtaining alkaline permanganates." A communication from C. M. T. du Motay and C. R. Maréchal, Jun., Metz, France.—June 28, 1866.

1734. H. Hobson, Middlesbro'-on-Tees, "Improvements in smelting iron ores, and in apparatus used with blast furnaces."

Notices to Proceed.

627. W. Weldon, Park Villa, Highgate, Middlesex, "A new process for obtaining soda from common salt."

628. W. Weldon, Park Villa, Highgate, Middlesex, "Improvements in the manufacture of soda from common salt."—Petition recorded March 1, 1866.

671. C. W. Siemens, Great George Street, Westminster, "Improvements in the manufacture of zinc, and in the construction of furnaces connected therewith, which latter improvements are also applicable to other metallurgical processes."—March 5, 1866.

683. J. Norman, Glasgow, N.B., "Improvements in apparatus for reburning, and in apparatus for washing animal charcoal or charcoal substitutes."—March 6, 1866.

1710. W. R. Lake, Southampton Buildings, Chancery Lane, "Improvements in the mode of distilling or separating volatile products from oils and other fluids." A communication from H. L. Smith, Gambier, Ohio, U.S.A.—June 27, 1866.

MISCELLANEOUS.

Royal Society.—The following eminent men of science have been elected foreign members of the Royal Society:—Franz Cornelius Donders, George Friedrich Bernhard Riemann, and Gustav Rose.

Colour of Light.—Dr. Memorsky and Professor Brucke, in a paper communicated to the Vienna Academy, describe diffuse daylight as strongly reddish, just as gas and lamplight is yellow. The only perfectly white light, they say, is the electric light from carbon points. The light of burning magnesium and the combustion of phosphorus in oxygen, they tell us, is violet.—*Journ. für prakt. Chem.*, No. 7, 1866, p. 447.

The Working of the Alkali Act.—Dr. Angus Smith's report for 1865 has just been published. It states that the average condensation is now nearly 99 per cent. A point or two of interest is alluded to in the report, to which we shall return.

The London Cowkeepers and their Petition.—The London cowkeepers have lately presented a petition to Parliament praying for a more extended inquiry on the subject of disinfectants and disinfecting measures. It is much to be regretted that while doing so they should have been prompted to cast some most undeserved aspersions on the character of Dr. Angus Smith. To any one who knows Dr. Smith, or has read his report, it is unnecessary to say a word in reply to this attack, but under the circumstances we feel called upon to make a few remarks in answer to the statements contained in the petition. In the first place, it is certainly quite true that Dr. Smith was "the co-patentee with one McDougal of a disinfecting article sold under the name of McDougal's powder." We have, however, the best reasons for knowing that Dr. Smith has never profited to the smallest extent by the sale of that article, and that, although his name is necessarily connected with the patent, he has for many years ceased to have any connexion with the manufacture of the article, from which, besides, his name has long been divorced. It would, however, have been perfectly consistent in a man of undoubted integrity to recommend an article of his own invention if he really believed it to be the best thing to use under the circumstances; but, in truth, Dr. Smith, in his report published in the Appendix to the third Report of the Commissioners, did not recommend McDougal's powder as a preventive against cattle plague. The reader who will take the trouble to refer to pages 171 and 172 of the Appendix named will find the following words in Dr. Smith's report:—"On account of this small amount of carbolic acid *it* (McDougal's powder) *is not put in the list of substances for fumigation and prevention of cattle plague. Its most fitting use is for preventing decomposition in manures.*" Probably no one of those who signed this petition ever saw Dr. Smith's report, and the same may perhaps be said for the writer in the *Medical Press and Circular* who endorses the statements contained in the petition, and, moreover, has the hardihood to assert that Dr. Smith's report and our own detail only laboratory experiments

Protected Gunpowder.—Mr. Hearder, of Plymouth, has made a series of experiments, which we might say have completely exploded protected gunpowder. In a future number we may give some account of these experiments. At present we may say that Mr. Hearder finds that when confined the so-called protected or non-explosive powder is as explosive as unprotected powder. 2. That in the ordinary process of carriage the gunpowder separates itself from the glass in quantities sufficient to explode and do great damage. 3. That the powder, after having been mixed with the glass and again separated, undergoes changes which injure its quality and reduce its power. 4. That it fouls the interior of the gun, so as to render it necessary to wash it thoroughly after each charge. 5. That in its application to "small arms" this fouling must necessarily injure the interior of the rifle. 6. That although glass dust may be mixed with very coarse powder and separated from it again through coarse sieves, after having lain a short time together, yet the process of sifting, after some months of union, fails to detach all the glass dust, whilst the powder loses its glazed surface, and becomes itself friable. 7. That with the fine powder used for small arms, which constitutes a very large proportion of that in use in the service, the process of sifting would be tedious, incomplete, and impracticable. 8. That since it would be perfectly impossible, under any circumstances, to sift powder and make it up into cartridges rapidly enough to supply a ship or battery during an engagement, or even a regiment of soldiers during or on the eve of a battle, it follows that powder thus necessarily kept in the form of cartridges, &c., of which there are immense stores in many parts of the kingdom, could in no wise have the protecting process applied to it. 9. As all powder must be made into cartridges of exact dimensions and weight, and as it is impossible to afford space for this operation as well as the sifting process on board ship, it never can be used at sea. No one, Mr. Hearder adds, has ever doubted that gunpowder can be rendered non-explosive by many processes, but the question is, to what practical use can the fact be turned?

How to make Nitroglycerine Safe.—Professor Seely, in the *Scientific American*, notices the following methods of "protecting" nitroglycerine:—"First: Mr. Nobel proposes to dilute the nitroglycerine with wood naphtha. These two liquids mingle in any proportion, and the explosibility of the mixture may be reduced to any desired extent. Probably a mixture containing about 25 per cent. of naphtha could not be made to explode by percussion, or gradual heating. When the nitroglycerine is required for use, water is added to the mixture and takes from it the naphtha, while the pure nitroglycerine sinks to the bottom. This plan is, however, liable to serious objections. 1st. The expense of the naphtha and loss of nitroglycerine in washing with water. 2nd. The volatility of the naphtha: whenever the mixture is exposed to air some of the naphtha escapes, and the nitroglycerine might be left unprotected. 3. It is probable that there would be a chemical action between the substances. 4th. The naphtha and the vapour from it are very combustible. The vapour mixed with air would be an explosive mixture. Second: It has been proposed by several persons, quite independently of each other, to keep the nitroglycerine mixed with sand, or other inert substance which should serve as a conductor of heat, in the same way as the glass powder in Gale's gunpowder mixture. This plan would greatly increase the weight and bulk of packages, and great loss would be sustained by reason of the adhesion of the nitroglycerine to the sand. Third: Dr. Henry Wurtz proposes to make a thorough mechanical mixture or emulsion of the nitroglycerine with a saline solution of the same specific gravity. A solution of nitrate of zinc, lime, or magnesia, will probably be found to be suitable. When the nitroglycerine is needed for use, water is added to the mixture, when the oil subsides and may be drawn off. Further experience seems to be needed to determine how long the mixture may be maintained without spontaneous separation. Fourth: I have proposed to prepare the nitroglycerine more carefully, in order that it shall be perfectly freed from acid; and to prevent any future accumulation of acid, I propose to keep suspended in the oil a small quantity of a substance in powder which shall neutralise any acid which may be generated, and which of itself shall have no action on the oil. This method is offered as an efficient prevention of spontaneous decomposition. The amount of neutralising powder required is very little—60 grains to the pound of oil might be sufficient. The quantity is so small that it would not interfere with the use of the oil, and need never be removed from it. In actual practice one or more of these plans may be combined. The fourth is compatible with all the others, and should be used with all the others; nitroglycerine should not be kept in storage unless it is free from the danger of its most formidable property—the liability to spontaneous change. In conclusion, I can say that I have as yet had no reason to modify the opinions which I expressed in my communication of May 5, and that I still hold that the manufacture, transportation, and use of nitroglycerine may be carried on with safety. I believe all the careful and thoughtful readers of this article will agree with me."

Excise Chemistry.—We are indebted to the *Chemist and Druggist* for the report from which we make the following abstract:—

The Commissioners for Inland Revenue charged Mr. Thomas Reade, chemist and druggist, of Cork Street, Wolverhampton, first, with selling methylated spirit without a licence; and, secondly, with selling certain methylated spirit, coloured and flavoured, to be used as a beverage. A supervisor proved the purchase of three pint bottles of a mixture labelled as follows:—"Reade's Original Indian Essence, a pleasant and effectual medicine, warming and comforting — Antispasmodic, Astringent, Diaphoretic, and Diuretic. Perfectly free from any injurious drugs, and may, therefore, be taken with the greatest confidence. Dose: Adults, one tablespoonful, to be repeated when required; children, one or two teaspoonfuls. Prepared by Thomas Reade, chemist, 9, Cock Street, Wolverhampton. Only 3d. per ounce." Witness took the bottles to his office, in Church Street; and he afterwards forwarded two of the bottles, securely packed, to Somerset House. A portion of the third bottle he gave to the defendant's solicitor, and the remainder he now produced.

Mr. William Harkness, analytical chemist to the Board of Inland Revenue, proved the receipt of the two bottles of the essence produced from the previous witness. He made an analysis of the contents of one of the bottles, and found it to consist of methylated spirit, strength 70·1 under proof, highly sweetened with either treacle or very coarse brown sugar. It also contained a small portion of chloroform. He produced the methylated spirit which he extracted from it. It was not a mixture recognised as a medicine in the British Pharmacopœia.

Cross-examined by Mr. Motteram: Had been in the employ of the Commissioners of Inland Revenue, as analytical chemist, for six years. Could tell from his analysis most of the ingredients contained in the essence. He found treacle present, and water and chloroform. He supposed chloroform was a medicine. Did not find essence of ginger, but would not swear there was none present. Did not try for it. If there was any it was in very small quantities. Did not try for essence of capsicum or for gentian, nor did he find any. The essence had a slightly pungent taste, and he would not swear that capsicum did not contribute to that pungency. Chloroform, and the tinctures of gentian, ginger, and capsicum, were all recognised in the British Pharmacopœia, provided they were made with pure alcohol. He did not find in the mixture any sweet spirits of nitre. Had there been 100th part of one per cent. he should have discovered it. Methylated spirit was used to a certain extent, he knew, in the making of tinctures, but, in his opinion, no respectable chemist would use it.—Mr. Motteram here handed a list of medicines sent out by the South Staffordshire Hospital in 1864 to be contracted for, specifying thirty-six tinctures made up with methylated spirit, and asked the witness what he thought of that. Witness replied, all he could say about it was, that it was disgraceful.—Mr. Motteram: And all I can say is that the governors of the South Staffordshire Hospital are very much obliged to the chemist of six years' standing for the compliment he has paid them. Don't you know that there is a standing order for their use both in the army and navy?—Witness: I do not.—Mr. Spooner: Do you know whether they are used in the London hospitals?—Witness: I do not.—Mr. Motteram: Why, sir, do you not know that these methylated tinctures are very extensively used by the great body of the surgeons and dispensers in the United Kingdom?—Witness: I did not know it; and my opinion is, if they are so used, the surgeons and dispensers care more for the profit on cheap spirits than for the health of their patients.—Mr. Motteram (sharply): What do you know about it? You're not a physician. If methylated spirit is cheaper, what has that do with it if the poor want it, and it is as good as ordinary spirit?—Witness: But is it as good?

Mr. Spooner: I can't help thinking that medicines made from the pure spirit are the best to use; and I must express my astonishment that an institution like the South Staffordshire Hospital should use any other.

Mr. Motteram: I am told, sir, that methylated medicines are not only cheaper but equally efficacious.

Mr. Richard Banister, another of the analytical chemists at Somerset House, spoke to the analysis of a portion of the essence, which he found to consist of methylated spirit, syrup of sugar, and a small quantity of chloroform.

In cross-examination, witness said that he found no traces of spirits of nitre.

This was the case for the prosecution.

The defence was that the compound was a medicine, and that no pure methylated spirit was used in its composition. To establish this, the following witnesses were called:—

Dr. Hill, Professor of Chemistry and Public Analyst for the Borough of Birmingham, was sworn: He said that he was applied to by Mr. Reade to analyse the "Indian essence" He received four samples of the essence. One was a bottle which had been purchased at a shop of a Mr. Cottis; the other three were—a bottle which was compounded at Mr. Reade's, in his presence; a portion of a bottle which came through the Excise; and a portion of methylated spirits of nitre which he saw put into the essence that was compounded in his presence. There was no pure methylated spirit put into the essence he saw compounded. He took four ounces and distilled it for the purpose of extracting the spirit and nitrous ether, and found it to contain nitrous ether with methylated spirit and chloroform. The nitrous ether was an essential element of the sweet spirits of nitre. Upon analysing the sample of spirits of nitre, he found methylated spirit contained in it. He detected the presence of sweet spirits of nitre containing methylated spirit in all the three other bottles of essence. They presented the same analytical results in like proportions. In the preparation of the essence which was compounded in his presence he saw the following among other ingredients used:—Scotch treacle, golden syrup, sweet spirits of nitre, essence of ginger, essence of capsicum, infusion of gentian, and chloroform. There was no pretence for saying that the mixture was anything but a medicine, for everything it contained was a medicine except the treacle and water. Methylated spirit was used very extensively in the preparation of medicines, and the methylated spirit of nitrous ether even more so. The advertisement described the medicine fairly enough; certainly it was diaphoretic and diuretic.

Andrew Hanning, sworn, said that he had been in the employ of the defendant since December last, and during that period had had the mixing of the essence. That prepared for Dr. Hill, in the presence of that gentleman, was made in precisely the same way as in all other instances. There was no pure methylated spirit used. They used, in all cases, methylated spirit of nitrous ether only, and all the methylated spirit ever present was that which existed in the ether. It was used as a medicine, and a medicine only. He had tried it himself, and found instant relief from it. During the time he had been in Mr. Reade's service they had had about forty gallons of methylated spirit of nitrous ether, and only about one gallon of the simple methylated spirit. They had only used about half of the latter, and that was in the preparation of varnish.

Mr. Harkness, recalled by the Bench, said he was quite sure that there was no nitrous ether in the essence.

Mr. Hanning swore positively on his oath that no simple methylated spirit had been used in the composition of the essence. During the time he had been with the defendant they had made altogether from eighty to a hundred gallons of the essence.

This being the case for the defence,

Mr. Spooner, the stipendiary magistrate, said that he was prepared then to give his judgment upon the case. The judgment was subject to appeal, and he was very glad that it could be appealed against, both as regarded facts and law; but with respect to law, he did not think that such a course would be necessary. As regarded the facts, however, it was a very different thing. Three chemists had been called, and had differed in their evidence, as chemists always did—(a laugh)—when employed on opposite sides. It was, he regretted to say, found to be the case that scientific men could always take a scientific view according to the wishes of the party whose cause they were engaged in; and science was not yet so certain but that they could do so conscientiously. It had been urged by the learned gentlemen for the prosecution that the Government chemists had necessarily more knowledge of such points as the one which had been considered than had Dr. Hill, because they were more constantly engaged in analyses of this kind than Dr. Hill, who was only called in on these particular investigations. He would grant, for the sake of the argument, that this was so; and possibly, if he had to decide upon the evidence of the chemists, he might have been inclined to come to the conclusion that those who had come from Somerset House were more likely to be right than Dr. Hill. But it would be seen that the case did not depend solely on the evidence of those witnesses; it went further, because the witness Hanning, who had been in defendant's employ six months, and who knew how the mixture was made—and whose evidence he was inclined to believe, for he appeared to give it in a perfectly truthful and straightforward manner—had sworn positively that no methylated spirits were used. Under those circumstances he should dismiss the case.

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.

W. D. (Amsterdam).—The best account of the water supply of London will be found in the Report and Appendixes presented to Parliament in 1850. It is now, however, somewhat out of date, large works having since been constructed by some or nearly all of the companies.

F. C. J. (Merthyr).—We much regret this disappointment. They were promised by a very eminent authority, who has them under revision, but a press of other engagements has prevented their completion for the present.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Proposed Doubling of the Received Chemical Formulæ, by THOMAS STEVENSON, *M.D. Lond.*

IN a paper "*On Certain Reasons for Doubling or otherwise Multiplying Chemical Formulæ,*" on page 25 of the current volume of the CHEMICAL NEWS, Mr. Newlands has put forth certain arguments for doubling the generally received formulæ of chemical compounds, in order to do away with certain apparent exceptions to the law of atomicity or quantivalence of the elements; arguments which appear to me, if valid, so damaging to the law he endeavours to support, that I think it may not be amiss to criticise them.

The author's first argument, drawn from the doctrine of chances, beyond giving an air of mathematical precision to the paper, does not state anything more than a truism. But I quite think that Mr. Newlands has employed it merely to show that his hypothesis is, *à priori*, as likely to be true as any other, and that the question must be settled by other considerations. It is only fair to add that the presumption is in favour of the simpler formulæ, and that the burden of proof lies with our author.

I confess that I am quite unable to grasp his second argument, drawn from geometrical considerations. It appears to me that it is at variance with his third, deduced from the nature of elementary molecules. Why the simplest compound molecule should necessarily form a four-sided pyramid (a tetrahedron is evidently meant), I cannot conceive. At the same time, what Mr. Newlands finds "almost inconceivable," that the single atoms of hydrogen and chlorine usually supposed to exist in the molecule of hydrochloric acid should be capable of occupying the same space as the three atoms of hydrogen and one of nitrogen in ammonia, is to me easily conceivable. He himself appears to be able to conceive that the two atoms of hydrogen and the two atoms of chlorine which he supposes to exist in hydrochloric acid may occupy the same volume as the two atoms of nitrogen and the six atoms of hydrogen that he supposes to exist in ammonia; and there does not appear to be much difference in the conceivability or inconceivability of these two suppositions.

Again, if we admit that four is the least number of atoms that can enter into a molecule, as our author requires us to do, it follows that the free molecule of mercury must be represented by Hg_4; and the corresponding volumes of hydrochloric acid and ammonia would be H_4Cl_4 and N_4H_{12}. Will chemists accept these formulæ?

Mr. Newlands regards four volumes as representing the true state of affairs with regard to the vapour of chloride of ammonium and pentachloride of phosphorus—a fact which it would be hardihood to deny; but he appears to reject dissociation as the true explanation of the phenomena, and prefers doubling the usual formulæ of those compounds. As, however, he does not deny the fact of dissociation, and as it affords a sufficient explanation of the anomalies in question, I prefer to hold it, as a provisional hypothesis, in preference to doubling the ordinary formulæ.

The proposed formulæ would represent carbon as entering into all its compounds with an even number of atoms, and would do away with elements of even and uneven atomicity—at least, so we are informed. Why there should not be elements with uneven as well as those with even atomicity, Mr. Newlands does not explain. I see no reason why one class is not as likely to exist as the other. Moreover, why should the least indivisible quantity of carbon entering into a molecule be represented by C_2, and not by Ꞓ (= 24)? The only reason, I conceive, why the latter representation should not be employed would be that, by making C_2 in carbonic acid exchange two affinities, we get rid of the apparent exception to the quadrivalence of carbon in that compound, which is what Mr. Newlands wishes to do. But then comes the question—What is the quantivalence of carbon in C_2H_8, of nitrogen in H_6N_2, of oxygen in H_4O_2? If, as the theory of atomicity requires, the polyatomic be the binding element in the compound, carbon must exchange here at least two affinities, and be at least quinquivalent; nitrogen must exchange at least two affinities, and be at least quadrivalent; and oxygen must be at least trivalent. Can these values be assigned to C, N, and O in substitution compounds?

I will not pursue the author's arguments further, for enough has, I hope, been said to show that his ingenious hypothesis does not, on the theory of atomicity, do away with the real or apparent exception to the constancy of quantivalence in the case of carbonic oxide, without, at the same time, introducing other and greater difficulties. For the present, I apprehend, we must accept the anomaly as inexplicable.

Laboratory, Guy's Hospital, July 21.

On the Relation of Rosaniline to Rosolic Acid, by H. CARO *and* J. ALFRED WANKLYN.

AT the meeting of the British Association held in Bath in the year 1864, it was pointed out by one of us that rosaniline and rosolic acid might be represented as ethylene which had undergone substitution—

$$\overset{\text{Type.}}{C_2\left\{\begin{matrix}H\\H\\H\\H\end{matrix}\right.};\qquad \overset{\text{Rosaniline.}}{C_2\left\{\begin{matrix}NC_6H_5H\\NC_6H_5H\\NC_6H_5H\\H\end{matrix}\right.};\qquad \overset{\text{Rosolic acid.}}{C_2\left\{\begin{matrix}OC_6H_5\\OC_6H_5\\OC_6H_5\\OH\end{matrix}\right.}$$

Rosaniline and rosolic acid became members of the same family, the former being an ethylene containing

$$N\left\{\begin{matrix}C_6H_5\\H\end{matrix}\right.$$

in place of hydrogen, the latter also an ethylene, but containing OC_6H_5 and OH in place of hydrogen. Some of the reasons for assigning these formulæ were given in the communication made to the Bath meeting.

The relationship between rosaniline and rosolic acid is very well brought out by the facts which will presently be brought forward.

Griess has shown that aniline and nitrous acid yield water and diazobenzol—

$$\overset{\text{Aniline.}}{C_6H_5NH_2}+\overset{\text{Diazobenzol.}}{HNO_2C_6=H_4N_2}+2H_2O.$$

Diazobenzol is a most remarkable compound, forming salts which are very explosive, and which undergo certain very interesting transformations under the influence of reagents. It is moreover the representative of a numerous class of compounds derived similarly by the action of nitrous acid on different bases, and for the most part resembling itself in the explosive character of the salts. One of the most remarkable reactions presented by diazobenzol is that with water, wherein the whole of the nitrogen of the diazobenzol is evolved, and its place supplied by an atom of water—

$$\overset{\text{Nitrate of diazobenzol.}}{C_6H_4N_2HNO_3}+H_2O=\overset{\text{Carbolic acid.}}{C_6H_6O}+HNO_3+N_2.$$

This elegant form of reaction appears to be characteristic of the class to which diazobenzol belongs; and Griess has resorted to a measurement of the quantity of nitrogen set free during the reaction, as a means of arriving at the composition of the azo-compounds.

Hofmann showed some years ago that rosaniline, after treatment with nitrous acid, is capable of forming a platinum compound endowed with explosive properties, but appears not to have followed the investigation further.

Paraf has recently shown that rosaniline salts are converted by nitrous acid into a dye, which he considered to be rosolic acid. We have also investigated the action of nitrous acid on rosaniline, and arrive at the following results:—

When an acid solution of a salt of rosaniline is mixed with nitrous acid, it forms an azo-compound, which corresponds very closely in character to diazobenzol. Like diazobenzol this compound forms explosive salts; like diazobenzol it decomposes with evolution of nitrogen gas when it is boiled with acids. In adding the nitrous acid to the solution of rosaniline to form the compound, it is easy to observe the exact point at which the solution ceases to contain unaltered rosaniline. It thus becomes easy to determine the amount of nitrous acid consumed in the conversion of a given weight of rosaniline into the azo-compound. We have done this by the employment of a method which gives excellent results when applied to aniline and toluidine, and the details of which will shortly be published by one of us. We obtain as the result of our experiments, that one molecule of rosaniline consumes three equivalents of nitrous acid; and the equation representing the reaction will be—

$$\underset{\text{Rosaniline.}}{C_{20}H_{19}N_3} + 3HNO_2 = \underset{\text{Azo-compound.}}{C_{20}H_{10}N_6} + 6H_2O.$$

On boiling this azo-compound with hydrochloric acid, there is evolution of nitrogen gas. The volume of nitrogen was measured. The result was that one molecule of rosaniline, after conversion into the azo-compound, yields six equivalents of nitrogen.

$$\underset{\text{Azo-compound.}}{C_{20}H_{10}N_6} + 3H_2O = C_{20}H_{16}O_3 + N_6.$$

These changes in composition are accompanied by striking physical effects. The deep-red solution of the salt of rosaniline becomes brown on the addition of excess of hydrochloric acid, then yellow as the nitrous acid is added; then there is much froth, and as the solution is boiled it gradually becomes red yellow, and a large quantity of a deep-coloured solid with cantharides-like lustre separates out.

Seeing that this solid is produced by treating rosaniline with three equivalents of nitrous acid, and that six equivalents of nitrogen are evolved, it must be a non-nitrogenous substance. A careful comparison of its properties and reactions with those of the rosolic acid described by Kolbe and Schmitt, and now made largely as an article of commerce, leads to the conclusion that it is identical with rosolic acid.

The following characters are common to it and to the rosolic acid of Kolbe and Schmitt:—

1. A yellowish-red solid with cantharides-like lustre, only sparingly soluble in water, soluble in ether and alcohol.

2. Easily soluble in ammonia, and in alkalies generally, forming red solutions of very great colouring power. Addition of acids to these solutions decolorises them, precipitating the colouring matter in the form of a yellowish precipitate, which varies much in tint.

3. When boiled with aniline and a little benzoic acid, it forms a blue dye, there being no evolution of ammonia. The blue dye is very soluble in alcohol, not soluble in water; it is the salt of a red-coloured base. It dissolves in strong sulphuric acid, giving a red solution.

4. Submitted to destructive distillation, it gives abundance of carbolic acid, leaving a carbonaceous residue.

5. The deep-red solutions in alkalies are easily reduced on boiling them with zinc powder; so treated they lose their colour; but restoration of the colour takes place on adding ferricyanide of potassium.

There is only one particular in which any difference could be detected between the product obtained from rosaniline and that obtained from carbolic acid by Kolbe and Schmitt's process.

The rosolic acid of Kolbe and Schmitt forms salts the solutions of which are darkened by ferricyanide of potassium. The product obtained from rosaniline does not darken, or darkens only very slightly, on the addition of ferricyanide. An explanation of this difference is afforded by the following experimental facts:—The product from rosaniline after reduction with zinc becomes capable of being darkened by ferricyanide; and if leucaniline instead of rosaniline be taken, there is obtained a cantharides-like product, which gives red solutions with alkalies, but is darkened by ferricyanide. Furthermore, if a solution of Kolbe and Schmitt's rosolic acid be darkened with ferricyanide of potassium, and then precipitated by the addition of an acid, there results a colour acid which dissolves in alkalies, giving solutions of the exact tint of the rosaniline product, and, like it, incapable of being deepened by ferricyanide. The interpretation of all this is, that the rosolic acid obtained from carbolic acid by the action of sulphuric and oxalic acid (Kolbe and Schmitt) contains more or less leuco-rosolic acid, produced probably by the reducing action of some sulphurous acid. The rosolic acid got from leucaniline also contains more or less leuco-rosolic acid. The rosolic acid obtained from rosaniline is free, or almost free, from leuco-rosolic acid.

Be this, however, as it may, there can be no doubt that rosaniline and carbolic acid give essentially the same product when the former is treated with nitrous acid in the manner we have described, and the latter with sulphuric and oxalic acids as in Kolbe and Schmitt's process.

Adopting the "ethylene type," we have the following expressions for the reactions of rosaniline—

$$\underset{\text{Rosaniline.}}{C_2\left\{\begin{array}{l}NC_6H_5H\\NC_6H_5H\\NC_6H_5H\\H\end{array}\right.} + \begin{array}{l}HNO_2\\HNO_2\\HNO_2\end{array} = \underset{\text{Azo-rosaniline.}}{C_2\left\{\begin{array}{l}N_2C_6H_3\\N_2C_6H_3\\N_2C_6H_3\\H\end{array}\right.} + \begin{array}{l}2H_2O\\2H_2O\\2H_2O\end{array}$$

$$C_2\left\{\begin{array}{l}N_2C_6H_3\\N_2C_6H_3\\N_2C_6H_3\\H\end{array}\right. + \begin{array}{l}H_2O\\H_2O\\H_2O\end{array} = \underset{\text{Rosolic acid.}}{C_2\left\{\begin{array}{l}OC_6H_5\\OC_6H_5\\OC_6H_5\\H\end{array}\right.} + 3N_2.$$

On comparing the formula of rosolic acid given thus by Griess's process applied to rosaniline, we find that it differs from the formula deduced from Kolbe and Schmitt's analysis, viz.—

$$C_2\left\{\begin{array}{l}OC_6H_5\\OC_6H_5\\OC_6H_5\\OH\end{array}\right.$$

by one atom of oxygen.

We are inclined to think that this difficulty must be got over by correcting the formula deduced from Kolbe and Schmitt's research. If the numbers required by the formulæ $C_{20}H_{16}O_4$ and $C_{20}H_{18}O_4$ be calculated, it will be found that both of them fall sufficiently near the analytical results actually obtained to allow of the deduction of either from the analyses.

Taking the latter—viz., $C_{20}H_{18}O_4$—all will become intelligible—

$$\begin{array}{cc} \text{Rosolic acid.} & \text{Type.} \\ C_{20}H_{18}O_4 = C_2\left\{\begin{array}{l} OC_6H_5 \\ OC_6H_3 \\ OC_6H_5 \\ H \\ H \\ HO \end{array}\right. & C_2\left\{\begin{array}{l} H \\ H \\ H \\ H \\ H \\ H \end{array}\right. \end{array}$$

Thus rosolic acid appears as an ethyl-hydride, and its generation in the Griess process applied to rosaniline is obvious. To the formula

$$C_2\left\{\begin{array}{l} OC_6H_5 \\ OC_6H_3 \\ OC_6H_3 \\ H \end{array}\right.$$

which is derived from rosaniline by the straightforward action of nitrous acid and water, we have to add H_2O, and we get

$$C_2\left\{\begin{array}{l} OC_6H_5 \\ OC_6H_3 \\ OC_6H_5 \\ H \\ H \\ HO \end{array}\right.$$

which is, as was said, a possible expression of the analyses of the rosolic acid obtained from carbolic acid.

On Ozone and Antozone, by M. C. WELTZIEN.*

M. SCHOENBEIN, who in all chemical combinations considers only the oxygen they contain, and attributes to it all the reactions they produce, admits that this oxygen, whether free or combined, may exist in three different states; as active negative oxygen $\overset{-}{O}$ (ozone); as active positive oxygen $\overset{+}{O}$ (antozone); as ordinary inactive oxygen O, resulting from the union of the two others $\overset{-}{O}$ and $\overset{+}{O}$. Combinations containing active negative oxygen he calls ozonides, and antozonides those containing active positive oxygen. Thus peroxide of lead is an ozonide, $PbO\overset{-}{O}$, and peroxide of hydrogen an antozonide, $HO\overset{+}{O}$; nitric acid, which M. Schœnbein considers as hyponitrate of peroxide of hydrogen, contains these three acids—

$$NO_2 + 2\overset{-}{O} + HO\overset{+}{O}.$$

Under the name of nitrous peroxide of hydrogen (Stickwasserstoff hyperoxyd) M. Schoenbein describes a compound which he gives as—

$$NO_2 + HO_2,$$

which must be nitrous acid.

According to some considerations by the same chemist, ordinary oxygen is susceptible of polarisation; certain bodies polarise it positively, others negatively. Moreover, certain bodies will transform active positive into negative oxygen, or inversely. With this method of interpreting facts it would be difficult to be taken unawares.

Some years ago I had occasion to pronounce against these theories; I showed the hypothesis of the two oxygens to be groundless, unnecessary, and that all the reactions discovered by M. Schoenbein might be explained like other chemical reactions. I also differ from M. Clausius, who considers ozone as the result of the condensation of two atoms of oxygen.

Sir B. Brodie also gives his opinion against M. Schoenbein's interpretations, and places the reactions of ozone amongst the normal chemical reactions; at the same time he claims priority respecting the theories on the polarity of the elements of a chemical molecule.

In 1855 M. Houzeau, whilst making concentrated sulphuric acid react on peroxide of barium, obtained a very odorous oxygen, apparently ozone, and to which he had then given the name of nascent oxygen. M. Schoenbein came upon this reaction in 1861, and he considered the disengaged oxygen as positive active oxygen—that is to say, antozone. M. Meissner says:—"The observations of M. Weltzien against M. Schoenbein's views are based upon this, that the existence of a second active oxygen, antozone, is not proved." We must then examine what foundation there is for the existence of antozone. According to M. Houzeau, the odour of nascent oxygen, although much resembling the odour of ozone, is still very different; its inhalation produces suffocation and even vomiting, which ozone never does; he compares its odour and flavour to that of lobster. His nascent oxygen quickly decolorises litmus, oxidises metals, especially silver, changes ammonia into nitrate, does not ignite spontaneously inflammable phospuretted hydrogen, decomposes iodide of potassium setting the iodine at liberty, and even takes hydrogen from hydrochloric acid; finally, under the influence of light or of a temperature of 75°, it changes into ordinary oxygen.

According to M. Schoenbein, antozone decomposes iodide of potassium; M. Meissner, on the contrary, asserts that this decomposition does not take place, and the latter chemist even uses iodide of potassium to separate antozone and ozone. He thus endeavours to explain the difference of opinion between himself and M. Schoenbein:—"It must be admitted that antozone does not act so energetically upon iodide of potassium as ozone, and it is for this reason, and partly also because of the presence of a great quantity of ozone, that after passing a current of electrified air through a solution of iodide of potassium very little antozone is retained by this salt." Meissner adds, however, that this explanation does not entirely satisfy him.

In Graham-Otto's treatise on chemistry a similar attempt is made to explain this contradiction by saying that antozone cannot provoke the reactions of ozone, except after having been by some means previously transformed into ozone, and here the agent of this transformation is evidently hydriodic acid, displaced from the iodide of potassium by the acid introduced. Other contradictions are found in the same work;† thus, p. 179:—"One cannot conceive a mixture of ozone and antozone." Then p. 181:—"The reactions of ozone are not much hindered by the presence of antozone, if, indeed, they are at all hindered."

According to M. Schoenbein, ozone and antozone are polarised negatively; according to Meissner, a metallic plate placed in antozone does not become charged with electricity. He has been unable to prove the electric state in either ozone or antozone.

The white vapours formed above phosphorus exposed in the air are formed of antozone, according to Meissner; of nitrite of ammonia, according to M. Schoenbein;

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* *Bulletin de la Société Chimique*, May, 1866.

† See 4th edition, vol. ii.

Meissner even goes so far as to say "it is evident that these vapours cannot be formed by nitrite of ammonia."

Having stated all these differences, I ask, What is the appearance of antozone, and how does it behave?

We may give the characteristics of this body as—1. It combines with water and forms peroxide of hydrogen. 2. It forms a white mist on contact with this last compound.

As to the formation of peroxide of hydrogen, what happens is this—there is a difference in the manner in which certain peroxides behave; thus, peroxide of barium behaves with water differently to the peroxides of manganese or lead. Instead of attributing this difference to the nature of the metal itself, people prefer resorting to hypotheses, admitting that this difference is due to the nature of the combined oxygen, and supposing that the peroxides of barium and oxygen contain antozone; according to this, if peroxide of hydrogen is formed in a reaction, it is to be supposed that antozone pre-existed in one of the reacting bodies, and that this antozone, uniting with the water, produced the peroxide of hydrogen. M. Meissner thus explains what passes in the electrification of the water:—" At the same time as the ozone, antozone is produced, if not free at least combined with water—which comes to the same thing."

M. Houseau's nascent oxygen freed from the peroxide of barium by sulphuric acid is, he says, antozone. Why? Because, says M. Meissner, the liquid contains peroxide of hydrogen; and yet we obtain this body by the action of acids upon peroxide of barium, and we should have reason to be astonished were it not produced in this reaction, for a small portion at least ought to escape the decomposition produced under the influence of temperature. As to the property which antozone possesses of producing vapours on contact with aqueous vapour, we find in Meissner's memoir the following, which ought to explain the formation of ozone and antozone in the action of phosphorus on air, and the action of antozone on water:—

"The phosphorus produces ozone and antozone in surrounding oxygen; it polarises neutral oxygen, and consequently acts on oxygen as a body charged with electricity. The phosphorus seizes upon the ozone to form phosphoric acid, whilst what antozone remains free unites with the water to produce peroxide of hydrogen, forming with the vapour of water the cloud which appears above the liquid."

M. Meissner calls antozone *atmizone*, on account of the white fumes it forms, and he uses the German word *abklingen* to express that atmizone gradually loses its energy, and ends by changing into ordinary oxygen. Chemists are aware that a tumultuous escape of gas and production of vapours often take place without the agency of antozone. It must be noticed that odoriferous oxygen, freed by M. Houzeau's process, and which, according to MM. Schoenbein and Meissner, is antozone, is produced in the presence of concentrated sulphuric acid; it is then dry, and cannot consequently produce any vapour.

(To be continued.)

Reactions of the Sulphates of Quinine and Quinidine.—Schwarzer points out a difference in the behaviour of chlorine water, ferrocyanide of potassium, and ammonia towards sulphate of quinine and sulphate of quinidine. With both, it is true, a red coloration is obtained; but in the case of quinine the red colour disappears after a few minutes, while with sulphate of quinidine a bulky persistent precipitate is obtained.—*Journ. de Pharm. et de Chimie*, June, 1865, p. 475.

TECHNICAL CHEMISTRY.

A Theoretical Study of the Manufacture of Soda by Leblanc's Process, by M. J. Kolb.* *(Second Part.)*

(Continued from page 17.)

The diminution of alkalinity in black ash long exposed to air is attributable to the presence of iron in the ash, which may contain as much as 3 per cent. of that metal. Iron is present in the anhydrous ash in the state of sesquioxide, not sulphide, for sulphide of iron in contact with lime at a high temperature will give oxide of iron and sulphide of calcium. As long as the ash is exposed to air without moisture, the peroxide of iron undergoes no change; but when moisture intervenes, the peroxide becomes hydrated, and now acts on the sulphide of calcium, producing sulphide of iron and lime.

The moist sulphide of iron oxidises in the air, and finally becomes the sulphate $(Fe_2O_3)2SO_3$, which is again destroyed by the lime, forming sulphate of lime and reproducing peroxide or sulphide of iron. The changes with the sulphide or peroxide then recommence, and thus a very small proportion of iron is sufficient in moist air to transform a large proportion of sulphide of calcium into sulphate of lime.

To sum up the results of the experiments:—They show that crude ashes exposed to perfectly dry air are not sensibly altered, however long the exposure may last. Over-roasted ashes, or ashes containing sulphide of sodium, may, indeed, be benefited by the exposure, the sulphide of sodium becoming converted into hyposulphite. At 100° dry air is equally without action, but as the temperature rises beyond that, and especially at a red heat, the sulphide of calcium is changed to sulphate of lime, and then, on contact with water, sulphate of soda is produced, and the alkalinity of the ash diminished. M. Pelouze has shown that this diminution commences between 200° and 300°. We can understand now how important it is for the manufacturer to hasten the cooling of the ash, and to effect the cooling in hermetically closed vessels.

The first effect of moisture of the air on ball soda is to hydrate the lime, producing fissures in the balls which separate them into fragments. The hydrate slowly carbonates; hence a small proportion of caustic soda in the leys. At the same time the sulphide of sodium oxidises to hyposulphite.

If these were the only reactions which took place, exposure to moist air would be an excellent thing; but unfortunately this salutary action is counterbalanced by the oxidation of the sulphide of calcium, which becomes sulphated by the direct action of the air, and more especially by the indirect action of oxide of iron previously described. Moist as well as dry air, then, can only be useful to overburnt ash. In general the exposure to air should be limited to the time necessary for the hydration of lime by atmospheric moisture. This hydration facilitates the breaking up of the lumps, which would otherwise be a difficulty with a body so hard as ball soda.

The time of the exposure may vary from three to six days, according to the amount of moisture in the air and the proportion of free lime in the ash; it is seldom that it can be prolonged beyond this without a loss to the manufacturer.

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* Abstract from *Annales de Chimie et de Physique*, June, 1866, p. 115. For abstracts of the former part of the author's memoir see Chem. News, vol. xiii., pp. 140, 162.

Before proceeding to the action of water on the crude ash, the author refers again to the composition of the ash. He agrees with MM. Kynaston and Scheurer-Kestner that no caustic soda is to be found in the ash. He believes that although traces of sulphide or bisulphide of sodium may be present in a badly made ash, the monosulphide found in a ley depends on the mode of lixiviation. The iron, as stated before, exists as peroxide, and is only converted into sulphide in contact with water.

M. Kolb next explains the manner in which he has presented the composition of the anhydrous ash (see page 16) which has been used in the experiments to be now described, and points out a distinction which must be made in the analysis of a dry ash and in that of the variable elements furnished by its treatment with water. The analysis of an anhydrous ash, he says, ought and can only indicate lime and peroxide of iron; if it mentions sulphide of sodium, it should only be that obtained by washing with alcohol. The analysis of a lixiviated soda, on the contrary, ought to give the caustic soda and sulphide of sodium as well as caustic lime, all three being variable according to the manner in which the ash has been treated with water. It should also give account of the sulphide of iron, carbonate of lime, &c., which also result from the action of water.†

In the tables which now follow will be seen the changes produced by the action of water under three conditions—1, the proportion of the water; 2, the length of the digestion; 3, the temperature:—

Table 1.—Influence of the Amount of Water.

100 grs. of ash.	In 350 c.c. of water.	In 500 c.c.	In 1000 c.c.	In 2000 c.c.
Digested for 6 hours at 15° C.:				
$NaOCO_2$ . .	,,	38·51	40·19	38·21
NaO . .	,,	3·32	2·34	3·32
NaS . .	,,	0·20	0·25	0·20
Digested for 6 hours at 40° C.:				
$NaOCO_2$ . .	,,	37·36	35·92	36·10
NaO . .	,,	3·94	4·40	4·67
NaS . .	,,	0·25	0·45	0·50
For 6 hours at 60°:				
$NaOCO_2$ . .	,,	31·49	34·20	37·91
NaO . .	,,	6·78	5·40	3·34
NaS . .	,,	0·65	0·75	0·60
For 24 hours at 15°:				
$NaOCO_2$ . .	34·70	38·58	38·56	37·62
NaO . .	5·70	3·29	3·30	3·84
NaS . .	traces	0·25	0·25	0·35
For 24 hours at 40°:				
$NaOCO_2$ . .	31·40	35·36	34·23	34·68
NaO . .	7·80	5·05	6·04	5·94
NaS . .	0·15	0·40	0·75	0·53
For 24 hours at 60°:				
$NaOCO_2$ . .	31·50	26·80	31·10	33·10
NaO . .	7·60	6·71	6·62	6·15
NaS . .	0·30	4·70	2·00	1·00
For a week at 15°:				
$NaOCO_2$ . .	31·50	37·02	35·18	34·50
NaO . .	7·60	4·23	4·97	5·28
NaS . .	traces	0·25	0·30	0·51
For a week at 40°:				
$NaOCO_2$ . .	25·80	34·21	31·40	31·50
NaO . .	9·50	5·67	6·30	6·31
NaS . .	2·20	0·40	0·80	1·48
For a week at 60°:				
$NaOCO_2$ . .	26·40	25·50	23·20	19·50
NaO . .	7·20	6·62	6·00	6·31
NaS . .	3·70	5·90	7·80	10·21

Table 2.—Influence of Time of Digestion.

100 grs. of ash.	Digestion lasting 6 hours.	Digestion lasting 24 hours.	Digestion lasting a week.
In 350 c.c. of water at 15°:			
$NaOCO_2$ . .	,,	34·70	31·50
NaO . . .	,,	5·70	7·60
NaS . . .	,,	traces	traces
In 350 c.c. at 40°:			
$NaOCO_2$ . .	,,	31·40	25·80
NaO . . .	,,	7·80	9·50
NaS . . .	,,	0·15	2·20
In 350 c.c. at 60°:			
$NaOCO_2$ . .	,,	31·50	26·40
NaO . . .	,,	7·60	7·20
NaS . . .	,,	0·30	3·70
In 500 c.c. at 15°:			
$NaOCO_2$ . .	38·51	38·58	37·02
NaO . . .	3·32	3·29	4·23
NaS . . .	0·20	0·25	0·25
In 500 c.c. at 40°:			
$NaOCO_2$ . .	37·36	35·36	34·21
NaO . . .	3·94	5·05	5·67
NaS . . .	0·25	0·40	0·40
In 500 c.c. at 60°:			
$NaOCO_2$ . .	31·49	26·80	25·50
NaO . . .	6·78	6·71	6·62
NaS . . .	5·65	4·70	5·90
In 1000 c.c. at 15°:			
$NaOCO_2$ . .	40·19	38·56	35·18
NaO . . .	2·34	3·30	4·97
NaS . . .	0·25	0·25	0·30
In 1000 c.c. at 40°:			
$NaOCO_2$ . .	35·92	34·23	31·40
NaO . . .	4·40	6·04	6·30
NaS . . .	0·45	0·75	0·80
In 1000 c.c. at 60°:			
$NaOCO_2$ . .	34·20	31·10	23·20
NaO . . .	5·40	6·62	6·00
NaS . . .	0·75	2·00	7·80
In 2000 c.c. at 15°:			
$NaOCO_2$ . .	38·21	37·62	34·50
NaO . . .	3·32	3·84	5·28
NaS . . .	0·20	0·35	0·51
In 2000 c.c. at 40°:			
$NaOCO_2$ . .	36·10	34·68	31·50
NaO . . .	4·67	5·94	6·31
NaS . . .	0·50	0·53	1·48
In 2000 c.c. at 60°:			
$NaOCO_2$ . .	37·91	33·10	19·50
NaO . . .	3·34	6·15	6·31
NaS . . .	0·60	1·00	10·21

(To be continued.)

Simple and Economic Process for obtaining Soda from Common Salt.—Mr. Walter Weldon has taken out patents for a process described as follows:—The new process consists in placing within a vessel capable of resisting the required pressure an equivalent of common salt, and another of carbonate of magnesia, with a small quantity of water, and then pumping into the vessel the carbonic acid formed by causing atmospheric air to traverse coal in a state of ignition. The carbonate thus becomes bicarbonate of magnesia, which dissolves in the water, and then decomposes the chloride of sodium, chloride of magnesium, which remains in solution, and bicarbonate of soda, which precipitates, being formed. The whole process lasts but a quarter of an hour at most, and the cost is only that of the coal used in forming the carbonic acid. A moderate heat drives off the second atom of carbonic acid from the bicarbonate of soda, changing it into carbonate; and the magnesia may be recovered from the chloride by evaporating the solution containing it to dryness, and raising the residue to a temperature below redness.

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† In a future paper the author intends to give an account of his analytical methods.

PHARMACY, TOXICOLOGY, &c.

Facts relating to Magnesium: its Action on Metallic Solutions, and its Application to Toxicological Researches, by M. Z. Roussin.*

(Continued from page 28.)

The acid liquids obtained from the viscera or other organic matters under analysis are concentrated by evaporation in a water bath, and brought to a syrupy consistence. The residue heated to 125° is redissolved in a small quantity of distilled water, then filtered.

We then arrange one of Marsh's ordinary apparatus, into which we introduce some water acidulated with sulphuric acid, and some grammes of magnesium ribbon. A considerable escape of hydrogen then takes place, which must be carried through a tube at a red heat in the middle, and ignited at the smaller extremity. If no rings are formed on the tube, and no spot on the porcelain plates held upon the flame of the gas, then successively introduce into the apparatus small portions of the suspected liquid. If either antimony or arsenic is present in the liquid, a ring will not be long in appearing, as in the ordinary Marsh's apparatus, and the flame flattened against the porcelain plate leaves there a shiny deposit. The spots and rings of arsenic are distinguishable from the spots and rings of antimony by characteristics known to toxicologists, and which, therefore, it is unnecessary to mention here.

If the suspected liquids contain no trace of arsenic or antimony, they may contain other poisonous metals, such as copper, lead, mercury, zinc, &c. In this case the metals are found as flakes, powder, or sponge, either at the bottom of the flask of the apparatus or on the surface of the plates of magnesium. To render the precipitation complete, the liquids must be kept in a proper state of acidity, and the experiment prolonged till the new plates of magnesium introduced into the liquid dissolve, whilst retaining their metallic brilliancy. To ascertain the end of the operation, it is well to take out at first a small proportion of the liquid of the flask, to put it into a small test tube, and to introduce a well-scoured ribbon of magnesium. However it may be, it is always necessary to leave in the flask a small excess of magnesium before putting the liquid on a filter. All that is in suspension—corroded plates of magnesium, powder, flakes, or metallic sponge—is washed on the filter until the washings show no acid reaction; the filtered liquids should not precipitate on the addition of hydrosulphuric acid. The filter being dried, collect the deposit it contains, and analyse it in the ordinary way to ascertain the metals precipitated by the magnesium.

The limits of an article like this do not admit of the minute details of the operations of the experimentalist and the precautions he ought to take. These precautions and verifications belong to all analyses appertaining to legal chemistry, and every operator imagines, multiplies, and varies them according to the principles of the method he employs and the research he is engaged upon. Here we bring forward merely a note on the formation of solid hydride of arsenic, when the liquids contain nitric acid, and the necessity in the last case of preventing its formation by the addition of some particles of pure sugar candy, according to M. Blondlot's valuable recommendation. Again, we content ourselves with indicating that in a solution of bichloride of mercury the mercury is not all precipitated in a metallic state by the plates of magnesium; a portion forms a deposit of protochloride.

There is one more important observation, the omission of which would not fail to call forth criticism—the magnesium which contains silicium gives off on contact with acids siliciuretted hydrogen, which decomposes at a dull red heat like arseniuretted and antimoniuretted hydrogens, leaving a dark-brown deposit. The formation of this deposit might give rise to an error. Such is the objection. A few words will answer it:—

1. The magnesium which is now manufactured gives no foreign deposit in Marsh's apparatus; no sample of magnesium ribbon (as it is made for burning) tested by us has given either rings or spots. The hydrogen it gives off has always appeared remarkably pure and inodorous; its flame is hardly visible.

2. Marsh's apparatus fed by magnesium is tested under precisely the same conditions as when fed by zinc. The suspected liquids are only introduced into the apparatus after the preliminary verification of the gas-producing agents.

3. The deposit of silicium left in the red-hot tube by the passage for the hydrogen, accidentally charged with siliciuretted hydrogen, is moreover clearly distinguishable from the deposits of arsenic and antimony.

These last two disappear immediately on contact with a drop of nitric acid or aqua regia; the ring and spot of arsenic disappear suddenly when touched with a diluted solution of a hypochlorite. These three tests have no effect on the deposits of silicium produced in the tube of the Marsh's apparatus.

PROCEEDINGS OF SOCIETIES.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, by Dr. Percy, F.R.S.

Lecture No. VI.

Ladies and Gentlemen,—We proceed this morning with the subject of the anhydrous silicates, and will then immediately take up the hydrated silicates, which form a very extensive and interesting class of bodies.

Before commencing, I will draw your attention to certain specimens on the table before you, which illustrate what I said about devitrification in the last Lecture. Here, for example, is a piece of the well-known trap rock, occurring in South Staffordshire in connexion with coal. It is known as the Rowley rag. There were for a long time beautiful quarries of this Rowley rag, presenting fine basaltic columns of the usual form, but these have been long since removed, owing to the excavations which have been made for different purposes, especially for roads. It is a very good stone for that purpose. Now, there is natural stone, the natural trap rock, which was no doubt very slowly cooled. Here is the same rock which has been melted. You see that when melted artificially it forms a perfect black glass, much resembling common obsidian. This was cooled, of course, with very great rapidity, and hence the vitreous property has been acquired. If we take this same glass and cool it very slowly, we then get the appearance of the spheroidal masses of crystals of which I showed you illustrations on the last occasion. You will find in the upper gallery of the Museum some very characteristic specimens of this kind.

The next mineral to which I have to direct your attention is one of no great interest—mineralogically, at all events. It is known as gehlenite, taking its name from the old chemist Gehlen. Gehlenite is a very unattractive mineral,

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* *Journal de Pharmacie et de Chimie*, iii., 413.

occurring in square prisms. It is found in limestone, crystallised, in syenite, in the Fusser Thal, in the Tyrol. You will see the crystals diffused throughout the mass. In the course of many years' search among furnace products I met with one specimen of gehlenite, or of a substance which is identical crystallographically and chemically with gehlenite. That is now a good many years ago. It came from a furnace in some iron works, in South Staffordshire, near Birmingham and Oldbury. Here is the specimen. It differs at first sight, indeed, very sensibly from the natural gehlenite; but it has been very carefully examined by Professor Miller, of Cambridge, undoubtedly the best observer we have in that line, and its crystallised form has been accurately determined by him. I made some very careful analyses of it some years ago, and found the composition to be identical with that of gehlenite. This substance was produced in a blast furnace at a very high temperature. Whether the gehlenite which we find in the Tyrol has been produced in exactly the same conditions, I think is very doubtful. It may possibly be a product of hydrothermic action, but of that we require further information. This is the only instance on record, as far as I know, of the artificial formation of this mineral. The formula is $3(3CaO,SiO_3) + 3H_2O_3,SiO_3$.

The substance next in order is one of great interest in many respects—chemically, mineralogically, geologically, and, I might add, metallurgically. It is the mineral known as felspar, of which there are several varieties, or distinct species rather; but the felspar to which I shall call your attention is the one known as orthoclase, or potash felspar, in distinction from periclase, or soda felspar. Then we have some containing a very large quantity of lime. This potash felspar consists essentially of silica, potash, and alumina. It has this formula, taking the old one proposed by Berzelius—$KOSiO_3 + Al_2O_3 3SiO_3$. You see I am maintaining the old notation; some fight stoutly for one, and some fight manfully for the other. Potash felspar is analogous in point of constitution with potash alum. If we replace the silica by sulphuric acid, we get alum.

Felspar exists very extensively diffused throughout the world, and plays a very important part. It is, no doubt, the source of our clays. Perhaps all the clays which we meet with in the world are derived from the decomposition of felspar, or some closely analogous compound. Of that I have little doubt.

What proof have we of the conditions under which felspar has been formed? Well, I think I can present you with some very satisfactory evidence on this subject. A good many years ago, on pulling down some old copper furnaces in the province of Mansfeld in Prussia, where copper smelting had been carried on for many centuries, some beautiful crystals were discovered, many of which had a delicate tint. Their form was exceedingly sharp and well defined, and sometimes they occurred of considerable dimensions. I am fortunate in being able to present you with three specimens of this felspar. I believe search has been often made for it since, but without success. It was found in the lower part of the furnace, especially in the hearth. It was found, also, not only in crystals, but also massive, and intermingled with some black matter. It contained sulphide of zinc and carbonaceous matter as well. Here is a sample of this black matter; and here is a specimen of felspar in numerous crystals coating this piece of rock. These crystals are identical, crystallographically and chemically, with potash felspar. Several analyses have been made of them by different and very competent observers with the same result. You shall have one analysis, from which you will be able to judge for yourselves of its composition. It contains a little foreign matter in addition to its combined elements, but this takes no part in the constitution of the formula. We very often find, as I said on a former occasion, this accidental presence of foreign matter which has nothing whatever to do with the chemical constitution of the body. Here are the results of an actual analysis:—

	Per cent.
Silica	64·53
Alumina	19·2
Peroxide of iron	1·2
Lime	1·33
Copper	0·27
Potash	13·47

The lime present is quite insignificant in quantity. The presence of a little copper need not surprise us, because these crystals were formed in a copper furnace. We shall ascertain, by calculating the composition of this formula, that really these two bodies, the natural and the artificial, are chemically identical.

I do not know that we have met with any other instance of the artificial formation of felspar in this way—that is, by igneous action alone. Here, unmistakably, these crystals have resulted solely from the operation of fire. We see, then, the possibility of the so-called plutonic formation of this mineral. On the other hand, it is equally certain that this mineral has been produced by what I have called hydrothermic action—that is, by the action of water at a high temperature and under considerable pressure. Daubrée, an observer on whose authority we may rely with confidence, and whose name I have often mentioned, produced felspar by acting upon obsidian, that black volcanic glass, by water at a high temperature. The obsidian was changed into a greyish matter, having still the same chemical characters, but by the naked eye it was seen to be crystalline, like a fine-grained trachyte. We shall speak of trachyte hereafter when we come to consider the subject of volcanic action. This substance, examined by the microscope, showed clearly the characters of felspar—that variety known as glassy felspar or rhyacolite. There is positive proof, then, of the formation of felspar by aqueous agency. He also produced it by heating kaolin in a glass tube with the water of a particular mineral spring containing alkalies—the water of Plombières; but I must defer the details of the process till we come to discuss the action of this water in the formation of minerals. There is no doubt that felspar was so generated. There can be no doubt, however, that granite, in which it occurs, and which we meet with all over the world, has been the result of mere fusion, as it is called. It is remarkable to me that it should be so produced, especially when we remember the difference of specific gravity between the fused and the crystallised quartz. The hydrothermic theory of its formation has many warm supporters, and one of the warmest and most able is undoubtedly Bischoff.

We now come to mica. I can tell you very little of this body. I know very little of it of my own knowledge—of its formation by artificial means; but there are one or two facts concerning it which must be laid before you. Mitscherlich found it in an old slag heap in Sweden. Hausmann is said to have found it in the cavities in the hearth of a furnace, in sandstone. Daubrée tells us that he formed uniaxial mica in hexagonal scales from clay in superheated water containing dissolved silicates. I need not enter into its properties. It is now very well known, and extensively employed in the arts. It has the curious property of splitting into thin leaves. There are many kinds of mica. Here is a specimen which I received, since I gave the last course of lectures, from Sir Charles Lyell. He found it among the specimens of the late Mr. Horner, and Mr. Horner received it from Mitscherlich direct, and it is said to have been formed by Mitscherlich. The formula of mica is this:—$3RO2SiO_3 + 2(R_2O_3)SiO_3$. You see this really seems to be wollastonite again combined with silicate of alumina, and thus forming mica. I do not say that the first part of the compound really is wollastonite; but it has the same formula. Wollastonite is, you know, a silicate of lime; but the RO is composed of various bases, not of one alone. It is very desirable to get further information concerning the conditions under which mica may be formed.

I will mention incidentally another mineral. It is one of no great importance geologically, as far as I know; still it has certain features of interest commercially and in other respects. I refer to that remarkable substance known as ultramarine, about which so much has been written, and concerning which so many experiments have been made, but unhappily with very little that is satisfactory with regard to positive information. Here is a specimen of ultramarine. It is a fine blue mineral substance, very highly appreciated, especially by the ancients, as a decorating stone. It is essentially a silicate of alumina and soda. Well, what about the colouring matter? Chemists are by no means agreed as to the cause of the blue coloration. Some suppose it depends upon a sulphide of iron in some particular state. There is a sulphide doubtless which is connected with the colouring matter, but the sulphide is only in very small quantity, for we can discharge the colour of this ultramarine immediately by the action of an acid. Take, for example, common ultramarine. Here it is in this glass vessel, suspended in water. We will add to it some hydrochloric acid; the whole of the colour will be gradually discharged, and there will be evolved the odour of sulphuretted hydrogen gas. That is invariably present in all specimens of ultramarine, so far as my knowledge goes. The colour will not disappear immediately, unless we put in a considerable quantity of the acid, but it is sure to go in the long run. It is now getting paler and paler. I will give you a common illustration of this. Formerly all the blue paper which we produced—common blue writing-paper, for instance—was coloured with a pigment having oxide of cobalt as its base—smalts, in fact. Now, if you acted upon such a paper with an acid, there was no discoloration. The blue colour remained. But owing to the artificial production of ultramarine it was found economical to replace the natural smalts by the artificial ultramarine in the manufacture of the paper, and now you will find that by dropping an acid on such paper the colour is discharged, but that is not the case with the natural mineral previously used. Smalts is still used to colour starch. Starch-makers have tried to substitute the artificial ultramarine, but in vain.

Ultramarine occurs naturally as lapis lazuli, and it is associated with iron pyrites. The iron pyrites is not visible to the naked eye, but under a microscope it is quite distinct. I think you will find that all lapis lazuli is associated with iron pyrites. This suggested the possibility, at all events, of iron being concerned in the production of the colour of this mineral. It is now a good many years since the mode of the formation of ultramarine was discovered. In a soda furnace a beautiful blue-coloured substance was met with, and this turned out to be ultramarine—identical with the natural substance. It is easily made, but of course there are certain points in the manipulation which require experience. I worked months at it, and made a considerable quantity. We have only to take sulphur, china clay, and carbonate of soda, put them in a crucible and cover them over, and then leave them at a good red heat for three or four hours. You will be somewhat astonished to see, on taking out the crucible, a magnificent blue colour. Below it will be green. You wash out the sulphur, and there remains behind a dull green product—green ultramarine. Then by roasting that, with access of air under certain precautions, you can convert that into a very fine blue. There are certain points of manipulation in the process which are kept secret by the manufacturers—the heating it with sulphur, and so on, but there is, I believe, no difficulty in making it if you have a furnace. This gives us proof, then, that ultramarine may be formed under these conditions of temperature, say a good red heat, but whether the ultramarine in nature has been so produced I should regard as doubtful. That is a point requiring further investigation. Possibly, here again we may have to do with hydrothermic action.

The artificial ultramarine is a very cheap thing, worth about eightpence a pound; the other is worth several guineas an ounce. I say they are *chemically* identical, but though they are chemically identical they are not physically the same. The natural is much better than the artificial for many purposes, and has a better colour. I will give you a striking example of this fact. It was related to me by a Royal Academician some years ago. On one occasion, the day before opening the Academy to the public, when the artists who are exhibiting generally attend and touch up their pictures, one of our greatest landscape painters, who was in the habit of doing a great deal to his pictures, was present, and on this particular occasion he wanted some ultramarine. He was looking about among his fellow-artists for some of the real ultramarine, and there happened to be another landscape painter present who had his palette beautifully set with a fine lump of the natural article. The painter was about to help himself from his friend's palette, whereupon the other artist called out "French," alluding to the artificial product, on hearing which the painter immediately withdrew. This shows you that the artists, at all events, recognise a great difference of quality between the real and the artificial stuff. That anecdote might be related in the history of one of the greatest landscape painters who ever lived. I believe it has never been recorded.

Having said thus much of the formation of certain natural anhydrous silicates, we will pass on to review the hydrated silicates, or the silicates containing water as an essential element of their composition. We can make hydrated silicates without difficulty. You have before you a pretty extensive series of these silicates. Here is one—a silicate of chromium. This [another specimen] is a silicate of copper powdered; and there is one of manganese, and there is one of lead, and here is one of cobalt. They are made easily enough by taking silicate of soda (water-glass), diluted to a certain extent with water, and then adding it to various metallic salts—say chloride of copper, if you please, or of nickel, or of cobalt. The water-glass should be perfectly pure and colourless. Here is a salt of cobalt; now to that we will add some silicate of soda, and there will go down a precipitate which will consist of silica combined with oxide of cobalt and water—a hydrated silicate of cobalt. The same with nickel. Here, again, is a silicate of copper produced in this way. Here is silicate of lead, a firm jelly-like mass.

Here is a silicate which really is interesting, and to which I will invite your special attention. It is the silicate of copper. This is some made about a year ago by throwing down copper from a copper salt—chloride, I believe it was—by means of this silicate of soda. It went down in the form of this greenish precipitate, which was collected on a filter, washed, and dried. If you examine it, you will see how much it resembles the well-known mineral called chrysocol. Here is a silicate of iron, and in this case there are two oxides combined. It is a silicate of two oxides. We find the same thing in that green Cleveland iron ore. As far as we can make out, we have a silicate of protoxide and peroxide of iron in this compound; but what the exact relation of the two constituents is we cannot say. Now, the colour here will suggest the colour of the green earth, or rather of the substance which you find in the green sand. It is a silicate produced artificially by the addition of silicate of soda to a salt of iron.

These hydrated silicates occur abundantly in nature. They are amongst the most beautiful minerals we see in mineralogical cabinets. The various zeolites, for example, are hydrated silicates. They only require to be seen and examined to be thoroughly appreciated. They lose their water when strongly heated (that you might expect); yet there is a singular point which may be mentioned here in connexion with this statement—namely, that Bunsen has shown us how a hydrated crystallised silicate may be produced even at a good red heat. If you take a finely powdered mixture of about two-tenths by weight of lime and one part of silica, and drop the mixture into molten caustic potash in a golden crucible (that is the best kind of crucible to use), and keep it at a strong red heat for some time, and then allow it to cool slowly, and afterwards treat the solid mass with cold water, the excess of potash will be dissolved out, and there will remain a beautiful crystallised apparently zeolitic mineral; it is a hydrated silicate of lime—one containing water, but the proportion of water is not determined. In fact, in other respects it has the same composition as wollastonite combined with a not yet definitely known proportion of water. It is impossible to make this experiment on a large scale. Here is some so prepared, but it has become opaque by exposure to the air. The oxide of potassium, when combined with water, retains that water at a red heat, and this is a condition of the formation of this hydrated silicate at this high temperature. You may ask, "How do you know whether this silicate has not become hydrated by the action of the water on the mass in washing out the potash?" Well, that is a question to be settled. I think it is not so: I think the evidence is in favour of the other view; but still it is a fair question to raise.

These hydrated silicates occur specially in the cavities or fissures in igneous rocks, as in the basalt in the north of Ireland. In those rocks there are cavities lined with these beautiful zeolitic minerals, but they occur not only in igneous rocks, but also in sedimentary beds. Then we find stilbite and apophyllite in certain fresh-water limestones, and also in fossiliferous limestones in Scotland.

Some hydrated silicates are decomposed, and decomposed pretty rapidly, by exposure to the air. Some, on the contrary, are quite permanent. One of the best examples—and one familiar to every mineralogist—of decomposition on exposure to the air, is presented by laumonite, which is a hydrated silicate containing especially soda. It consists of soda, lime, and alumina, in combination with silica and water. It decomposes pretty rapidly on exposure to the air. But even those silicates which appear the most persistent are slowly decomposed by exposure to the air. Take common glass, for instance, of which I showed you a specimen acted upon by the weather. Even that substance, permanent as it seems, becomes decomposed on very long exposure to atmospheric influences. Illustrations of this fact may be seen in the Museum above. Take, again, the well-known mineral felspar, which occurs in granite. In some granite the felspar rapidly decomposes through the weathering action of the air, and is converted into china clay, a mineral which is well known and of great importance in the manufactures of Cornwall and elsewhere. Hydrated silicates resist the action of cold water for a long time. This is seen in the case of an ordinary bottle. But under other conditions of temperature the result is different. If you take a common wine-bottle, for example, and expose it to the action of water at a very high temperature and under great pressure, it becomes entirely disintegrated—I was going to say dissolved. What takes place with these artificial silicates would take place with the natural silicates when exposed to water at a high temperature.

In nature these zeolites, or hydrated silicates, have undoubtedly been formed in many cases by the percolating action of water or steam. Water or steam separately, or water and steam conjointly, have percolated during, it may be, a very long period through cellular volcanic rocks—igneous rocks containing cavities in them—and hydrated silicates, or zeolites, have been formed by the action of the water and steam separately or conjointly upon the constituents of these rocks, and we accordingly find the cavities filled with beautiful zeolites. The basalt of the Giant's Causeway presents us with many specimens of zeolites formed in this way. There is a very good name suggested by Bunsen, I think, for this gaseous action. He proposes to call it "Pneumatolitic action." No doubt gas or steam has played a very important part in the structure of the globe. Bunsen has made observations on this point in Iceland.

Now, ladies and gentlemen, I have to bring before you illustrations of the formation of zeolites in this way. We owe the information to Daubrée, who has written a capital paper on the subject in the *Annales des Mines*. Daubrée has presented specimens to my colleague, Professor Ramsay, who, unfortunately, is out of town, and I am unable to lay my hand on them. At Plombières, the well-known French watering-place, there are well-known hot springs which have been flowing for thousands and thousands of years, certainly two thousand years or more. We find there the remains of Roman works constructed with a view to carry off the water of these hot springs; and under the pavement of the streets, at a great depth, are aqueducts, the object of which was to intercept the water and convey it to reservoirs. Where the waters emerge, the Romans made a bed of concrete with lime—lime not mixed with sand, but mixed with fragments of brick and sandstone. The Roman mortar, you will find, almost always presents small particles of brick. I have of late several times examined the mortar in the outer walls of Pepin's Castle, and there is a very good illustration of this. You will find thick tiles, and then mortar, and then stone; and, on examining the mortar used there, you will find throughout small particles of brick disseminated. It may be that the clay was actually burnt and used as such—this is sometimes done in the manufacture of fire-bricks and fire-clay, instruments of various kinds—or it might have been pounded. Now, this channel or bed of concrete, at Plombières, extends more than ninety metres in length, and in some places it is not less than three metres in depth. The beds rest, here and there, directly upon the granite of that district; but in general it is separated from the granite by an alluvial gravel. By the long-continued action of these thermal waters upon this bed of concrete, remarkable changes have taken place, and zeolites—unmistakable zeolites, having the same composition as the natural minerals, and the same crystalline form—together with certain other minerals, have been produced. They are found especially in cavities in the mass, as you would expect, and they form in these cavities mammellated, more or less rounded concretions, and are sometimes more or less crystallised. In the granite, which was subject to the same conditions as the brick and mortar, no zeolites were detected. Here, then, you see, we can examine the results of an experiment which has been going on uninterruptedly for about 2000 years—a very short time in a geological sense, yet during this time we find that well-defined, distinct crystals of zeolites have been produced.

One of the zeolites resulting from the action of this thermal water is apophyllite, that magnificent mineral which constitutes a special ornament of geological cabinets, and which crystallises in the pyramidal system. This apophyllite may be represented by the formula of 3 equivalents of wollastonite *plus* 2 equivalents of water—$3(RO_2SiO_3+2HO$. But, different from wollastonite, this base, RO, in apophyllite, consists of lime and potash—that is, CaO and KO—and they are in the ratio of 1 to 8 equivalents, 1 of lime and 8 of potash. We find fluor mentioned as a constituent in many analyses of apophyllite. Daubrée found apophyllite lining the cavities of the calcareous part of this bed of concrete. The thermal waters at Plombières contain an alkaline silicate. It appears to be by the long-continued action of this alkaline silicate upon the lime of this bed of concrete, during many centuries, that the apophyllite has been formed. You see that in this body there is the silica, there is the alkali, and there is the lime, while in the Plombières water there are the silica and the alkali, and in the concrete there is the lime. We get well-shaped, unmistakable crystals of apophyllite. They may not be so large as those which nature presents; but then, remember, the time during which they have been forming—two thousand years—is a comparatively short period. Nature, in the formation of the native mineral, may have taken twenty thousand years. Once let us have a clue to the conditions under which these crystals have been formed, and then *give us time*, and we can make them of any imaginable size. Native apophyllite is usually met with in veins in amygdaloidal rocks, in cavities and veins in transition slate, and in basalt.

The next mineral which Daubrée met with in the bed of concrete was chabasite, which is also a well-known mineral in our geological cabinets. Here, again, in representing its constitution, we begin with $3\text{RO}2\text{SiO}_3$, which represents the first part of the formula of chabasite. Then we have *plus* $3(\text{Al}_2\text{O}_3 2\text{SiO}_3)$ *plus* 18 equivalents of water.

$$3\text{RO}2\text{SiO}_3 + (\text{Al}_2\text{O}_3 2\text{SiO}_3) + 18\text{HO}.$$

The RO here represents three bases—lime, soda, and potash. In many cases there are blisters in the bricks, which are filled with chabasite. The crystals are colourless and perfectly limpid, rhombohedral and approximating to the cube. They were feebly striated and parallel at the edges, like the natural crystals, and occasionally presenting the macle which we find in the natural specimen. In its chemical characters and crystalline form the artificial chabasite was found to be identical with the natural mineral. Chabasite occurs in nature in cavities and veins in amygdaloidal rocks—this, again, being a place where percolation may have been at work.

Daubrée, in addition to these well-known hydrated silicates, found certain other hydrated silicates or zeolitic minerals, but he has not—or at all events when he wrote his paper two or three years ago he had not—certainly proved their identity with the native species, from the impossibility of getting them pure enough and in sufficient quantity for exact analysis. The chabasite crystals he met with were often studded over with microscopic crystals resembling in all respects a variety of gismondine, more rarely with crystals like those of scolezite, and with a few prisms like harmatome—one of the finest minerals in geological cabinets. You will find here very beautiful specimens of all these minerals.

The thickness of the zeolitic incrustations on the concrete was not less than one twenty-fifth of an inch. That is a tolerably good thickness. In cavities at the lower part of the bed of masonry, and near the point which received a direct jet of hot water, were found tolerably copious, gelatinous, transparent, and colourless deposits, which on drying in the air became opaque, snow-white, and mammellated — presenting this sort of form . The chalcedony, you remember, was mammellated—in round masses. A surface of that kind is called mammellated, in mineralogical language. Their construction was concentric. They were in concentric layers, and fibrous in fracture, like chalcedony, malachite, and brown hæmatite. We find those minerals presenting just the same characters of structure as those particular deposits met with at Plombières by Daubrée. This substance gelatinises with acids, showing the separation of silica, which had existed in a state of combination. The composition was supposed to be a silicate of lime—a trisilicate of lime, or a neutral one, it would be according to one view, there being one equivalent of lime and one of silica—that is, a silicate in which the oxygen of the acid is exactly three times as much as that of the base. There were also exactly two equivalents of water.

Well, along with these minerals he found also another, which we examined in our first lecture, and which you will no doubt remember—namely, hyalite, a beautiful variety of amorphous silica. This could not be distinguished, he says, from the hyalite met with in basalts, of which you saw specimens. He found also common opal, grey and resinous in lustre. He met, too, with arragonite and calc' spar associated with chabasite, as in the volcanic rocks of Iceland. Fluor spar was also detected, white, and occasionally of a violet tint, just like that we meet with under the name of "blue John," and often in the vicinity of apophyllite. Now, that is a point worthy of notice. I said, when speaking of apophyllite, that many analyses would be found to mention fluor spar. This suggests in a very striking way that in nature, in all probability, the apophyllite we meet with may have been formed under exactly similar conditions—namely, by the long-continued percolating action of water containing, it may be, an alkaline silicate and fluor, upon certain rocks containing lime. He found also a hydrated carbonate of magnesia which he believed to be a new species. Nothing more, I think, has been done with that. Fluorine, as I said, is a very widely diffused element, though not diffused in large quantity. These zeolites do not occur exceptionally, but in every part of the concrete traversed by the thermal waters.

Now, I think you will agree with me that the fact of the identity of these zeolites, not only in physical but in chemical characters, with those occurring in nature suggests naturally an identity of conditions for their formation. I do not mean to say that it is absolute proof, but it is next to it. I can scarcely conceive of any proof more strong than this in geological reasoning. We do not want here the action of water at very high temperatures. We find that by the action simply of this thermal water flowing for a long period of time we generate these minerals. I do not mean to say that possibly, if we had employed a somewhat higher temperature, they might not have been produced at a more rapid rate; but it is a mere assumption that it would be so, and we have no proof of it. We do not, however, require a very high temperature here, and certainly not a very high pressure. I do not suppose that increased pressure has played any part in the production of these minerals in the thermal spring. When we want to attain a high temperature with water, we must have a high pressure, or we cannot get the temperature; but it is not the pressure that does the work. We must not make that mistake of confounding the *post hoc* with the *propter hoc*. Wöhler dissolved and crystallised apophyllite in water at a temperature of 180° Centigrade, under a pressure of ten atmospheres; but in the waters of Plombières the same mineral was produced and crystallised after a length of time without any such pressure. Daubrée remarks that, notwithstanding the extreme hardness of the Roman masonry, it was yet pervious to the thermal waters, by cavities, by fissures, by the substance of the mortar itself being porous, and especially by the innumerable blisters (*boursoufflures*) produced in the bricks by burning. The current of water was very small; but it was constantly renewed, and thus we find that means of a very feeble nature become multiplied immensely by the action of time. In fact, it is a question of time, not only in this matter, but throughout the whole range of geological research.

Now, it is singular, and it must strike you all as singular, that such distinct minerals should be formed close to one another under conditions so apparently similar, if not identical—formed from the same matter, by the same agency, in the same thermal water. As Daubrée says (these are his own words)—"If it were not for the difference of colour it, would even be very possible to confound parts of the concrete charged with zeolites with basaltic tufas in which the same minerals have been formed. The bricks, with their blisters and their drusy cavities, imitate, in a remarkable manner, amygdaloidal rocks." Then he says: "Such an identity in results reveals incontestably great analogies in origin." Another experiment which bears upon their origin is one of high interest—namely, the transformation of common glass into a zeolite by the action of superheated water—hydrothermic action. Here, again, we must acknowledge our obligation to Daubrée, who has done so much in this department of observation.

If glass (silicate of lime) be acted upon by water at 200° Centigrade, the product is a hydrated silicate containing some of the alkali. The form is preserved, but the glass itself is increased in volume. There is a swelling up of the glass to the extent of about one-third, and it becomes opaque and snow-white, very decidedly fibrous in structure, easily fusible, and completely decomposed by acids when cold. Here you see a marked difference. The composition of it was determined after washing with boiling water and drying at 100° Centigrade. It was found to be analogous to the mineral called pectolite, which occurs in spheroidal masses composed of delicate fibres radiated from the centre. It is found with mesolite in amygdaloidal rocks. The composition of this product was:—

Silica	61·8 per cent.
Lime	21·9 „
Magnesia	3·9 „
Soda	6·3 „
Water	4·2 „
Alumina	*simply traces.*

This, understand, was the result of the action of water at 200° Centigrade upon glass. Now for the action of water at a higher temperature upon the same kind of glass. At 400° Daubrée obtained crystallised quartz and wollastonite in acicular crystals. This I conceive to be very important, as showing us that different products may result from the action even of pure water at different temperatures upon the same rock. I repeat this—it is important as showing that different products may result from the action even of pure water at different temperatures upon the same rock.

The next substance for our examination is one to which I have incidentally referred. I shall not have time to finish it entirely to-day, but I will just begin it. It is one of considerable interest in various respects—the substance clay.

There is reason to believe that clay is nothing more than the result of the decomposition of felspar, or a somewhat analogous rock. It is a secondary product in every case. We can show you how this clay is produced step by step from the felspar occurring in certain kinds of granite. We can present you with specimens of granite in every stage of weathering. We can show you the perfect mineral, and you can trace the formation of the china clay, which is a silicate of alumina, with certainty, leaving no doubt of the conditions under which this clay has been generated. There is reason to believe that all clay has been produced, I will not say from felspar, but from some analogous rocks. All clays contain, without exception, alkali. I say this without fear of contradiction. Although decomposition takes place through weathering action, the alkali is never perfectly washed out. We have made a very large number of analyses of different kinds of clay at different times, and when we have sought for alkali we have never failed to detect it—potash and soda. Now, if you refer to books giving analyses of clays, I know that often you will find no mention whatever of alkali; but this omission is to be ascribed to the fact of the alkali not being sought after. To determine the alkali requires a separate process, and a very tedious one; and unless there is some special object in finding it, the chemist will not give himself the trouble of searching for it. We will proceed with the subject of clay in the next Lecture.

ACADEMY OF SCIENCES.

July 16.

M. **Marignac** presented an account of some "*Researches on the Combinations of Tantalum.*" The author's researches have had for one object the more correct determination of the atomic weight of tantalum. This, Rose, from the analysis of the chloride ($TaCl_5$), has given as 172 ($H=1, O=16$), but M. Marignac is of opinion that the chloride analysed by Rose had a considerable admixture of niobium. M. Marignac has analysed the fluotantalates of potash and soda, and has arrived at the corrected number 182 as the atomic weight of tantalum. He points out that the atomic weight of niobium is very nearly the half of that of tantalum, $Ni=94$ $Ta=182$, and remarks a strict parallelism in the compounds of these two metals. Tantalic acid, the formula of which is given Ta_2O_5, the author states, is found in two distinct modifications analogous to those of stannic and antimonic acids.

MM. Landenburg and Leverkus presented a note "*On the Constitution of Anethol.*" Anethol is the essential principle in oil of aniseed. It is a crystalline body, distilling without decomposition at 234°. Its composition answers to the empirical formula $\text{Ꞓ}_{10}H_{12}\Theta$. The author, however, has satisfied himself that anethol is the methylic ether of allylphenol, and so writes the rational formula thus—

$$\text{Ꞓ}_6H_4\left\{\begin{matrix}\Theta\text{Ꞓ}H_3\\ \text{Ꞓ}_3H_5.\end{matrix}\right.$$

MM. G. de Laire, Ch. Girard, and P. Chapoteaut presented a note "*On the Formation of Secondary Monamines of the Phenylic and Tolulyic Series.*" The authors have formed *diphenylamine* by the reaction of aniline on a salt of the same base—the hydrochlorate answered best In a similar manner they have formed *ditoluylamine. Phenyltoluylamine* was formed by the reaction of aniline on hydrochlorate of toluidine. The reactions are effected most quickly in sealed tubes, but will take place in a convenient distilling apparatus. In all the reactions ammonia was eliminated, and the changes that took place are indicated in the following equation, which accounts for the production of diphenylamine:—

$$\left.\begin{matrix}C_{12}H_5\\ H\\ H\end{matrix}\right\}N+\left.\begin{matrix}C_{12}H_5\\ H\\ H\end{matrix}\right\}N=\left.\begin{matrix}C_{12}H_5\\ C_{12}H_5\\ H\end{matrix}\right\}N+\left.\begin{matrix}H\\ H\\ H\end{matrix}\right\}N.$$

We shall give a fuller description of the process next week.

M. Lecoq de Boisbaudran sent a note of no interest "*On Supersaturated Solutions.*"

M. Zaliwski-Mikorski sent a note "*On the Disaggregation of Metallic Carbon,*" which, it seems, may be effected in a Bunsen's battery by using, instead of zinc, iron rendered passive by nitric acid. Fuming nitric acid and a little sulphuric is placed in the porous cell; the external cell is filled with water. As soon as the battery is in action, the carbon begins to disintegrate, and continues to do so as long as the iron is passive.

At the previous sitting of the Academy, M. Chevreul gave an account of some experiments illustrating what he calls *capillary affinity*. He made a paste of white lead and water and another of white lead and linseed-oil, and placed them in separate tubes. Above the oily paste he placed water, and above the watery paste, oil. The oil in the latter case displaced the water, but water did not displace the oil in the former. In corresponding experiments with clay and pure kaolin it was found that water would in each case drive out oil, but oil would not drive out water.

Concretions in Pears.—Erdmann has examined the hard granular concretions in pears, and found them to be composed of a distinct principle to which he has given the name *glyco-drupose* $C_{48}H_{36}O_{32}$. Under the influence of an acid this body splits up into glucose and an insoluble body $C_{24}H_{20}O_{16}$, which the author calls *drupose.* We may mention, for the information of our medical readers, that the author was led to the research by the examination of a mass of these concretions passed from the bowels of a patient which was regarded as a pathological product.—*Annal. der Chem. und Pharm.*, cxxviii., p. 1.

NOTICES OF BOOKS.

Zeitschrift für analytische Chemie. Parts iii. and iv. 1865.

(*Continued from page 34.*)

The next paper we may mention is by Dr. O. Lindt, "*On the Estimation of Sulphur in its Metallic Combinations in the Presence of Sulphuric Acid.*" The process is a slight modification of Rose's for the determination of sulphur in metallic sulphides. Rose passes chlorine over the sulphide and carries the chloride of sulphur into a vessel of water, where it decomposes, free sulphur separating and some being eventually converted into sulphuric acid. Dr. Lindt says it is better to carry the chloride of sulphur into a soda solution, where it first forms sulphide of sodium, hyposulphite of soda, chloride of sodium, and hypochlorite of soda. By continuing the action of chlorine for two hours chlorate of soda is formed, and now, on evaporating the solution and igniting the residue, the whole of the sulphur compounds are converted into sulphate of soda, in which the amount of sulphur is easily determined. A drawing of the apparatus the author recommends is given, but we doubt whether it offers many advantages over the ordinary arrangement with a simple flask.

The next paper is one, by Dr. Remelé, we have mentioned before, "*On the Estimation and Separation of Oxide of Uranium by the Use of Sulphide of Ammonium.*" We shall give an abstract of this paper on a future occasion.

The last original paper is "*On the Recognition of Alkaloids,*" by Rudolf Wagner. Suppose we have a solution rich in extractive matter, and containing a small amount of strychnine, brucine, morphine, codeine, quinine, &c.—say a litre of beer with from 0·002 to 0·004 grm. of strychnine in solution—the author recommends the following mode of proceeding:—Dilute the beer with twice its weight of water, and then add 5 c. c. of a solution of iodine in iodide of potassium (12·7 grms. of iodine in a litre). When the solution becomes clear pour it off from the deposit (the formation of this deposit will be hastened by acidulating with sulphuric acid), and dissolve the precipitate in a dilute solution of dithionite of soda; then filter the solution and again add the iodine solution, and this time dissolve the precipitate in an excess of sulphurous acid. In this solution, when freed from hydriodic and sulphurous acids by evaporation, the bases will be found as sulphates quite free from organic matter, to be recognised by the usual tests.

The rest of the Journal is occupied with the usual "*Reviews of the Progress of Analytical Chemistry,*" by Forster, Fresenius, Neubauer, and Braun. The titles of the papers noticed in these reviews would occupy a column of the Chemical News, and it is necessary to say that the greater number have already appeared or been noticed in our pages. Such others as present any novelty and interest will be transferred to our columns.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

1737. S. Holmes, Lincoln's Inn Fields Chambers, Middlesex, "Improvements in the manufacture of printing ink."—June 29, 1866.

Notices to Proceed.

934. E. P. H. Vaughan, Chancery Lane, "Improvements in the methods of solidifying the juice or sap of the bullet tree, otherwise known as Balata juice, and the [illegible] or saps of trees yielding similar or analogous elastic [illegible]." A communication from S. R. Pontifex, F.C.S., [illegible]ritish Guiana.—April 2, 1866.

CORRESPONDENCE.

A Ridiculous Patent.

To the Editor of the Chemical News.

Sir,—Referring to your complaint in your number of July 6 about the strange things which appear, not unfrequently, as inventions protected by letters patent, or at least by a provisional protection, I beg to draw your attention to the specification of Mr. J. Roddy—"An improved washing or cleansing liquor or solution," dated October 7, 1865. To save you the trouble of looking yourself for it, I beg to subjoin the following abstract from the *Mechanics' Magazine* of May 4:—

"In performing this invention (!) the inventor takes by weight two parts of crystals of soda and one part of unslaked lime, and adds thereto twelve and a half parts of water, preferably boiling water. This crude liquor he allows to stand until all the insoluble matter has been precipitated, when he pours off or collects the clear fluid. This fluid is the improved washing or cleansing liquor or solution."

Is it not a pity on one side, but an incalculable gain to manufacturers—nay, to all humanity—on the other side, that the patent on this grand "invention" has been abandoned? I am, &c., G. Z.

July 21, 1866.

MISCELLANEOUS.

Exhibition of Objects relating to Pharmacy at Nottingham.—We must remind intending exhibitors that immediate application for space must be made to Mr. J. H. Atherton, Long Row, Nottingham, as only limited accommodation is left.

Preparation of Nitrite of Potash.—In a note to his paper on the nitrous acid compounds of cobalt and nickel, Erdmann gives the following process for the preparation of nitrite of potash. He recommends the fusion of the nitrate with several times its weight of iron filings or borings in a cast-iron crucible at a carefully regulated red heat. When a small portion taken from the crucible and tested shows a strong evolution of nitrous acid, the mass is poured from the crucible. When cold the mass is dissolved, and then the undecomposed nitrate is removed by crystallisation; the liquor is then supersaturated with nitrous acid from starch and nitric acid, and afterwards evaporated to dryness at a gentle heat.—*Journ. für prakt. Chem.*, No. 7, 1866, p. 387.

Amount of Sulphuric Acid obtainable from Pyrites.—An obliging correspondent, W. H. D., forwards the following calculation, which we publish at length, as an example. "Sulphuric acid from 20 cwts. of ore containing 30 per cent. of sulphur. Sp. gr. of acid 1·75.

Theoretical quantity.

100 cwts. of ore contain 30 cwts. of sulphur

20 " " 6 "

$S\ 32,\ \Theta_4,\ 94\ H_2\ 2 = 98$

$32 : 98 :: 6 : 18{\cdot}38$ cwts. of $H_2\ S\Theta_4$.

Sp. gr. (Ure)	Sp. gr. (Ure)
$1{\cdot}754 = 84\ \%$ of $H_2\ S\Theta_4$	$1{\cdot}7425 = 83\ \%$ of $H_2\ S\Theta_4$
$\dfrac{100 \times 18{\cdot}38}{84}\ 21{\cdot}89$ cwts. acid	$\dfrac{100 \times 18{\cdot}38}{83}\ 22{\cdot}18$ cwts. acid

Our correspondent also gives calculations based on the tables of Bineau and Otto given in Fresenius; but those we have quoted will suffice.

ANSWERS TO CORRESPONDENTS.

Books Received.—Bleeding and Change in Type of Disease, by W. O. Markham, M.D., F.R.C.P.; Buckmaster's Elements of Chemistry, third edition; On Cholera, its Nature and Treatment, edited by Dr. C. Drysdale (pamphlet).

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

New Analysis of the Montpellier Saline Chalybeate (Kissingen) Water at Harrogate, by Dr. Sheridan Muspratt, *M.D. (Hon.), Ph.D., F.R.S. Ed., M.R.I.A., &c.*

Some very extraordinary changes seem to be occurring in the waters of Harrogate. Since they were so elaborately investigated by my valued friend Dr. A. W. Hofmann in 1854, chloride of iron* $FeCl$ has made its appearance in one of them (discovered by me in July, 1865), and salts of barium, strontium, lithium, &c., in others. Sulphates have nearly disappeared from all. In the Kissingen water Dr. Hofmann found nearly forty-two grains of carbonate of magnesia and *no carbonate of lime.* Now it contains about half a grain of the former and sixteen of the latter! Appended are the numbers just obtained :—

	Grains in the imperial gallon.
Carbonate of iron . . .	3·106
Carbonate of baryta . .	·517
Carbonate of lime . . .	16·262
Carbonate of magnesia . .	·497
Chloride of calcium . .	124·112
Chloride of magnesium . .	56·074
Chloride of potassium . .	5·408
Chloride of sodium . .	650·409
Strontium, lithium, &c. .	traces.
	856·385

I am engaged with several other of the waters, and hope shortly to furnish you the results. In the Chemical News of June 29 it is said that the Kissingen water contains 7·657 grains of *carbonate of baryta* in the gallon, apparently a most erroneous statement.

On Certain Reasons for Doubling or otherwise Multiplying Chemical Formulæ, by John A. R. Newlands, *F.C.S. (Second Paper.)*

Dr. Stevenson, in criticising my paper on the above subject, says that my "first argument, drawn from the doctrine of chances, does not state anything more than a truism," yet in that first argument I observed that "the statement that the hydrochloric acid molecule contains only one atom of hydrogen and one of chlorine is a mere assertion; it is only one possibility out of millions of possibilities, and consequently there are millions of chances to one that it is wrong." Now, after admitting this to contain nothing more than a truism, or self-evident proposition, Dr. Stevenson still clings to the doctrine that the hydrochloric molecule contains only one atom of hydrogen to one of chlorine, he still believes that this one possibility out of millions of possibilities is quite correct; at any rate, he states "that the presumption is in favour of the simpler formulæ." But, I would ask, why so? If we look solely and singly to conclusions drawn from the doctrine of probabilities, the lowest, or simplest, number has no greater chance of being correct than any above it. If, for example, there were fifty thousand tickets in a lottery, I do not see any reason for thinking, or even "presuming," that the ticket bearing the lowest or simplest number stands a better chance of winning the principal prize than any above it. In the same way I do not understand how any one admitting "the molecule of hydrochloric acid to contain $HxClx$, the value of x being uniform," should, from considerations drawn from the doctrine of probabilities, state "that the presumption is in favour of the simpler formulæ"—that is, of x being one instead of any other sum from one to infinity.

Upon this point it would be well to bear in mind the opinion of Dr. Hofmann, who observes, in his late work, that "the smallest quantity in which hydrogen combines may, for aught we know to the contrary, be a cluster numbering ten, or a hundred, or a thousand, or a million, of really ultimate atoms." Perhaps Dr. Stevenson considers this a truism—at least he appears to possess information upon a subject on which one of the most illustrious of our modern chemists has not hesitated to plead his ignorance.

Dr. Stevenson says that my "second argument, drawn from geometrical considerations, is at variance with my third, drawn from the nature of elementary molecules;" and he very properly observes that if four is the least number of atoms that can form a molecule, that of mercury must be represented by Hg_4, and that of hydrochloric acid by H_4Cl_4. But though, according to my second argument, most formulæ would be quadrupled, and though, according to my third argument, they would be merely doubled, and though, according to my fourth argument, certain formulæ, such as NH_4Cl and PCl_5, would even remain unaltered, still they all point in the same direction—they all indicate that the greater part, if not all chemical formulæ, should be doubled or otherwise multiplied.

Each of the arguments should be taken upon its own merits; it is quite possible that some chemists might admit the strength of one argument who would, like Dr. Stevenson, be "quite unable to grasp" another; and the object I have in view will be attained whether the formula of hydrochloric acid be doubled or whether it be otherwise multiplied.

I will now offer a few words in defence of my "argument from geometrical considerations." I have endeavoured to imagine what would be the smallest number of atoms capable of occupying space of three dimensions, regarding the atoms as "infinitesimally small points, or centres of force, distributed through space, not filling it, but merely occupying it, or indicating its boundaries." Now, a little consideration will show that one such point or atom might serve to indicate a given position, two points or atoms would serve to indicate the extremities of a straight line, three points or atoms would be the lowest number capable of indicating a superficies—which would, of course, be a triangle—and four points or atoms would be the lowest number capable of indicating the boundaries of a solid figure, which would be a tetrahedron.

The only reason why I have chosen the tetrahedron is because it is the simplest figure I could have selected for the purpose. I might have taken a cube, but then eight points or atoms, at least, would be required to indicate its boundaries. I think it will be obvious that, in accordance with this idea, it is quite possible for five or any higher number of atoms to occupy the same space as the four which serve to indicate the boundaries of the tetrahedron; only they would, of course, be more closely packed. It is also, in accordance with the same idea, impossible to conceive less than four atoms as capable of occupying any space at all.

Dr. Stevenson has no difficulty in conceiving that two atoms can occupy the same space as four; I almost doubt, however, if he is prepared to go a step further, and main-

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* "Dr. Muspratt's Chalybeate or the Chloride of Iron Spring," in the "Royal Chalybeate Spa" rooms.

tain that one atom is capable of occupying the same space as two.

When, in my fourth argument, I say that instead of regarding the four volumes occupied by chloride of ammonium and pentachloride of phosphorus as due to dissociation, we may look upon them as representing the true state of affairs, and double other formulæ to make them correspond to the same volume—that is to say, we may look upon the relative formulæ of chloride of ammonium and of ammonia as NH_4Cl in the one case, and N_2H_6 in the other—I think it is manifest that, for the purposes of this particular argument, I leave the formulæ of chloride of ammonium and pentachloride of phosphorus untouched, as NH_4Cl and PCl_5, whilst doubling those of ammonia N_2H_6, and terchloride of phosphorus P_2Cl_6, so as to make them occupy the same volume.

On this point, I have been completely misunderstood by Dr. Stevenson. He says that I "appear to reject dissociation as the true explanation of the phenomena, and prefer doubling the usual formulæ of these compounds"—*i.e.*, of chloride of ammonium and pentachloride of phosphorus. Now it is clear that doubling the formulæ of chloride of ammonium and pentachloride of phosphorus, so far from reconciling the vapour densities of those bodies with that of ammonia and terchloride of phosphorus, would make the discrepancy between them twice as great as it is at present.

Dr. Stevenson speaks of the "four volumes as representing the true state of affairs with regard to the vapour of chloride of ammonium and pentachloride of phosphorus" as "a fact which it would be hardihood to deny;" but, nevertheless, he virtually denies it, because according to the principle of dissociation, which he admits, it is not by chloride of ammonium and pentachloride of phosphorus that the four volumes are occupied, but by the ammonia and hydrochloric acid in the one case, and by the terchloride of phosphorus and free chlorine in the other, into which they are supposed to be dissociated.

With regard to my fifth argument, in which I mention that "all the elements would be united with an even number of atoms," if we double the formulæ, I readily admit that if we multiply the formulæ by an odd number, the present variety will still be maintained.

With reference to the question, "What is the quantivalence of carbon in C_2H_8, of nitrogen in N_2H_6, of oxygen in O_2H_4?" I have already endeavoured to explain how the two atoms of nitrogen in N_2H_6 are linked together, by supposing that they interchange two affinities—the single atom of nitrogen being quinquivalent as in NH_4Cl. I have, however, on a former occasion, gone fully into this subject (Chemical News, May 18, 1866), and have then observed that the "apparent quantivalence of an element affords no absolute proof of the real or maximum quantivalence which it would exhibit were its atoms in a thoroughly free condition." We may, therefore, suppose the real quantivalence of a given element to be anything we please over and above its apparent quantivalence.

I will only observe, in conclusion, that when Dr. Stevenson says "that the carbon in C_2H_8 must exchange at least two affinities, and be at least quinquivalent," he evidently means that the two atoms of carbon interchange one affinity. Again, when he says that the "nitrogen in N_2H_6 must exchange at least two affinities, and be at least quadrivalent," he evidently means that the two atoms of nitrogen interchange one affinity.

Lab[illegible] Great St. Helen's, E.C., July 31.

On Ozone and Antozone, by M. C. Weltzien.*

(Continued from page 40.)

The Preparation of Ozone and Conditions of its Production.—M. Houzeau having obtained ozone by making sulphuric acid react on peroxide of barium, one might conclude that this ozone would also be produced by the action of hydrochloric acid. Sir B. Brodie has also studied the action of hydrochloric acid on peroxide of barium. He found that with concentrated acid he produced chlorine and a weak solution of peroxide of hydrogen, and that, at a certain degree of concentration, the two reactions take place simultaneously. He believes that this action takes place in obedience to a certain law, and, from the result of his experiments, he constructs a curve of the decomposition of hydrochloric acid. The reactions which may be produced are explained by the following equations:—

$$\text{Ƀa}\Theta_2 + 4HCl = \text{Ƀa}Cl_2 + 2H_2O + Cl_2.$$
$$\text{Ƀa}\Theta_2 + 2Cl_2 = \text{Ƀa}Cl_2 + \Theta.$$

and finally

$$3\text{Ƀa}O_2 + 8HCl = 3\text{Ƀa}Cl_2 + 4H_2\Theta + Cl_2 + \Theta_2.$$

I have made dry hydrochloric acid gas react upon peroxide of barium contained in a tube; the peroxide became much heated, and became covered with a crust of chloride of barium, which prevented the continuation of the operation.

I then made hydrochloric acid react upon pulverised peroxide of barium, mixed with sand and enclosed in a balloon. In both cases I obtained, besides oxygen and chlorine, some ozone, recognisable by its odour, and the balloon containing the residue of the reaction retained the smell for several days. In most cases no ozone, but only oxygen and chlorine, are produced, probably mixed with hypochlorous (?) acid.

As to the formation of ozone in the air, some seems to be produced during storms, as M. Schoenbein's experiments show; but I do not think it remains long. To ascertain its presence the reaction of iodide of potassium is insufficient, and the oxidisation of silver can alone be regarded as a certain proof.

In a memoir published in 1860, I enunciated, contrary to the views of Clausius, the theory that ozone is oxygen formed of two atoms. Since that time, some very valuable experiments on ozone have been made by MM. de Babo, Claus, and Soret, and especially on its density. These *savants* propound the same opinion—namely, that ozone is oxygen denser than ordinary oxygen; only M. Soret, considering ozone as a molecule formed of three atoms of oxygen, has named it binoxide of oxygen.

Clausius thus expresses himself on the subject:—"M. de Babo supports an opinion previously given by M. Weltzien, and from which I differ, as it regards ordinary oxygen as formed of simple atoms, and ozone as constituted by these diatomic molecules, and he promises a new memoir furnishing the proofs of this theory."

This is an error, for in my memoir there is not a word which could be interpreted in this sense; as to the proofs in support of my opinion, I have given them. They are, the great activity of ozone, especially with regard to silver, and its decomposition by heat.

Lately M. Soret has published some new researches on the density of ozone, in which, relying on the absorbing powers of essences of turpentine and cinnamon, he arrives at the result that the density of ozone is one and a half that of oxygen; the formula of ozone is then Θ_3.

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* *Bulletin de la Société Chimique*, May, 1866.

Dr. Odling, confirming Dr. Andrews, comes to the same conclusion.

In all these cases what appears to be now decided is that ozone is condensed oxygen.

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

(Continued from vol. xii., page 295.)

XV. John Mayow.—We have mentioned in the preceding paper that, from an early period in the history of physical thought, the scientific had admitted a relationship between the air and nitre—undefined, indeed, and unintelligible, yet too palpable to be denied. The fixity of this theory is proved by the fact that it was maintained by philosophers who differed in the generality of their views, and who were more wont to oppose each other than to agree even upon the most trivial point. In this instance they acknowledged the main fact, and only differed as to the precise nature of the relationship. Towards the middle of the seventeenth century the theory was established upon a firmer basis; it was inevitable, in a period when the physical sciences began to engage the serious attention of mankind, when scientific literature was on the increase and new instruments and modes of research were perpetually invented, while experimenters were arising on all sides—it was inevitable, we say, that the value of a theory which had endured for so long a time should be critically examined.

We have before mentioned that Robert Hooke was the first who threw much light upon the subject by asserting as part of his theory of combustion[*] that there is "a substance inherent and mixed with the air which is like, if not the very same, with that which is fixed in saltpetre," and which is the "dissolvent" of combustible bodies. Unfortunately the experiments upon which this theory was founded were never published, and we are thus left completely in the dark as to their nature and the extent to which we may rely upon them.

Hooke's theory of combustion was eagerly embraced by an Oxford student named John Mayow,[†] who in 1674 published a volume of essays,[‡] in which he extended the theory, and detailed a number of very ingenious experiments in support of it.

Mayow commences his treatise by affirming that nitre consists of an alkaline salt united with an acid, which latter derives its active principle from the air. This principle produces combustion, and is the cause of acidity. Mayow calls it "*fire-air*," "*nitre-air*," and "*nitro-aërial spirit*" indiscriminately; it will perhaps be most convenient for us to speak of it throughout as *nitre-air*. The atmosphere does not consist entirely of nitre-air, as is proved by the fact that when a candle is allowed to burn in a jar of air standing over water, a portion only of the air is consumed. Nitre-air is not itself combustible, but it causes combustible bodies to be consumed by producing a fermentation (*fermentatio*), for combustion is a very destructive kind of fermentation. Nitre contains no combustible matter, as may be proved by throwing a small quantity into a red-hot crucible, when it will be observed that ignition will not take place until some combustible body has been added. Nitre-air is condensed in large quantities in nitre; it is for this reason that combustible bodies mixed with it can burn in vacuo, or under water. But although the nitre-air is all contained in the acid of nitre, the latter cannot inflame combustible bodies when poured upon them, because the nitre-air particles are surrounded by particles of water. It is needless to remark here that Mayow was unacquainted with the now familiar experiment of pouring turpentine into nitric acid.

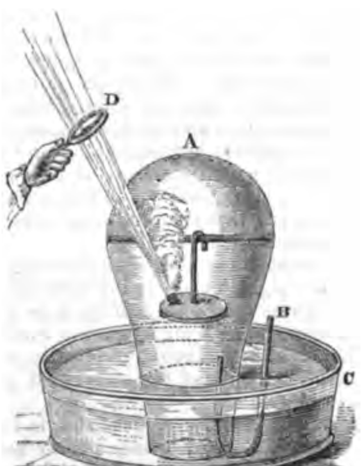
Mayow attributes the increase of weight experienced by antimony during calcination to the fixation of nitre-air, a supposition borne out by the fact that he procured a substance exactly resembling calx of antimony by treating the metal with nitric acid, and evaporating. Vitriol of iron is produced from marcasite by nitre-air forming an acid with the sulphur of the mineral, which acid unites with the iron. Rust of iron is formed by the union of nitre-air with iron. Vitriol of iron is a perfect vitriol, while rust is an imperfect vitriol.

Nitre-air is present in all acids; sulphuric acid is produced by the union of nitre-air particles with sulphur; wines are changed into vinegar by the assimilation of nitre-air from the atmosphere. Nitre-air is also the cause of fermentation and of putrefaction; hence bodies covered with butter or oil, or otherwise kept out of contact with the atmosphere, do not putrefy.

Mayow treats at some length of the analogy between respiration and combustion, and we are here introduced to the first experiments in pneumatic chemistry.

A piece of camphor dipped in melted sulphur was supported in a glass jar, A, Fig. 1, standing over water. As stoppered air jars were not known at the time (from the simple fact that they had hitherto been unneeded), Mayow was obliged to adopt some special means for rendering the height of the water inside and outside the jar the same; he effected this by introducing a small siphon B, which was placed in the position shown in the figure during the depression of the jar into the water vessel C, and was afterwards withdrawn. The camphor

FIG. 1.



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[*] For an account of this theory see the tenth of those papers, CHEM. NEWS for February 17, 1865.

[†] Born 1645, died 1679.

[‡] This work is entitled "Tractatus quinque Medico-physici. Quorum primus agit de Sal-nitro et spiritu nitro-aëreo. Secundus de Respiratione. Tertius de Respiratione fœtus in utero et ovo. Quartus de Motu Musculari et spiritibus animalibus. Ultimus de Rachitide. Studio Joh. Mayow, LL.D. et Medici, nec non Coll. Omn. Anim. in Univ. Oxon. Socii.—Oxonii 1674." The Vice-Chancellor's order for printing the work is dated July 17, 1673; it was therefore completed in Mayow's twenty-ninth year. The first edition is very scarce, but the 1681 edition printed at the Hague is comparatively common. The treatise on respiration was first published in 1668, in Mayow's twenty-third year.

was then fired by the lens D. When it was extinguished, and the water had ceased to rise into the jar, he attempted to fire the remaining camphor, but without success.

In order to prove that air is diminished in volume by breathing, Mayow procured an open glass jar, A, Fig. 2, and tied firmly over the opening a piece of bladder B, upon which he inverted a cupping-glass C containing a mouse. The edges of the cupping-glass were pressed firmly upon the bladder, so as to prevent communication with the outer air. It was soon observed that the bladder was pressed up into the cupping-glass, because, says Mayow, an inequality of pressure has been produced by the diminution of the bulk of air within the cupping-glass caused by the breathing of the mouse.

FIG. 2.

The experiment was modified by placing the mouse in a vessel inverted over water, when it was found that water rose into the vessel as the animal continued to breathe, and by roughly graduating the vessel Mayow calculated that the air was diminished one-fourteenth by breathing. He then attempted to ignite combustible matter in a closed vessel in which an animal had been suffocated, but without success—a proof that air which is unfit to support life is also unfit to support combustion. It was thus conclusively proved that during the processes of respiration and combustion there is a something abstracted from the air necessary for the maintenance of those processes, and that the residue is unfit to support either life or combustion.

A mouse was placed in a jar of air inverted over water, together with a lighted candle; the latter speedily went out, and the mouse lived only half the time that a mouse lived in the same bulk of air when the candle was not present; hence, argues Mayow, respiration and combustion both deprive the air of the same kind of matter—viz., of nitre-air.

Air deprived of its nitre-air particles is lighter than atmospheric air, because a mouse placed near the top of a closed vessel of air dies sooner than when it is placed near the bottom of the vessel; and if we take two mice and place one at the top and the other at the bottom of a closed vessel, that at the top will die before the other.

Mayow made several experiments to determine whether air can be generated *de novo*, and the first artificially produced gas which he examined, in order to ascertain whether it was atmospheric air, was hydrogen, which, as we have seen, was procured some years previously by Boyle. In order to determine whether this gas was capable of as much expansion as air, Mayow made the following experiment:—hydrogen was procured by inverting a vessel of water over small pieces of iron placed in a vessel containing dilute sulphuric acid, and some of the gas was transferred § to a graduated tube in sufficient quantity to occupy the space of one division. The tube, with its lower end dipping beneath the surface of water, was then placed under an air-pump receiver, which was exhausted as completely as possible. The gas expanded to about two hundred times its original volume, and atmospheric air was not found to expand to a greater extent. It was thus ascertained that this property is common to both kinds of air; but the experiment proves nothing as to the nature of the generated air, because Mayow had previously found that air in which a candle had been extinguished was capable of expanding to a similar extent.

In order to ascertain whether air procured from iron filings and dilute sulphuric acid was respirable, Mayow placed a mouse in an inverted vessel partially filled with air, and noted the length of time before it died: the same volume of air was then passed into a similar vessel, a mouse introduced, and a large volume of hydrogen transferred to the vessel; but the mouse lived scarcely longer than its predecessor, whereas if the new air were respirable it ought to have lived two or three times longer. Mayow attributes the fact of its living rather longer to the dilution of the nitre-air particles by the introduced gas, and the consequent prevention of their rapid consumption.

We have seen that almost every writer on the nature of the air has touched upon the subject of respiration. In the first of these papers we have the theories of Plato and Aristotle; in almost the last that of Boyle. It was natural that a question so intimately connected with life should from the earliest ages engage the attention of mankind—indeed, almost the only evidence which the ancients possessed of the existence of air was derived from its observed necessity to animal life. From the continued observation that the cessation of breathing was the cessation of life, the belief became prevalent that the soul passed from the body with the last expiration of air; hence the expressions "*efflare animam*," "*exhalare animam*," "*expirare animam*." Again, πνεῦμα, *spiritus*, and *anima*, have each the triple meaning of *soul*, *breath*, and *wind*, and Mr. Hodges informs me that in Hebrew the word נָפַשׁ means "efflare animam," also that רוּחַ has the three meanings of *soul*, *breath*, and *wind*. The close connexion existing between the function of respiration and the principle of life being thus clearly recognised and acknowledged, we cannot wonder that a number of theories were promulgated in every age to account for the precise nature of that function.

The more important of these theories were combated by Mayow in a treatise "On Respiration," which was far in advance of those of all previous writers on the subject. He had proved that only the nitre-air particles of the air are necessary for the support of life, and he contends that these particles are absorbed by the blood, whilst the rest of the air is rejected. The absorption of nitre-air produces heat in the body, and it is the object of respiration to produce animal heat, which arises from a kind of fermentation caused by the union of nitre-air with the combustible particles present in the blood. In like manner muscular motion is caused

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§ The gas was transferred from one vessel to another by the method adopted in the present day, which, we believe, was devised by Mayow, since we have seen no mention of it in any work earlier than the treatise we are considering.

by nitre-air uniting with combustible particles in the structure of the muscle. During violent motion we breathe quickly because nitre-air is required in greater quantity than when we are at rest, to supply the greater amount of muscular motion called into activity; and as combustible particles are removed very rapidly from the body under such circumstances, we require food containing a large quantity of such particles before and after violent action. When the chest is expanded, air, by its elastic force, rushes into the lungs, which are composed of a number of minute bladder-shaped membranes, through which nitre-air passes to the blood.

Mayow's work is remarkable in several respects. In it he conclusively proved that respiration and combustion are analogous processes; he upset the four-element theory by demonstrating the compound nature of air; and he recognised oxygen and nitrogen as clearly and almost as notably as they were recognised a hundred years later—the one the supporter of life and combustion, the principle of acidity, and the cause of fermentation and putrefaction, heavier than atmospheric air; the other incapable of supporting life or combustion, and lighter than atmospheric air. We find, moreover, in this work the dawn of the idea of chemical affinity, in the "fermentation" which he speaks of as taking place between nitre-air and combustible particles, and as tending to the production or destruction of things. Mayow even employs some of the terms in general use in the present day; thus he speaks of "*affinitas*" existing between acids and earthy substances, and uses the words "*combinetur*" and "*combinentur*" in speaking of the "*congressus*" of different substances.

The treatise is characterised by much clear and condensed thought, well-sustained argument, and accurate reasoning; moreover, we seldom meet with instances of too hasty generalisation—always the dominant source of error in the early development of a science. We further observe a great advance towards that exact and discriminative mode of thought which is necessary for the investigation of chemical phenomena. The period in which Mayow wrote was, as regards chemistry, a period of transition; there was as yet no work on scientific chemistry, yet Mayow's treatise approached more nearly to such a work than that of any of his predecessors. The works of previous writers in this direction belonged to one of the three following classes; they were either chemico-metallurgic, chemico-medical, or alchemical treatises; or they partook of the nature of all three. The publication of works on alchemy was fast waning before the advances of the new philosophy; for as superstition retreated, and as men began to devote their energies to the legitimate investigation of Nature, a false and chimerical art must of necessity cease to find votaries. Mayow was the first to discuss the intimate nature of an intangible body; other writers had treated of the air as a whole, but no one had endeavoured to ascertain the nature of its internal constitution, or to determine why it produces certain changes in surrounding bodies, upon what these changes depend, and the nature of the constituent or constituents of the air producing them. The old dogma of the elemental nature of the air was received as an absolute truth, although entirely unproven; it was thought that a theory which had been received since the earliest ages must of necessity be correct, and no attempt was made to disprove it

We see from the above that it was the investigation of the nature of nitre which led to the knowledge of the constitution of the air. Mayow remarks at the commencement of his treatise that so much had been written about nitre that it would appear "*ut sal hoc admirabile non minus in philosophia, quam bello, strepitus ederet; omniaque sonitu suo impleret.*" And, indeed, from the time of Mayow nitre *has* made almost as much noise in philosophy as in war. If on the one side it has subdued unruly factions, has it not on the other destroyed obstinate theories? If it has dispersed turbulent assemblies, has it not dissociated the most firmly united compounds? New dynasties have arisen by its aid alike in the realms of the earth and of philosophy. The greatest of the philosophic dynasties which has thus arisen was established by Mayow, and it has endured almost unchanged to the present day—a monument alike to his ingenuity, his perseverance, and his scientific ardour.

TECHNICAL CHEMISTRY.

A Theoretical Study of the Manufacture of Soda by Leblanc's Process, by M. J. Kolb.[*] (*Second Part.*)

(*Continued from page* 41.)

The next table given by the author is a rearrangement of the two previous to show more plainly the influence of the elevation of temperature during the digestion:—

Table 3.—Influence of Temperature.

100 grs. of ash.	Temperature (Centig.).		
	15	40°	60°
In 350 c.c. of water for 24 hours:			
$NaOCO_2$ . .	34·70	31·40	31·70
NaO . . .	5·70	7·80	7·60
NaS . . .	traces	0·15	0·30
In 350 c.c. for a week:			
$NaOCO_2$ . .	31·50	25·80	26·40
NaO . . .	7·60	9·50	7·20
NaS . . .	traces	2·20	3·70
In 500 c.c. for 6 hours:			
$NaOCO_2$ . .	38·51	37·36	31·49
NaO . . .	3·29	3·94	6·78
NaS . . .	0·25	0·25	0·65
In 500 c.c. for 24 hours:			
$NaOCO_2$ . .	38·58	35·36	26·80
NaO . . .	3·29	5·05	6·71
NaS . . .	0·25	0·40	4·70
In 500 c.c. for a week:			
$NaOCO_2$ . .	37·02	34·21	25·50
NaO . . .	4·23	5·67	6·62
NaS . . .	0·25	0·40	5·90
In 1000 c.c. for 6 hours:			
$NaOCO_2$ . .	40·19	35·92	34·20
NaO . . .	2·34	4·40	5·40
NaS . . .	0·25	0·45	0·75
In 1000 c.c. for 24 hours:			
$NaOCO_2$ . .	38·56	34·23	31·10
NaO . . .	3·30	6·04	6·62
NaS . . .	0·25	0·75	2·00
In 1000 c.c. for a week:			
$NaOCO_2$ . .	32·18	31·40	23·20
NaO . . .	4·97	6·30	6·00
NaS . . .	0·30	0·80	7·80
In 2000 c.c. for 6 hours:			
$NaOCO_2$ . .	38·21	36·10	37·91
NaO . . .	3·32	4·67	3·34
NaS . . .	0·20	0·50	0·60
In 2000 c.c. for 24 hours:			
$NaOCO_2$ . .	37·62	34·68	33·10
NaO . . .	3·84	5·94	6·15
NaS . . .	0·35	0·53	1·00
In 2000 c.c. for a week:			
$NaOCO_2$ . .	34·50	31·50	19·50
NaO . . .	5·28	6·31	6·31
NaS . . .	0·51	1·48	10·21

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[*] Abstract from *Annales de Chimie et de Physique*, June, 1866, p. 135. For abstracts of the former part of the author's memoir see Chem. News, vol. xiii., pp. 140, 162.

From a comparison of the figures in the three foregoing tables we may draw the following conclusions:—

The quantity of water has no very marked influence on the causticity, which, however, increases with the length of the digestion, and also with the elevation of the temperature.

The proportion of sulphide of sodium goes on increasing with the quantity of water, and more especially with the length of the digestion and the rise of temperature.

The diminution of carbonate of soda coincides not only with the formation of caustic soda, but is equally in relation with the variation of sulphide of sodium, which proves that this last is formed at the expense of the carbonate and not of the caustic soda. There appears, indeed, to be no relation between the proportion of caustic soda and sulphide of sodium.

So far as the causticity is concerned, there is nothing surprising in the results; but the results of the sulphuration of the leys were more astonishing, and the author endeavoured to trace the causes. For this purpose he studied the action of water first on pure sulphide of calcium alone, and then with carbonate of soda, soda, and lime, singly and altogether. Sulphide of calcium is but slightly soluble in water. A litre, after forty-eight hours, dissolved

At a temperature of	15°	0·15 CaS
,, ,,	18	0·23 ,,
,, ,,	40	0·30 ,,
,, ,,	60	0·48 ,,
,, ,,	90	0·33 ,,
After boiling for two hours		0·27 ,,

The presence of common salt was found to diminish the solubility, which partly explains how it is that ashes containing salt are generally less sulphuretted than others.

Sulphate of soda appears to have an opposite effect, the solubility of the sulphide of calcium being slightly increased.

The action of lime appears to be irregular. A litre of lime-water at 60°, after forty-eight hours, dissolved 0·18 CaS, while a litre of milk of lime, in the same time and at the same temperature, dissolved 0·55. These solutions are only the transformation of the sulphide of calcium into the sulphydrate of the sulphide and into lime—

$$2CaS + Aq = CaS,HS + CaO + Aq.$$

This transformation takes place slowly, for the proportion of sulphur made soluble increases with the length of the digestion; and boiling water, which after two hours gives but little soluble sulphide, contains large quantities if the boiling be continued for one or two days.

A solution of caustic soda containing 3·15 grms. in a litre, at 10° and even on boiling, took up merely traces of sulphide of calcium. It was the same with solutions containing 16·7 grms. 42 grms., and 79 grms. NaO. But when the same solutions were boiled or digested for forty-eight hours the reaction

$$CaS + NaO = CaO + NaS$$

took place.

When, however, the lime and sulphide of sodium were boiled or digested together, no change whatever happened. It appears, then, that when once the sulphide of sodium is formed, the lime has no further action upon it, although its presence has a notable influence on the changes which may take place between the carbonate of soda and sulphide of calcium.

M. Kolb next gives a table showing the progress of the decomposition which goes on between these bodies, according to the temperature, duration of contact, amount of water, and the presence of lime or caustic soda. We need only in this case give the results arrived at. The amount of sulphide of calcium dissolved or decomposed in water is, as we have seen, very small, but it increases with time and temperature. Lime has no sensible influence on this solubility, but caustic soda is a decided impediment to the solution, especially at the ordinary temperature.

So far as carbonate of soda is concerned, the concentration of the liquor is a powerful obstacle to the reaction

$$NaOCO_2 + CaS = NaS + CaOCO_2.$$

This decomposition, indeed, which is well-marked in very dilute liquors, diminishes until it becomes inappreciable in a saturated solution of carbonate of soda. It is, however, increased by length of digestion and elevation of temperature.

The presence of caustic soda in small quantity puts another obstacle in the way of the action of carbonate of soda on sulphide of calcium; lime produces exactly the same effect, which is not astonishing, since the effect is probably not produced by itself, but by the caustic soda formed.

We need not detain our readers over the general conclusions of the author, to which we have before alluded. The most important point dwelt on is the advisability of rapidly lixiviating the ash, and the great desideratum is an apparatus to effect this.

PROCEEDINGS OF SOCIETIES.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, by Dr. Percy, F.R.S.

Lecture No. VII.

The first subject for this morning's consideration is that of clay.

We are all familiar with the term clay, but under that term are included bodies which differ considerably in external appearance, and also in chemical composition. They are, however, all essentially hydrated silicate of alumina—silica combined with alumina and with water. The water is there in a state of actual positive chemical combination. They are not definite compounds. In almost every case you will find them to be mixtures of a silicate of alumina of definite constitution, with an excess of silica, and there are also present other bodies in small and variable proportion, which take no part whatever in the chemical constitution of the mineral. A clay, when it loses its water by exposure to heat—say a red heat—becomes what is termed dehydrated, deprived of water, and then its properties are altogether changed. As a familiar example, take the case of common brick. That is nothing more than a dehydrated silicate of alumina. The clay has been fashioned into a bricklike form, and exposed to a temperature at or above redness, and so deprived of water. The product has lost all plasticity—that is, all capability of being moulded again—although it may be pounded and mixed with water. The plasticity of the clay depends on the fact of a certain amount of water being in actual combination with the silicate of alumina. Take that water away, and then, I say, the plasticity is immediately lost.

There are various kinds of clay known to us. Perhaps one of the most typical is the well-known china clay, or kaolin, which is the Chinese word. The Chinese, you know, are adepts in making china ware. Hence the name. They use two materials especially for that purpose—

kaolin, which is china clay, and silica. Those two in mixture constitute essentially the material of china. Kaolin is one of the purest kinds of silicate of alumina with which we are acquainted. It is prepared largely in Cornwall. It is, in fact, the result of the weathering, or decomposition by exposure, of the felspar contained in certain kinds of granite. In Cornwall there exists much of that granite, which undergoes disintegration or decomposition by the continued action of moisture. The felspar becomes decomposed, and is resolved into silicate of alumina, hydrated, and also into certain other products which are washed away; for instance, almost the whole of the alkali is removed, but not the whole. There is always some alkali left in clay in spite of the weathering, however perfect it may be. There is also a certain proportion of silica always removed. I will show you the transformation presently by means of a simple formula. The granite undergoes decomposition by exposure: it gets washed and levigated, to use the old chemical phrase; there is a portion of silica removed, and there remains kaolin. I will place before you an analysis of kaolin. It is not one of ours, but I have no doubt this is perfectly accurate and typical so far as regards the proportions of silica and alumina. You see it contains

Silica	46·32 per cent.
Alumina . . .	39·74 „
Combined water. .	12·67 „

The silica and alumina are the chief constituents. The water I have stated, is water which cannot be displaced by gentle desiccation, but can only be driven out by exposing the clay to a red heat. Then you will observe there are other bodies present in small quantity—

Lime	0·36 per cent.
Magnesia . . .	0·44 „
Protoxide of iron . .	0·27 „

and there ought to be potash. I have no doubt that all kaolin contains potash in a notable quantity, but, as I said previously, the determination of alkali involves a good deal of trouble, and unless there is some reason for it, chemists will generally shirk the task of estimating it.

I have also an analysis of some fire-clay—one of the best we have. It is found in the coal measures of South Staffordshire, and is largely used there for the purpose of making pots for glass-makers.

Silica	65·10 per cent.
Alumina . . .	22·22 „
Water	7·10 „
Potash . . .	0·18 „
Lime	0·14 „
Magnesia . . .	0·18 „
Protoxide of iron .	1·92 „
Phosphoric acid . .	0·66 „
Organic matter . .	0·58 „

The potash occurs only in small quantity. It is a very troublesome ingredient in the clay, refractory clay or fire-clay being intended to resist high temperatures. It is a very troublesome thing when the potash amounts to 1 or 2 per cent.; it then renders the clay much more easily softened by heat than it would otherwise be, or even fusible. So also with regard to lime, which in a certain proportion is also injurious. There is sometimes a little manganese present in this fire-clay. You see it contains a little phosphoric acid, and I have no doubt that that would be much more generally found in recorded analyses if they were more carefully and scrupulously conducted. Phosphoric acid is a thing which in its determination gives trouble. Then we have a certain proportion of organic matter present upon which the colour of these fire-clays depends. These clays are always more or less coloured; some have a deep colour, almost brown. Here is one of them; it is, in fact, one of those of which I am giving an analysis. It has a dark greyish colour, due entirely to finely disseminated coaly matter. There is also a little hygroscopic water stated in the analysis—2·18 per cent. Now, what is the difference between the hygroscopic water and the combined water? Why, the fact is, you can displace the hygroscopic water by gentle heat, and when the clay is cold it may reabsorb it in even a larger proportion. The water is simply in the clay as so much mechanically mixed matter. Not so the combined water. The moment you displace that, you entirely alter the properties of the clay. It is the combined water which constitutes it a hydrate. Now cast your eye for a moment on the quantity of silica represented by the top figures, 65·10 per cent. You say there is a difference in the composition of the two clays I have brought before you. So there is; but I have no doubt this fire-clay is essentially one of which the other analysis represents nearly the composition. It is a silicate of alumina mixed with foreign matter; that foreign matter is to a large extent, in this case, silica, which may be separated easily by a washing process. It is so much sand diffused. We know that because we have made exact experiments upon it. In fact, we have determined the proportion, and in order to make the experiment a simple apparatus may be adopted. I cannot perform the experiment before you, because it would not be striking, and it would take too long a time; but there may be some gentleman present interested in agriculture, and for his sake I will explain the process of determining the silica in clay. We first of all reduce the clay to powder and leave it in water for a long time, or by preference boil it thoroughly. The object of this is to disintegrate it as completely as possible. In the manufacture of pottery it is customary to boil the clay. Having disintegrated the clay, we take a glass—say, like the old-fashioned champagne glasses, with no stem to it. At the top you affix a piece of brass—a brass rim, and to that rim you have a little spout bending over. Then you introduce a common glass tube descending to the bottom of the glass. The tube should be drawn out somewhat at the lower extremity to a fine point. Then at the upper part it should terminate with a funnel or mouthpiece. The glass tube is placed in the glass. That done, let a current of water from a tap flow down the glass tube. Then put the piece of clay, which you have reduced to powder by boiling in water, or otherwise disintegrated, into the glass, and leave the apparatus for a long time, allowing the stream of water to flow down the tube. Now, the lightest particles of the clay will be removed and flow over the edge through the spout. They will be the silicate of alumina; and the sand will separate at the bottom. Continue this operation for a considerable time, and you will find the pure sand at the bottom. Then, by repeating the process of levigation again, you can make a tolerably correct estimate of the amount of silica present mechanically, independent of that combined as silicate of alumina.

Now for an analysis showing how clay may be derived from felspar. We will take, for the sake of illustration, two equivalents of felspar. Two equivalents of felspar will contain two equivalents of potash, two of alumina, and eight of silica—

$$2KO + 2Al_2O_3 + 8SiO_2.$$

You will find that by doubling the formula I gave you for felspar you will get at those numbers. Let us take from this two equivalents of silicate of alumina—

$$2(Al_2O_3SiO_3).$$

I have used the formula which is most generally accepted as correct for silicate of alumina now-a-days. There is some difference of opinion in regard to the constitution of this kaolin or silicate of alumina. The presence of free silica renders it very difficult to get a pure body to act upon. Well, having taken away those two equivalents of silicate of alumina from the two equivalents of felspar, there will remain two equivalents of potash and five of silica; or—what is equal—take away two equivalents of potash and five of silica, and that will leave you two equivalents of silicate of alumina, or kaolin. Well, that represents exactly what takes place in the weathering action, occurring in nature or artificially excited, by which kaolin is produced from felspar.

A curious matter turned up some four or five years ago in North Wales, and we have never yet been certain about the constitution of it, though we have made several inquiries into it. It is a micaceous or mica-like body. It has been examined crystallographically by Professor Miller, of Cambridge, and we have made several analyse of it which have not been published. It appears to be a definite silicate of alumina, represented by the formula which I have just employed. It is a body requiring farther examination, which, indeed, it ought to have received long ere this.

Note especially the presence of potash or soda in all these clays. I will be bound to say there is no clay without one or other or both of those alkalies. You will generally find potash, and sometimes soda, to the extent of 2 or 3 per cent. We have them recorded in analyses of our fire-clays. Occasionally we have found both alkalies in such clays. Now, these fire-clays are often associated with coal, as we shall hereafter see, and no doubt this association may indicate the conditions under which some of the coal plants have lived. The presence of those alkalies would indicate a marine origin.

Phosphoric acid is also present; and we also find bisulphide of iron diffused in small particles in these clays. It is not unfrequently present, and when it is there it is sometimes a source of great inconvenience to the brickmaker in the burning of the bricks. In consequence of a large quantity of free oxygen being contained in the air, the iron pyrites becomes oxidised when the clay is burned, and an oxide of iron is produced, which acts rapidly on the silicate of alumina. The silicate of alumina is fluxed by the iron pyrites, and little perforations occur all over the bricks. In examining a fire-clay it is always desirable to examine this point especially, and that may be easily done by subjecting the clay to a process of levigation similar to that I described just now when speaking of the separation of free silica.

Clay forms, as you know very well, a very large part of the earth's surface. London, for example, rests, to a large extent, on clay. When we consider these facts with reference to the production of kaolin and so forth, there can be no doubt whatever, as I said before, that all these clays have been derived from felspar, or some analogous silicate. In some cases we have the process going on upon a very large scale; and we can take the felspar and watch its gradual transformation into this substance, kaolin.

Sometimes clay is converted at a high temperature into a mineral called porcelanite, or porcelain jasper, a very pretty mineral; and this mineral we sometimes find imitated accidentally on coal-heaps which have been ignited for a long time. The shelly matter being exposed to a long-continued heat becomes converted into porcelanite; and where we find it we know perfectly well that heat has existed. There are circumstances which justify the inference that porcelanite is nothing more than clay which has been transformed by heat. I have seen it frequently upon old pit mounds. Occasionally you will find it presenting a beautiful ribbon-like structure in alternate layers of red and green.

The next division of our subject is one of considerable comprehensiveness and importance. It is that of sulphur and the compounds of sulphur which exist in nature. Of course I shall treat of this department only in reference to geological considerations.

Now, sulphur is, as you know, an elementary body—that is to say, by no known process can it be resolved into simpler forms of matter. Treat it, torture it, as we may, it remains sulphur for ever. There is another element very analogous to it in chemical relations—namely, selenium, a body discovered by Berzelius a great many years ago. Here is a specimen of selenium cast in the form of a medal. These two bodies sometimes occur together; but selenium is of very rare occurrence in nature compared with sulphur. Sulphur burns, you know, with access of air, forming sulphurous acid. We are all familiar with the fumes of burning sulphur; that is nothing more than sulphur united to oxygen chemically, in the form of sulphurous acid. There are various other kinds of combinations and acids. There is sulphuric acid, and there are other sulphur acids.

Sulphur occurs abundantly in nature, even in a state of isolation. Here is a fine specimen of crystallised native sulphur. It is essentially a volcanic emanation, as we shall observe hereafter when we come to treat of volcanic action. It exists to a very large extent in the earth's crust, in combination with metals, forming sulphides. It is also present to a very large extent in the state of salts, saline combinations—in the form, especially, of sulphate of lime, with which you are familiar under the name of gypsum.

Let us first examine these sulphides in a general way. Now, sulphur has a very powerful affinity for many metals. Take, in illustration, the familiar experiment with iron, so often performed by youths at a smith's fire. Obtain a piece of iron, heat it to whiteness, and touch it with sulphur. Instantly the iron trickles down as liquid as water, a combination of iron and sulphur having taken place. Take, again, a little lead, heat it with sulphur, and a combination takes place, accompanied by the phenomenon of incandescence. In fact, sulphur combines with many metals, producing great heat and light—in other words, causing incandescence.

We will study in detail some of the most important sulphides which we meet with. They differ considerably in their properties, but they are all solid. They are either amorphous—that is, without form—or they are crystallised. They sometimes occur magnificently crystallised. Look at this specimen of iron pyrites. It is, as you observe, distinctly crystallised, and sometimes we obtain it in very fine crystals—large cubes or modifications of the cube, and also in other crystalline forms. Take, again, common galena, sulphide of lead: here it is, forming a large crystalline mass. Here you can trace distinctly the form of cubes. Again, you have these sulphides presenting a metallic appearance. Here is one which some persons would pronounce a metallic substance, but it is merely a metallic compound. Then, again, we have a compound of sulphur and mercury, which is without any metallic lustre. Here, again, is a combination of sulphur and antimony. What is very singular is, that we may have the same sulphide in two distinct forms, each of them possessing precisely the same chemical composition, and yet no two bodies differing more in external characters than these two forms of the same sulphide. I could place before you several illustrations of this fact. Here is some sulphide of bismuth which has been thrown down from a solution of bismuth. It is in the form of a black powder, perfectly non-metallic in appearance. Take this black powder, expose it to a good red heat, and you then obtain a beautifully crystallised body having a decided metallic lustre. But here is, perhaps, one of the most striking illustrations you can have. You see this orange powder. It is nothing more than sulphide of antimony thrown down in contact with sulphur from solution. This other specimen is the same compound after being exposed to a red heat and melted. You see it now possesses a bright metallic lustre. There are also different forms of sulphide of mercury. Here it is in the state of common cinnabar, a black powder. If I take this black powder and expose it to a high temperature in a glass vessel, which is essential in this case, I then get this brick-red powder, which has the same composition per cent. Then, again, by taking this dull-red powder and submitting it to a certain treatment, I obtain this beautiful body, vermilion, which has precisely the same composition. These three forms are all sulphide of mercury, all having the same constitution, and yet you see how different they are in external appearance.

Some of the sulphides are very fusible. As a general rule, the sulphides of the more fusible metals, such as lead and tin, fuse at a much higher temperature than those metals. On the other hand, the sulphides of the more difficultly fusible metals—iron, for example—fuse at a much lower temperature than those metals. There are exceptions, however, to this rule; still it is generally true. The temperature at which they fuse varies considerably. Some are perfectly fixed at whatever temperatures we expose them to. Take a certain compound of sulphur and copper which occurs in nature—the disulphide. If I heat it in a close vessel—(I demand that condition)—I may expose it to the highest temperature we can command in our furnaces, and it undergoes no change whatever. Again, if I take iron pyrites and heat it in a close vessel to the highest temperature I can, it undergoes no change; but if I heat it openly to a good red heat, it then loses about half its sulphur. Other sulphides sublime when heated, and we find such sulphides in volcanic emanations. Sulphide of mercury, for example, is one capable of being thus sublimed. Sulphide of arsenic, also, can be sublimed. There are some points of considerable interest in connexion with the sublimation of these sulphides. Take, for instance, common galena, sulphide of lead. I have seen this body beautifully sublimed in blast furnaces when lead slag was being melted. Beautiful crystals of sulphide of lead have been seen in the upper part of the furnace, showing that it has been sublimed. But then this sublimation can only take place with the exclusion of oxygen. If oxygen have access, you burn out the sulphur and oxidise the metal. In fact, you get a series of changes of great interest in a metallurgical point of view, but which I have not time to dwell upon. The changes which take place by exposing these sulphides to the action of heat and air are very important, and lie at the foundation of some of the most important processes for the extraction of metals from their ores, especially copper, lead, and silver. The sulphides of many of the metals are frequently decomposed by steam at a high temperature. The sulphur goes away in combination with the hydrogen as sulphuretted hydrogen, and the metal becomes oxidised at the expense of the oxygen of the steam.

(To be continued.)

ACADEMY OF SCIENCES.

July 23.

Two papers were read "*On Hexagonal Blende,*" and more especially its phosphorescent properties. They were by M. E. Becquerel and M. Sidot. The latter author states that to obtain the most phosporescent sulphide of zinc he volatilises the natural blende or artificially prepared amorphous sulphide in a current of pure and dry sulphurous acid. The sulphide is placed in a porcelain tube, and is strongly heated for four or five hours, after which crystals will be found at the cold end of the tube. M. Becquerel has examined the properties of the crystals so produced, and has found them phosphorescent in the highest degree after insolation. He remarks that the outer crystals in the mass he examined were white, while the inner ones had a yellow tint resembling that of uranium compounds, and this yellow tint, he thinks, is due to a molecular arrangement which is the cause of phosphorescence. Yellow crystals are generally phosphorescent. M. Becquerel examined the light by the aid of the phosphoroscope, and found that the white crystals with a moderate velocity of the instrument showed a beautiful blue light; the yellow crystals showed a greenish-yellow with the lowest velocity, which passed to a blue as the velocity increased, but a blue less deep than that furnished by the white crystals, thus indicating a mixture of the green with the blue light of shorter duration. The coloured crystals thus afford rays of different refrangibility and of unequal duration, like diamonds, silicate of lime, and other bodies. It is observed, however, that the bodies showing blue light are very few in number. M. Becquerel has also studied the effects of the different rays of the spectrum upon hexagonal blende, and has found that the maximum of action is between the lines G and H, rather nearer G than H.

M. G. Planté presented a note "*On the Production of Ozone.*" The author has found that more ozone is produced in the electrolysis of water when the poles are of lead than when they are made of platinum—half as much again, indeed. The fact, he says, is difficult to explain, but he conjectures it is the result of the secondary action of a layer of oxide on the electrode.

M. Cloez entertained the Academy with "*A Mode of destroying Rats and other Animals that burrow.*" The Museum of Natural History at Paris is, or rather was, dreadfully infested with rats, but, thanks to M. Cloez, it is now free from the nuisance. The happy thought of pouring bisulphide of carbon into the holes occurred to this gentleman, and the vapour, we need hardly say, was fatal to all the rats who stopped to inhale it. The description of the funnel and tube by means of which the operation was effected we need not detain our readers with. Those who are curious or simple will find it in the *Compte Rendu* for the date at the head of this article.

M. E. Kopp sent "*On the Use of Nitroglycerine in Stone Quarries*" in his neighbourhood. To avoid accidents in transport M. Kopp prepares nitroglycerine on the spot, and at the time it is wanted. His directions for the preparation and use are clear and precise, and we shall give them at length next week.

NOTICES OF BOOKS.

Annales de Chimie et de Physique. July, 1866.

The chemical papers in this number of the *Annales* are unimportant. We append the titles of all the papers.

I. "*The Quantitative Determination of the Calorific Phenomena produced during the Change of Volume in Metals, and Determination of the Mechanical Equivalent of Heat independently of the Internal Work of the Metal.*" By E. Edlund.

II. "*On the Effects of Coloration and Extinction of Colours produced by Artificial Lights.*" By M. J. Nickles. This paper was read before the Academy of Sciences, and a notice will be found at page 31 of our last volume.

III. "*On the Crystallisations of Tribasic Acetate and Hydrated Oxide of Lead, and Crystallised Anhydrous Protoxide of Lead.*" By M. Payen. The author obtains all these crystals by adding different proportions of ammonia to solutions of acetates of lead of different strengths.

IV. "*On the Vibratory Movements occasioned in Conducting Bodies by the Combined Action of Magnetism and Discontinuous Currents.*" By Professor de la Rive.

V. "*On a New Electromotor.*" By M. Toepler.

VI. "*On the Composition of the Ashes of Vegetables.*" By M. G. Marchand. The author gives analyses of the ashes of wheat, oats, potatoes, beets, carrots, swedes, peas, vetches, trefoil, lucerne, sainfoin, colza, and linseed, together with those of some fuci, and starfish, and, lastly, an analysis of milk.

VII. "*On the Dilatation of Solid Bodies by Heat.*" By M. Fizeau.

VIII. "*Experimental and Theoretical Researches on the Figures of Equilibrium in a Liquid Mass without Weight.*" By M. J. Plateau. In this paper the author gives an improved method of preparing the glycerine and soap compound for giving persistent air-bubbles.

Translations of two papers by Professor Rankine follow, and lastly we have the commencement of a memoir by M. Boussingault "*On the Sensation of Heat produced by the Contact of Carbonic Acid with the Skin.*"

Journal für praktische Chemie. No. 8. 1866.

In this Journal we have Marignac's "*Researches on Niobium Compounds;*" a contribution to the "*Knowledge of Sulphocyanogen Compounds,*" by O. Hermes; and a paper "*On Sulphur Compounds,*" by Pelouze, which will be found in our last volume. There is next a paper, by Dr. Rudolf Weber, "*On the Formation of Sulphuric Acid,*" combating the views of Peligot on this matter. As the subject is of considerable interest, we shall return to the paper. The next paper is by Baudrimont, "*On the Nature of White Phosphorus,*" a notice of which will be found in the Chemical News for Nov. 5, 1865. Then follows a short paper "*On Petolite and Osmelite,*" by Von Kobell, and a communication, by Dr. Graeger, "*On the Determination of Potash in the Presence of Soda,*" in which he gives a convenient and ready method of examining adulterated potashes. To determine the amount of carbonates the author employs a "normal" nitric acid, and he gives a table which shows the amount in cubic centimetres of this normal acid required to saturate one gramme of a mixture of the carbonates of potash and soda of from 1 to 99 per cent. of either. This table will be found very useful by many analysts. The next paper is by Dr. Martius, "*On a Double Compound of Ferrocyanide of Potassium with Nitrates of Potassium and Sodium.*" The author found this compound in the mother liquor of the prussiate when saltpetre is used in the preparation. It is a beautifully crystallised salt of a clear yellow colour, and possesses in the highest degree the property of becoming phosphorescent when the crystals are rubbed or shaken together in the dark. The compound may be obtained by adding a solution of ferrocyanide to a boiling solution of potassium and sodium nitrate. After the greater part of the saltpetre has crystallised out, the mother liquor, on very slow evaporation, will yield the crystals described. At a high temperature they go off like gunpowder. They have the composition—

$$Fe'K_4(NC)6 + 2NaNO_3 + 2KNO_3.$$

The last paper we need notice is by Stolba, "*On the Use of Saturated Aqueous Solutions in determining the Specific Gravity of the Body in Solution.*" The method is obviously good when a perfectly saturated solution is obtained, but its application must require many precautions.

NOTICES OF PATENTS.

Obtaining Spirits, &c., from Wood. Letters patent to William Edward Newton, sealed February 6, 1866, and dated August 31, 1865.

This invention consists in obtaining spirits of turpentine, rosin, tar, pitch, pyroligneous acid, gas, charcoal and wood, naphtha, directly from pine wood by one operation.

The wood containing the resinous gum (pitch pine wood) is placed in iron retorts, which are closed up steam tight, and a stream of steam is let into the retort, which may at the same time be heated externally to expedite the process. As soon as the condensation of the steam ceases or partially ceases, the pressure of steam in the retort rapidly forces the heat through the mass of wood until the heat reaches from 300° to 320° Fahrenheit, when the valve which connects the retort with a condenser is opened and the vapours containing water and spirits of turpentine pass over into the condenser and are condensed, the spirits rising on to the top of the water. This process continues several hours, the heat being gradually raised until the wood begins to char and forms acid, gas, and other products, at which time a large portion of the turpentine spirits have passed through the condenser. This process is hastened, and the yield of spirits in this part of the operation much increased, by reducing the pressure of the vapours in the retort to two or three pounds per square inch by the aid of air pumps and condensers, or otherwise. When the pressure is thus mainly removed, the evaporation is so rapid that without the use of superheated steam it is difficult to keep up sufficient heat without charring the wood in some parts, which must be avoided as long as possible, as the quality of the spirits is very poor after charring commences until they have passed through difficult processes of refining. While this process is going on rosin is formed and runs down to the bottom of the retort, and is drawn out before the charring commences.

In using the vacuum or partial vacuum in the distillation, it will be found advantageous to shut off the connexions of pump and condensers with the retort occasionally, to allow pressure of steam in the retort, which rapidly forces the heat through the wood again without charring it, unless the temperature of the steam is too high. The pressure of steam in the retort is not generally allowed to reach more than three or four atmospheres before it is again reduced. As soon as the yield of the spirits of turpentine becomes inconsiderable, the heat is raised and the charring commences, and as soon as this progresses rapidly, the steam may be nearly or quite shut off, and the acid formed will be much stronger than if the supply of steam be kept up during the entire distillation. The use of the vacuum or partial vacuum may be resorted to frequently throughout the entire distillation, the products coming over purer and at a much lower heat than they otherwise would. While the charring of the wood takes place the vapours passing off consist of acid, wood, naphtha, spirits, oil, tar, incondensable vapours, &c. A very advantageous way of separating the tar from the other vapours is to surround the condenser with a bath, heated to such a degree as to enable the vapours of the naphtha, acid, and spirits, together with the light oils, to pass through it without condensation, but cool enough to condense the tar, and so placed that the tar will run back into the retort while the vapours of the acid, naphtha, spirits, &c., pass on through another condenser, which may be cold, and separate the gas from the other products, or it may be heated sufficiently to carry the wood naphtha over with the gas into another condenser, where it is finally separated from the gas. The distillation is continued until the wood is thoroughly charred and the tar converted into a beautiful black lustrous pitch, the oils being nearly driven therefrom. Should the rosin be left in the retort, it will also be converted into pitch. Care should be used not to heat the retort too highly on the bottom, as the pitch will be destroyed, if heated too much, by turning it into coke. It should be watched and drawn out as soon as sufficiently hard, whatever be the heat of the retort bottom. Should neither steam nor superheated steam be used in the distillation, the retort should be closed tightly at first, and the steam formed from the water of the wood, and the other vapours, aid in increasing the pressure of vapours in the retort, and thus more equally distribute the heat through the wood. When the pressure in the retort reaches two or three atmospheres, the valve to the condenser may be opened.

Much more caution will have to be used to heat gradually and drive off most of the spirits before charring commences; if steam or superheated steam be not used to aid in heating the wood, these will be necessary if they are used.

Preparing Colouring Matters. By John Holliday. (This invention received provisional protection only.)

The nature of the said invention for "Improvements in preparing certain Colouring Matters" is as follows:—

"I take the dye usually known in commerce as 'cotton violet' (made from salts of rosaniline), of various violet tints, which dye is fugitive, rendering it valueless for dyeing wool, silk, and other fibres. I treat one part of this dye by adding to it about six parts of water, or it will act better if four ounces, more or less, of liquid ammonia sp.

gr. 0·880 be added thereto, though any alkali or salt of an alkali, such as common salt, may be used instead. This will cause the colouring matter previously in solution to be precipitated; this precipitate I wash with water, and place upon filters to dry. It is then in a fit state for sale; but I prefer to dissolve it in alcohol, so that it is fit for use direct into the dye bath. To render the colour purer, and vary the tint, I take the hereinbefore described precipitate and dissolve one part in from 8 to 16 parts methyl alcohol (wood naphtha), and when dissolved I add half a pound (more or less may be used) of sulphuric, muriatic, or nitric acid. This mixture I allow to stand some time, or I facilitate the operation by heating it to its boiling point a few minutes, and when cold this I again treat with alkaline water and precipitate, as above described. This latter operation may be repeated to advantage. I do not confine myself to the exact proportions or mode of operation herein above stated, as the same may be varied. In all cases I can recover the methyl alcohol (wood naphtha) by distillation from the liquid after the colour is precipitated."

Dyeing and printing Fabrics and Yarns. Letters patent to John Lightfoot. Sealed March 6, 1866, and dated September 11, 1865.

The object of this invention is to dye, print, or stain a fast black from aniline on wool, silk, feathers, or other animal substances or fabrics made from wool, and also fabrics made of a mixture of animal and vegetable substances, such as delaines and similar mixed goods.

"For mixed goods I wince or steep them in a solution of hypochlorite of lime, commonly known as chemick, or a mixture of hypochlorite of lime, hydrochloric acid, and water, for the purpose of preventing the deoxidising properties of the animal fibres and substances, thereby rendering them capable of receiving the aniline black, as described by me in the specification of a patent bearing date January 17, 1863, number 151.

"Although I have here named only hypochlorite of lime, I wish it to be understood that other similar oxidising agents will answer the purpose, such as hypochlorous and chlorous acids, hypochloric, chloric, and perchloric acids, or a solution of their salts of alkaline or metallic bases. Other oxidising acid salts, such as nitric acid, nitromuriatic acid, bichromate of alkalies, and permanganate of alkalies, will produce a certain effect; but I prefer, as more economical and of greater utility, the chlorine mixtures before described. When the wool or animal substance is thoroughly oxidised to its maximum, and in a fit state to receive the aniline black already named (by oxidation being understood the change, whatever it may be, that animal fibres undergo, when exposed to the substances described), it may be known by the following simple test:—Take a dilute solution of permanganate of potash in two test-tubes, and into one put a piece of the oxidised wool and into the other a piece that has not been oxidised, and apply a gentle heat; the solution containing the one that is in a fit state to receive the aniline black remains pinky, but the other is decolorised immediately.

"The proportions for preparing the wool are about as follows:—I take for every pound of cloth, wool, yarn, silk, delaine, feathers, or animal substance (well cleaned) six gallons of water at about 100° Fahrenheit, two and a half ounces by weight of hydrochloric acid of commerce, and one pint of hypochlorite of lime in solution, containing sixteen ounces of hypochlorite of lime per gallon. I keep the goods in this solution for from twenty to thirty minutes, or until the wool becomes quite yellow; I then wash well in water and dry.

"I am aware that woollen fabrics and fabrics of mixed wool and cotton have been previously steeped or prepared in mixtures containing chlorine or hypochlorous acid for the purpose of subsequently printing or dyeing such fabrics with ordinary colours not aniline black, but the chlorodising or oxidation sufficient for such purposes is not applicable to aniline black, and a point of oxidation or chlorodising is required which would not be advisable to give to fabrics intended for ordinary colours.

"In dyeing coburgs and similar goods the present processes involve two operations; firstly, the cotton has to be dyed, and then the wool or silk. I avoid this twice dyeing by preparing the mixture of cotton, wool, silk, or other animal substance as above, so that they will both take a black dye at one and the same time. I steep or pad the goods either before dyeing or after in the following dye:—One gallon of water, four ounces of chlorate of potash, twelve ounces of chloride of aniline crystals, six ounces of sal-ammoniac, two ounces of sulphate of copper. I then dry the goods at as low a heat as possible and age for two or three nights in a moist room at from about 76° to 80° Fahrenheit, and when the colour is thoroughly developed it becomes an intense myrtle green, almost black. I raise the goods either in water or any weak alkali, or in a weak cold solution of neutral chromate of potash, which I use in preference; and if a brownish black is required the goods may be subsequently dyed in a weak hot solution of archill or cudbear.

"When the prepared cloth is used for printing, I print on the aniline black colour as described in the specification of my former patent already referred to, and dry and age in a warm moist room, and raise in weak alkali as before. I then pass the goods through a warm solution of sulphite or hyposulphite of soda, or a solution of any suitable deoxidising agent, to improve the white or whites; or the goods may be passed through Mr. Thom's sulphuring apparatus, which restores the white in the parts not printed, but does not injure the black. It is preferable, after sulphuring, to repass the goods through a weak alkali."

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

1761. W. Stanfen, Barossa Place, Brompton, Middlesex, "Improvements in the treatment and application of vegetable fibres."—Petition recorded July 2, 1866.

1680. A. Lee, Bradford, "Improvements in preparing wool or other animal fibrous substances, yarns, and woollen fabrics for dyeing."—June 23, 1866.

1782. H. G. Fairburn, St. Luke's, Middlesex, "An improved process for forming and combining small coal or coal-dust into lumps, blocks, or otherwise, to be employed for the purpose of fuel."—July 5, 1866.

1789. J. A. Salmon, Liverpool, "Certain improvements in furnaces."—July 6, 1866.

1827. W. G. Walker, and R. F. Smith, Kilmarnock, N.B., "A certain improved method of producing illuminating gas."—July 12, 1866.

Notices to Proceed.

732. G. Phillips, Offord Road, Barnsbury, Middlesex, "Improvements in preparing purple and blue colouring matters."—Petition recorded March 10, 1866.

756. J. F. Bringes, Fieldgate Street, Whitechapel, "Improvements in machinery or apparatus for distilling bituminous shale and other bituminous substances of a like nature.—March 13, 1866.

779. T. G. Ghislin, Hatton Garden, Middlesex, "Improvement in the preparation of peat for the purpose of rendering it applicable to the manufacture of articles which are capable of being produced by stamping, moulding, embossing, or rolling."—March 15, 1866.

811. E. Field, Adelphi, Westminster, and F. Lloyd, Hoddesdon, Hertford, "Improvements in the mode of, and apparatus for, diffusing moisture and heat through vegetable or other matters."

812. T. Routledge, Ford Works, near Sunderland, T. Richardson, Newcastle-upon-Tyne, and W. H. Richard-

son, Jarrow-on-Tyne, "Improvements in treating the waste liquors resulting from the preparation of esparto grass, alfa straw, and other fibrous substances, and in purifying the alkali recovered therefrom, and in furnaces or evaporating pans connected therewith."—March 19, 1866.

827. W. E. Newton, Chancery Lane, "Improvements in the process of and apparatus for distilling petroleum and other mineral oils."—A communication from E. Braggins, M. P. Ewing, H. B. Everest, Rochester, New York, U.S.A.—March 20, 1866.

842. E. D. Elliot, Plymouth, "Improvements in treating animal charcoal used in refining sugar."—March 21, 1866.

1348. A. V. Newton, Chancery Lane, "Improved apparatus for manufacturing illuminating gas."—A communication from L. Stevens and N. C. Munson, Shirley, Mass., U.S.A.—May 10, 1866.

MISCELLANEOUS.

Bird's Method of Purifying Water.—Mr. Alfred Bird, of Birmingham, has patented the use of the neutral sulphate of alumina for purifying water. Its action depends upon the presence of carbonate of lime in the water to set free hydrated alumina, and as carbonate of lime is almost universally present the process is as universally applicable. The advantage of the use of this compound is, that beyond converting carbonate into sulphate of lime it introduces no new salt, while the organic matter is carried down with the hydrated alumina.

Gale's Protected Gunpowder Company (Limited).—The first ordinary meeting of the shareholders was held on Monday last. The report stated that the directors had found it desirable to erect crushing machinery at Bristol for the purpose of preparing the protecting material. These works are nearly completed, and will soon be in operation. The chairman (the Hon. H. W. Petre) moved the adoption of the report. What follows we extract from the *Standard*:—

"Mr. Rendle moved an amendment to the effect that a committee of five or seven shareholders be appointed to communicate with some eminent professors, such as Faraday, in order to ascertain the merits of Mr. Gale's discovery, and to report the result of their investigation to a future meeting.

"The meeting lasted three hours and a half, and in the course of the palaver the right of Mr. Gale to claim the merit of being the original inventor of this discovery was disputed. A more irregular meeting we never witnessed. Personalities formed the greater part of the discussion.

"The question of the amendment being put, there appeared, on a show of hands, two for the amendment and nine against it. The original motion was then put and carried."

Parliamentary Views of Infection.—In the course of a discussion on the Public Health Acts, the following extraordinary conversation took place. On clause 28, which relates to inspection by the medical officers,

Sir J. Jervoise thought the word "infection" which occurs in this clause ought to be defined. The medical officer, before surveying a house which was supposed to be infected, was recommended by the Committee of Privy Council to have on a particular dress, consisting of "strong water-tight boots, reaching to the knees, and greased all over (a laugh), a waterproof coat closely buttoned up to the neck and at the wrists, and the head covered with a cap which takes the hair well in." (A laugh.) He hoped the medical officer would be clothed in this safety dress before he embarked in the dreadful danger of visiting these nuisances, especially as he had to report to the nuisance authority; or, going into these pest-houses, he would himself come out pestiferous. (A laugh.) It was the more necessary that there should be a definition of "infection," from the visitation of cholera with which we were threatened. He had formerly asked a question on this subject, and referred to the fact that the Emperor of the French had been visiting the cholera hospitals in Paris. There was also the experiment mentioned in the newspapers of a young student, named Jerard, who, to show that cholera was not infectious, took the perspiration off the forehead of a dying man and the fur off his tongue, and put them in his own mouth. It was announced that the Emperor of the French had for the second time visited the cholera patients in the hospitals at Amiens. A commission which inquired into the ravages of the yellow fever at Bermuda reported that it was not infectious; and he could give a long list of similar conclusions respecting diseases that were supposed to be infectious.

Mr. Bruce would not argue whether cholera was or was not infectious. He presumed it would not be denied that there were diseases which were infectious, and if there were only one, whether it was small-pox, typhus, or any other disease, this clause ought to stand.

The first amendment made in the clause authorised the cleansing, not only of a house or part thereof, but "of any articles therein likely to retain infection."

Mr. Childers proposed to substitute for the words "the nuisance authority may" the words "it shall be the duty of the nuisance authority to" (cleanse and disinfect).

Mr. Walpole accepted the amendment, having intended to propose one similar to it.

Mr. Ayrton objected that this amendment would place a community at the entire mercy of "any legally qualified medical practitioner," on whose certificate the cleansing was to take place. It was a most monstrous proposition to invest "any legally qualified medical practitioner" with such domineering functions.

Mr. Bruce replied that the words "if it appear to the nuisance authority" (that cleansing would prevent infection) invested that authority with discretion.

The amendment was agreed to without a division.

On clause 29, giving the nuisance authority power to provide carriages for the conveyance of persons suffering from contagious diseases to a hospital, some discussion took place as to whether such provision should be made compulsory.

Mr. Powell moved to add the words, "Provided such carriage shall be disinfected."

Mr. Henley remarked that the House ought to be informed what disinfecting meant. The particular process to be used ought, in his opinion, to be specified in the Act. (Hear, hear.)

Mr. Bruce said the process of disinfection was perfectly well known at the hospitals.

Mr. Henley said that might be, but would the right hon. gentleman kindly inform the House what the method was? (Laughter.)

Sir Jervoise Jervoise pointed out that there were great doubts as to what was the most efficacious system of disinfection. A work recently published on the subject stated that one of the methods employed made matters worse than they were before. He thought it was desirable that the particular process to be made use of should be specified in the Act.

Mr. Walpole said that was a matter which might safely be determined by the authorities.

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.

E. J. G.—Add first ammonia and then sulphite of soda.

J. H.—Your quotation is probably incorrect. The copper would be the negative and carbon the positive element. In the action the carbon is oxidised by the liberated chromic acid.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

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

PART III.

CONNEXION BETWEEN ORGANIC AND INORGANIC CHEMISTRY.

SECTION III.—*Combinations of Multiple Radicals.*

IN the preceding pages we have called attention to the property possessed by radicals and polyatomic elements of uniting with each other and becoming accumulated in one and the same combination. This property explains the constitution of a great number of compounds, and reveals a certain analogy of structure, and, as it were, a family likeness, between very many groups of bodies.*

Let us take as examples those ethylenic compounds which we have just considered. The ethylene radicals possess the property of accumulating themselves in the polyethylenic alcohols, so as to form compounds belonging to more and more complicated types.

TYPE.	TYPE.	TYPE.
$\left.\begin{matrix}H_2\\H_2\end{matrix}\right\}\Theta_2,$	$\left.\begin{matrix}H_2\\H_2\\H_2\end{matrix}\right\}\Theta_3,$	$\left.\begin{matrix}H_2\\H_2\\H_2\\H_2\end{matrix}\right\}\Theta_4,$ &c.
$\left.\begin{matrix}(\Theta_2H_4)''\\H_2\end{matrix}\right\}\Theta_2,$	$\left.\begin{matrix}(\Theta_2H_4)''\\(\Theta_2H_4)''\\H_2\end{matrix}\right\}\Theta_3,$	$\left.\begin{matrix}(\text{Ꞓ}_2H_4)''\\(\text{Ꞓ}_2H_4)''\\(\text{Ꞓ}_2H_4)''\\H_2\end{matrix}\right\}\Theta_4.$
Ethylenic alcohol.	Diethylenic alcohol.	Triethylenic alcohol.

In organic chemistry there exist hydrates which may be compared to the polyethylenic alcohols. According to the analyses of MM. Mitscherlich, Payen, and Mulder, plumbic hydrate—a well defined and crystallised body—contains $3PbO,HO$, which composition is expressed in our notation by the formula—

$$\left.\begin{matrix}Pb''\\Pb''\\Pb''\\H_2\end{matrix}\right\}\Theta_4.$$

In this compound the diatomic atoms of lead and oxygen form a chain, to the extremities of which is attached the monatomic hydrogen; and it may be supposed that the atoms of oxygen are inserted between the atoms of lead, as we may admit that they are between the ethylene groups in the polyethylenic alcohols. (Vol. xiii., page 205.)

The normal stannic hydrate contains—

$$\left.\begin{matrix}\overset{\text{iv.}}{Sn}\\H_4\end{matrix}\right\}\Theta_4.$$

By losing $H_2\Theta$ it is converted into another hydrate—or rather into a first anhydride—

$$\left.\begin{matrix}\overset{\text{iv.}}{Sn}\\H_2\end{matrix}\right\}\Theta_3$$

which is stannic acid dried in vacuo, analysed by M. Fremy. The composition of the stannates is represented by the formula—

$$\left.\begin{matrix}\overset{\text{iv.}}{Sn}\\2R'\end{matrix}\right\}\Theta_3.$$

According to M. Fremy, metastannic acid contains in its molecule 5 atoms of tin. When it has been dried at 100° its composition is expressed by the formula—

$$\left.\begin{matrix}5\overset{\text{iv.}}{Sn}\\H_{10}\end{matrix}\right\}\Theta_{15}$$

The metastannates, which contain, according to M. Fremy,

$$\left.\begin{matrix}5\overset{\text{iv.}}{Sn}\\R_2H_8\end{matrix}\right\}\Theta_{15}$$

correspond to this latter hydrate.

Silicium, tetratomic like tin, possesses also, like it, the property of becoming accumulated in those combinations which I have called *polysilicic*,† and which form a very large number of the complex silicates. The following may be considered the mode of generation of these compounds:—

Anhydrous silicic acid contains $Si\Theta_2$. Its hydrate is—

$$\left.\begin{matrix}\overset{\text{iv.}}{Si}\\H_4\end{matrix}\right\}\Theta_4$$

By losing H , it gives a first anhydride—

$$\left.\begin{matrix}\overset{\text{iv.}}{Si}\\H_2\end{matrix}\right\}\Theta_3$$

But several molecules of silicic hydrate can unite and form, by losing water, a series of anhydrides intermediate in composition between the normal hydrated silicic acid and anhydrous silicic acid. We thus obtain series of polysilicic acids in which hydrogen may be replaced, completely or partially, by metals. These series are the following:—

POLYSILICIC COMPOUNDS.

$$\left.\begin{matrix}Si\\H_4\end{matrix}\right\}\Theta_4 \quad \left.\begin{matrix}Si_2\\H_8\end{matrix}\right\}\Theta_8‡ \quad \left.\begin{matrix}Si_3\\H_{12}\end{matrix}\right\}\Theta_{12} \quad \left.\begin{matrix}Si_4\\H_{16}\end{matrix}\right\}\Theta_{16} \quad \left.\begin{matrix}Si_6\\H_{24}\end{matrix}\right\}\Theta_{24}$$

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* We have already shown how the atoms of oxygen are united together in perchloric acid (vol. xiii., p. 200). The number of them united together may be more or less great, thus forming with chlorine and hydrogen the whole series of the hydrated acids of chlorine. This series, as Laurent first showed, may be considered as formed, to some extent, by the oxidation of hydrochloric acid in the same way that the series of the phosphorus acids may be looked upon as resulting from the oxidation of phosphoretted hydrogen—

ClH	Hydrochloric acid	PH_3	Phosphuretted hydrogen
$ClH\Theta$	Hypochlorous acid	$PH_3\Theta$	Unknown
$ClH\Theta_2$	Chlorous acid	$PH_3\Theta_2$	Hypophosphorous acid
$ClH\Theta_3$	Chloric acid	$PH_3\Theta_3$	Phosphorous acid
$ClH\Theta_4$	Perchloric acid	$PH_3\Theta_4$	Phosphoric acid

Dr. Odling, who has investigated this subject, has, in fact, shown the formation of hypochlorous acid by submitting hydrochloric acid to the action of oxygen under the influence of platinum black.

Analogous series exist in organic chemistry—

Ꞓ_2H_4	Ethylene	Ꞓ_7H_6	
$\text{Ꞓ}_2H_4\Theta$	Oxide of ethylene (aldehyde)	$\text{Ꞓ}_7H_6\Theta$	Hydride of benzoyl
$\Theta_2H_4\Theta_2$	Acetic acid	$\text{Ꞓ}_7H_6\Theta_2$	Benzoic acid (salic)
$\Theta_2H_4\Theta_3$	Glycolic acid	$\text{Ꞓ}_7H_6\Theta_3$	Salicylic acid
$\Theta_2H_4\Theta_4$[?]	Glyoxylic acid	$\text{Ꞓ}_7H_6\Theta_4$	Carbohydroquinonic acid
		$\text{Ꞓ}_7H_6\Theta_5$	Gallic acid

† *Répertoire de Chimie pure*, vol. ii., p. 449.

‡ The following considerations will show that all these polysilicic hydrates cannot exist in a free state. The first hydrate—

$$\left.\begin{matrix}Si\\H_4\end{matrix}\right\}\Theta_4$$

can exist; tetratomic silicium can, in fact, unite with four monatomic groups $(H\Theta)'$. But, in the hydrates which contain several atoms of silicium, part of the affinities of the silicium and the oxygen must be employed to join these atoms together, without which the molecular edifice would fall to pieces. The most probable supposition is to admit that the atoms of silicium are joined to each other by the atoms of oxygen. Now, to join n atoms of silicium, there must be $n-1$ atoms of oxygen. The latter deprive the silicium of $2(n-1)$ affinities; and if we subtract $2(n-1)$ from the sum of the affinities

$\left.\begin{matrix}\mathrm{Si}\\\mathrm{H}_2\end{matrix}\right\}\Theta_3$	$\left.\begin{matrix}\mathrm{Si}_2\\\mathrm{H}_6\end{matrix}\right\}\Theta_7$	$\left.\begin{matrix}\mathrm{Si}_3\\\mathrm{H}_{10}\end{matrix}\right\}\Theta_{11}$	$\left.\begin{matrix}\mathrm{Si}_4\\\mathrm{H}_{14}\end{matrix}\right\}\Theta_{15}$	$\left.\begin{matrix}\mathrm{Si}_6\\\mathrm{H}_{22}\end{matrix}\right\}\Theta_{23}$
	$\left.\begin{matrix}\mathrm{Si}_2\\\mathrm{H}_4\end{matrix}\right\}\Theta_6$	$\left.\begin{matrix}\mathrm{Si}_3\\\mathrm{H}_8\end{matrix}\right\}\Theta_{10}$	$\left.\begin{matrix}\mathrm{Si}_4\\\mathrm{H}_{12}\end{matrix}\right\}\Theta_{14}$	” ”
$\left.\begin{matrix}\mathrm{Si}\\(\mathrm{C}_2\mathrm{H}_5)_4\end{matrix}\right\}\Theta_4$	$\left.\begin{matrix}\mathrm{Si}_2\\\mathrm{H}_2\end{matrix}\right\}\Theta_5$	$\left.\begin{matrix}\mathrm{Si}_3\\\mathrm{H}_6\end{matrix}\right\}\Theta_9$	$\left.\begin{matrix}\mathrm{Si}_4\\\mathrm{H}_{10}\end{matrix}\right\}\Theta_{13}$	$\left.\begin{matrix}\mathrm{Si}_6\\\mathrm{H}_{12}\end{matrix}\right\}\Theta_{18}$
Tetrethylic silicate.	Silicic hydrate of Fuchs.	$\left.\begin{matrix}\mathrm{Si}_3\\\mathrm{H}_4\end{matrix}\right\}\Theta_8$	$\left.\begin{matrix}\mathrm{Si}_4\\\mathrm{H}_8\end{matrix}\right\}\Theta_{12}$	” ”
$\left.\begin{matrix}\mathrm{Si}\\2\mathrm{Mg}''\end{matrix}\right\}\Theta_4$ Peridot		Silicic hydrate of M. Fremy.	$\left.\begin{matrix}\mathrm{Si}_4\\\mathrm{H}_6\end{matrix}\right\}\Theta_{11}$	$\left.\begin{matrix}\mathrm{Si}_6\\\mathrm{H}_8\end{matrix}\right\}\Theta_{16}$
$\left.\begin{matrix}\mathrm{Si}\\2\mathrm{Gl}\end{matrix}\right\}\Theta_4$ Phenacite.	$\left.\begin{matrix}\mathrm{Si}_2\\\overset{\text{vi}}{\mathrm{Al}_2}\\\mathrm{Ca}''\end{matrix}\right\}\Theta_8$ Anorthite.	$\left.\begin{matrix}\mathrm{Si}_3\\\mathrm{H}_2\end{matrix}\right\}\Theta_7$ Hydrate of Doveri.	$\left.\begin{matrix}\mathrm{Si}_4\\\overset{\text{vi}}{\mathrm{Al}_2}\\\mathrm{Na}_2\mathrm{H}_6\end{matrix}\right\}\Theta$ Analcime.	$\left.\begin{matrix}\mathrm{Si}_6\\2\overset{\text{vi}}{\mathrm{Al}_2}\\6\mathrm{Ca}''\end{matrix}\right\}\Theta_{24}$ Grossulaire.
$\left.\begin{matrix}\mathrm{Si}\\2\mathrm{Zn}''\end{matrix}\right\}\Theta_4$ Willemite.	$\left.\begin{matrix}\mathrm{Si}_2\\\mathrm{Ca}''\\\mathrm{H}_4\end{matrix}\right\}\Theta_7$ Okenite.	$\left.\begin{matrix}\mathrm{Si}_3\\2\mathrm{Mg}''\\\mathrm{H}_4\end{matrix}\right\}\Theta_{10}$ Magnesite.§	$\left.\begin{matrix}\mathrm{Si}_4\\\mathrm{Al}_2\\2\mathrm{K}\end{matrix}\right\}\Theta_{12}$ Amphigene.	$\left.\begin{matrix}\mathrm{Si}_6\\2\overset{\text{vi}}{\mathrm{Al}_2}\\6\mathrm{Fe}''\end{matrix}\right\}\Theta_{24}$ Almandine (Oriental garnet).
$\left.\begin{matrix}\mathrm{Si}\\\overset{\text{iv}}{\mathrm{Zr}}\end{matrix}\right\}\Theta_4$ Zircon.				
$\left.\begin{matrix}\mathrm{Si}\\(\mathrm{C}_2\mathrm{H}_5)_2\end{matrix}\right\}\Theta_3$ Diethylic silicate.	$\left.\begin{matrix}\mathrm{Si}_2\\\mathrm{Ca}''\\\mathrm{Mg}''\end{matrix}\right\}\Theta_6$ Diopside.	$\left.\begin{matrix}\mathrm{Si}_3\\\overset{\text{vi}}{\mathrm{Al}_2}\\\mathrm{Ca}''\end{matrix}\right\}\Theta_{10}$ Labradorite.	$\left.\begin{matrix}\mathrm{Si}_4\\\overset{\text{vi}}{\mathrm{Al}_2}\\\mathrm{H}_2\end{matrix}\right\}\Theta_{12}$ Pyrophyllite.	$\left.\begin{matrix}\mathrm{Si}_6\\\overset{\text{vi}}{\mathrm{Al}_2}\\3\mathrm{Gl}''\end{matrix}\right\}\Theta_{18}$ Emerald.
$\left.\begin{matrix}\mathrm{Si}\\\mathrm{Mg}''\end{matrix}\right\}\Theta_3$ Enstatite.	$\left.\begin{matrix}\mathrm{Si}_2\\(\mathrm{C}_2\mathrm{H}_5)_2\end{matrix}\right\}\Theta_5$ Diethylic disilicate.	$\left.\begin{matrix}\mathrm{Si}_3\\\overset{\text{vi}}{\mathrm{Fe}_2}\end{matrix}\right\}\Theta_9+12\mathrm{aq}.$ Chlorophæite.	$\left.\begin{matrix}\mathrm{Si}_4\\3\mathrm{Mg}''\\\mathrm{H}_2\end{matrix}\right\}\Theta_{12}$ Talc.	$\left.\begin{matrix}\mathrm{Si}_6\\\overset{\text{vi}}{\mathrm{Al}_2}\\\mathrm{K}_2\end{matrix}\right\}\Theta_{16}$ Orthose felspar.

It is clear that this theory allows us to conceive, and even to predict, the existence of innumerable silicates. Their constitution and the formulæ which represent them are not always very simple, and, in a large number of cases, cannot be so. One thing, however, is simple and rational—viz., their mode of generation, which is based on the one hand upon the principle of *the accumulation of the polyatomic radicals*, and on the other hand upon the *successive dehydration* which may be undergone by hydrates containing polyatomic radicals. These principles, which govern the constitution of a crowd of organic compounds, are susceptible of a great number of applications in inorganic chemistry and in mineralogy. We will give some new examples of them:—

1st. Glycerine contains—

$$\left.\begin{matrix}(\mathrm{C}_3\mathrm{H}_5)'''\\\mathrm{H}_3\end{matrix}\right\}\Theta_3$$

It may form, by losing $\mathrm{H}_2\Theta$, glycide—

$$\left.\begin{matrix}(\mathrm{C}_3\mathrm{H}_5)'''\\\mathrm{H}\end{matrix}\right\}\Theta_2$$

whose curious combinations were made known by M. Reboul.‖

The hydrates of aluminium, of iron, and their analogues may similarly suffer a partial decomposition—

$\left.\begin{matrix}\overset{\text{vi.}}{\mathrm{Al}_2}\\\mathrm{H}_6\end{matrix}\right\}\Theta_6$ Gibbsite.	$\left.\begin{matrix}\overset{\text{vi.}}{\mathrm{Al}_2}\\\mathrm{H}_4\end{matrix}\right\}\Theta_5$	$\left.\begin{matrix}\overset{\text{vi.}}{\mathrm{Al}_2}\\\mathrm{H}_2\end{matrix}\right\}\Theta_4$ Diaspore.	$\overset{\text{vi.}}{\mathrm{Al}_2}\Theta_3$ Corundum.
$\left.\begin{matrix}\overset{\text{vi.}}{\mathrm{Fe}}\\\mathrm{H}_6\end{matrix}\right\}\Theta_6$ Ferric hydrate.	”	$\left.\begin{matrix}\overset{\text{vi.}}{\mathrm{Fe}_2}\\\mathrm{H}_2\end{matrix}\right\}\Theta_4$ Goethite.	
		$\left.\begin{matrix}\overset{\text{vi.}}{\mathrm{Mn}_2}\\\mathrm{H}_2\end{matrix}\right\}\Theta_4$ Manganite.	
		$\left.\begin{matrix}\overset{\text{vi.}}{\mathrm{Ur}_2}\\\mathrm{H}_2\end{matrix}\right\}\Theta_4$ Uranic hydrate.	

There exist salts corresponding to these different hydrates. Such are disthene and the spinels—

$\left.\begin{matrix}\overset{\text{vi.}}{\mathrm{Al}_2}\\\overset{\text{iv.}}{\mathrm{Si}}\end{matrix}\right\}\Theta_5$ Disthene.	$\left.\begin{matrix}\overset{\text{vi.}}{\mathrm{Al}_2}\\\mathrm{Mg}''\end{matrix}\right\}\Theta_4$ Spinel.

2nd. M. Lourenço¶ has shown that several molecules of glycerine may unite with elimination of water, and form polyglyceric combinations—

$$2\left[\left.\begin{matrix}\mathrm{C}_3\mathrm{H}_5\\\mathrm{H}_3\end{matrix}\right\}\Theta_3\right]=\left.\begin{matrix}\mathrm{C}_3\mathrm{H}_5\\\mathrm{C}_3\mathrm{H}_5\\\mathrm{H}_4\end{matrix}\right\}\Theta_5+\mathrm{H}_2\Theta.$$

Pyroglycerine.

$$2\left[\left.\begin{matrix}\mathrm{C}_3\mathrm{H}_5\\\mathrm{H}_3\end{matrix}\right\}\Theta_3\right]=\left.\begin{matrix}\mathrm{C}_3\mathrm{H}_5\\\mathrm{C}_3\mathrm{H}_5\\\mathrm{H}_2\end{matrix}\right\}\Theta_4+2\mathrm{H}_2\Theta.$$

Pyroglycide.

$$3\left[\left.\begin{matrix}\mathrm{C}_3\mathrm{H}_5\\\mathrm{H}_3\end{matrix}\right\}\Theta_3\right]=\left.\begin{matrix}3(\mathrm{C}_3\mathrm{H}_5)\\\mathrm{H}_5\end{matrix}\right\}\Theta_7+2\mathrm{H}_2\Theta.$$

$$3\left[\left.\begin{matrix}\mathrm{C}_3\mathrm{H}_5\\\mathrm{H}_3\end{matrix}\right\}\Theta_3\right]=\left.\begin{matrix}3(\mathrm{C}_3\mathrm{H}_5)\\\mathrm{H}_3\end{matrix}\right\}\Theta_6+3\mathrm{H}_2\Theta.$$

The bodies thus formed constitute, in a manner, basic hydrates. Similarly limonite constitutes a basic ferric hydrate—

$$2\left[\left.\begin{matrix}\overset{\text{vi.}}{\mathrm{Fe}_2}\\\mathrm{H}_6\end{matrix}\right\}\Theta_6\right]=\left.\begin{matrix}2\overset{\text{vi.}}{\mathrm{Fe}_2}\\\mathrm{H}_6\end{matrix}\right\}\Theta_9+3\mathrm{H}_2\Theta.$$

Limonite.

It is evident that in such hydrates the basic hydrogen may be replaced by radicals of acids. We thus obtain basic salts, of which the polyethylenic and polyglyceric ethers are the representatives in organic chemistry, and of which very numerous examples are known in inorganic chemistry.

Let us first take the constitution of the basic ethers in question—

$\left.\begin{matrix}\mathrm{C}_2\mathrm{H}_4\\\mathrm{C}_2\mathrm{H}_4\\(\mathrm{C}_2\mathrm{H}_3\Theta)_2\end{matrix}\right\}\Theta_3$ Diethylenic diacetate.	$\left.\begin{matrix}\mathrm{C}_2\mathrm{H}_4\\\mathrm{C}_2\mathrm{H}_4\\\mathrm{C}_2\mathrm{H}_4\\(\mathrm{C}_2\mathrm{H}_3\Theta)_2\end{matrix}\right\}\Theta_4$ Triethylenic diacetate.	$\left.\begin{matrix}\mathrm{C}_2\mathrm{H}_4\\\mathrm{C}_2\mathrm{H}_4\\\mathrm{C}_2\mathrm{H}_4\\\mathrm{C}_2\mathrm{H}_3\Theta\\\mathrm{H}\end{matrix}\right\}\Theta_4$ Triethylenic monacetate.

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residing in n atoms of silicium (that is to say, from $4n$), the difference $4n-2(n-1)=2(n+1)$ will express the affinities remaining in the chain of n atoms of silicium united by $n-1$ atoms of oxygen. The silicic hydrate, which is the richest in hydrogen, is therefore—

$$\mathrm{Si}_n+\Theta_{(n-1)}+(\mathrm{H}\Theta)_{2(n+1)}$$

If we make $n=3$, the trisilicic hydrate containing the greatest amount of hydrogen will be—

$$\mathrm{Si}_3\Theta_2(\mathrm{H}\Theta)_8=\left.\begin{matrix}\mathrm{Si}_3\\\mathrm{H}_8\end{matrix}\right\}\Theta_{10}$$

The following formula expresses the mutual relations existing between the atoms of such a hydrate:—

$$\begin{array}{l}\mathrm{Si}-(\mathrm{H}\Theta)_3\\|\\\Theta\\|\\\mathrm{Si}-(\mathrm{H}\Theta)_2\\|\\\Theta\\|\\\mathrm{Si}-(\mathrm{H}\Theta)_3\end{array}$$

§ Or, $\left.\begin{matrix}\mathrm{Si}_3\\2\,\mathrm{Mg}\end{matrix}\right\}\Theta_8+2\text{ aq }(\mathrm{Aq}=\mathrm{H}_2\Theta).$

We may similarly decompose the formulæ of okenite, pyrophyllite, analcime, talc, &c.

‖ *Annales de Chimie et de Physique*, 3rd series, vol. lx., p. 5, 1860.

¶ *Comptes Rendus*, vol. lii., p. 369.

It is evident that the basic acetates of lead and copper are the analogues of these ethers—

$$\left.\begin{matrix}\mathrm{Cu}''\\ \mathrm{Cu}''\\ (\mathrm{C_2H_3\Theta})_2\end{matrix}\right\}\Theta_2+3\mathrm{aq.}\qquad\qquad \left.\begin{matrix}\mathrm{Cu}\\ \mathrm{Cu}\\ \mathrm{Cu}\\ (\mathrm{C_2H_3\Theta})_2\end{matrix}\right\}\Theta_4$$

Dicupric diacetate.[**] Tricupric diacetate.

$$\left.\begin{matrix}\mathrm{Pb}\\ \mathrm{Pb}\\ \mathrm{Pb}\\ (\mathrm{C_2H_3\Theta})_2\end{matrix}\right\}\Theta_4+3\mathrm{aq.}\qquad\qquad \left.\begin{matrix}\mathrm{Pb}\\ \mathrm{Pb}\\ \mathrm{Pb}\\ \mathrm{C_2H_3\Theta}\\ \mathrm{H}\end{matrix}\right\}\Theta_4.$$

Triplumbic diacetate. Triplumbic monacetate (called sexbasic acetate).

(To be continued.)

The Formation of the Secondary Monamines of the Phenylic and Toluylic Series, by MM. G. DE LAIRE, CH. GIRARD, *and* P. CHAPOTEAUT.[*]

IN 1864 Dr. A. W. Hofmann discovered diphenylamine and phenyltoluylamine whilst examining the products of the dry distillation of rosaniline and phenylic and toluylic blues; since then he has obtained diphenylamine by decomposing leucaniline and melaniline by heat. But in these instances the diphenylamine and the phenyltoluylamine only appear as the products of the destruction of higher phenylic and toluylic amines.

Numerous experiments have been undertaken to determine the synthesis of these interesting bodies, but without success. M. Lauth, with this intention, made monobromobenzine and also acetate of phenyle react upon aniline. These experiments gave no result; we have also repeated them, but with as little success.

We recollect that in 1860, whilst heating some salts of rosaniline with an excess of aniline, we obtained a blue colouring matter, and an escape of ammonia proportioned to the quantity of blue formed.

In 1863 Dr. A. W. Hofmann interpreted this curious reaction, and formulated it thus—

$$\left.\begin{matrix}\mathrm{C_{12}H_4H}\\ \mathrm{C_{14}H_6H}\\ \mathrm{C_{14}H_6H}\end{matrix}\right\}\mathrm{N_3}+3\left\{\begin{matrix}\mathrm{C_{12}H_5}\\ \mathrm{H}\\ \mathrm{H}\end{matrix}\right\}\mathrm{N}=\left.\begin{matrix}\mathrm{C_{12}H_4,C_{12}H_5}\\ \mathrm{C_{14}H_6,C_{12}H_5}\\ \mathrm{C_{14}H_6,C_{12}H_5}\end{matrix}\right\}\mathrm{N_3}+3\left\{\begin{matrix}\mathrm{H}\\ \mathrm{H}\\ \mathrm{H}\end{matrix}\right\}\mathrm{N}.$$

In a moderately high temperature three equivalents of phenylamine react upon the salt of rosaniline, and phenyl becomes substituted for the hydrogen, equivalent for equivalent.

Noticing this facility of substitution, we surmised that, by the action of aniline on its salts, diphenylamine and ammonia might be produced.

$$\left.\begin{matrix}\mathrm{C_{12}H_5}\\ \mathrm{H}\\ \mathrm{H}\end{matrix}\right\}\mathrm{N}+\left.\begin{matrix}\mathrm{C_{12}H}\\ \mathrm{H}\\ \mathrm{H}\end{matrix}\right\}\mathrm{N}=\left.\begin{matrix}\mathrm{C_{12}H}\\ \mathrm{C_{12}H}\\ \mathrm{H}\end{matrix}\right\}\mathrm{N}+\left.\begin{matrix}\mathrm{H}\\ \mathrm{H}\\ \mathrm{H}\end{matrix}\right\}\mathrm{N}.$$

Experiment confirmed this supposition, and we have the honour of placing before the Academy the result of our researches.

We made aniline react on several of its salts—the sulphate, hydrochlorate, nitrate, arseniate, phosphate—and on the combinations this base forms with the chlorides of zinc, tin, calcium, and mercury. In each case there was disengagement of ammonia, with the production of a greater or less quantity of a matter which perfectly agreed both in its analysis and its various reactions with the formula of diphenylamine $C_{24}H_{11}N$, and the excellent description of it given by Dr. A. W. Hofmann.

Of all the salts of this base hydrochlorate of aniline seems to us best adapted for the purpose of substitution.

Diphenylamine.—In a long-necked flask, furnished with a condensing tube to avoid the loss of any of the aniline, we heat one and a half equivalent of pure aniline with one equivalent of its hydrochlorate to a temperature between 210° and 240°; the diphenylamine begins to form when this temperature is reached, and the commencement of the reaction is indicated by the escape of ammonia; by prolonging the operation thirty or thirty-five hours, an amount of diphenylamine is obtained, which may equal the fifth part of the aniline employed.

The formation of diphenylamine takes place more rapidly and in larger quantity in a sealed vessel and under a pressure of from four to five atmospheres.

In each case the product of the experiment is a compound of hydrochlorate of diphenylamine, hydrochlorate of aniline, some free aniline, and some colouring matters varying in quantity according to whether the operation is performed in an open or closed vessel.

To extract the diphenylamine from this mixture, it must be treated by hydrochloric acid and warm water (twenty or thirty times the weight of the acid); the hydrochlorate of diphenylamine being decomposable by water, the fused base floats on the surface, and forms a mass on cooling. The purification is accomplished by several successive crystallisations from ether or benzine; as the colouring matters are insoluble in these liquids, a single distillation yields a white matter with a boiling-point of 310°.

Ditoluylamine.—Toluidine, being the homologue of aniline, behaves in all its reactions like it, and, therefore, ought to give us its secondary monamine by reacting on its hydrochlorate. The operation is conducted in the same manner, and the conditions of the formation are the same, as in the case of diphenylamine. We have escape of ammonia, then, as the final result of the experiment, a compound of hydrochlorate of the new base, of hydrochlorate of toluidine, of free toluidine, and of some colouring matters.

In dealing with this raw matter, the treatment already employed for diphenylamine must be used—that is to say, hydrochloric acid, water, then several successive crystallisations in ether to separate the colouring matters.

The purified base is solid, crystallised, and perfectly white; its boiling-point is between from 355° to 360°. Several combustions gave us the following formula, which is that of ditoluylamine—namely, $C_{28}H_{15}N$.

The reactions of this new body are very analogous to those of diphenylamine. Like diphenylamine, it combines with acids and produces very unstable combinations, which, on contact with water, separate into their principal constituents.

When nitric acid is poured over the crystals they turn yellow, by which this base may be distinguished from diphenylamine.

Phenyltoluylamine.—This base, which Dr. A. W. Hofmann has already obtained by distilling the toluidine blue, ought to be produced during the reaction of aniline on hydrochlorate of toluidine, and of toluidine on hydrochlorate of aniline. The experiment is performed as though it were for the production of diphenylamine or ditoluylamine. The treatment already followed for the extraction of these two bases from the raw product, hydrochloric acid, water, and several crystallisations in ether, gives us a perfectly white base.

In the reaction of aniline on hydrochlorate of toluidine, and still more in that of toluidine on hydrochlorate of aniline, the purified product is a mixture of diphenyl-

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[**] It is possible that this salt may be a monocupric monacetate—

$$\left.\begin{matrix}\mathrm{Cu}\\ (\mathrm{C_2H_3\Theta})'\\ \mathrm{H}\end{matrix}\right\}\Theta_2+\mathrm{H_2\Theta}.$$

[*] *Comptes Rendus*, t. lxiii., p. 91.

amine, phenyltoluylamine, and ditoluylamine. In order to isolate respectively these three bases, we have been forced to make use of fractional distillation; their separation is as difficult as that of aniline from toluidine, their boiling-point only differing from about 25° to 30°. The boiling-point of pure phenyltoluylamine is about 330°. Analysis gives it this formula—$C_{26}H_{13}N$.

We have already stated that the operations performed in a closed vessel occupy much less time than those performed in an open one; but in both cases, if the operation lasts too long, the quantity of secondary monamines is diminished. Bodies are produced, probably the tertiary monamines of aniline and toluidine, with boiling-points exceeding any temperature observable with mercurial thermometers.

TECHNICAL CHEMISTRY.

On the Employment of Nitroglycerine in Quarries, *by M.* E. Kopp.*

The explosive properties of nitroglycerine $C_6H_5(NO_4)_3O_6$, and the accounts of experiments made with it in different parts of Sweden, Germany, and Switzerland, determined MM. Schmitt and Dietsch, the proprietors of the great quarries of sandstone in the valley of Zorn, Lower Rhine, to try to use it in their works.

The trial proved so successful, both as regards economy and the ease and rapidity with which the work was performed, that, for the time at least, they have abandoned the use of powder, and the quarries have been entirely worked by nitroglycerine for six weeks.

From the first we have considered that the nitroglycerine should be prepared on the spot; it always seemed to us the transport of an explosive compound of such frightful power ought not to be allowed either by land or water. The terrible accidents which have happened at Aspinwall and at San Francisco, justify these fears, and the transport of nitroglycerine should be positively forbidden.

After having, with M. Keller's assistance, studied in my laboratory the different processes of the preparation of nitroglycerine (mixtures of glycerine with concentrated sulphuric acid and nitrates of potash and soda or with nitric acids of different concentrations), we have determined on the following method of manufacture, which is performed in a wood cabin, constructed in one of the quarries.

I. Preparation of Nitroglycerine.—We begin by mixing in an earthenware vessel placed in cold water some fuming nitric acid at 49° or 50° Baumé (1·51—1·53) with twice its weight of the strongest sulphuric acid. These acids are purposely prepared at Dieuze, and sent on to Saverne. At the same time we evaporate in a pot some commercial glycerine free from both lime and lead, until it makes 30° or 31° Baumé (1·26—1·27). This concentrated glycerine should, after cooling, have a syrupy consistence.

The workman then throws 3300 grammes of a mixture of sulphuric and nitric acids well cooled into a glass flask (a pot of earthenware or a capsule of porcelain might equally be employed) placed in a trough of cold water, and then he slowly pours into it, stirring it continually, 500 grammes of glycerine. The thing to be observed is the avoidance of any sensible heating of the mixture, which would determine a tumultuous oxidisation of the glycerine and the production of oxalic acid. For this reason it is that the vessel in which the transformation of the glycerine into nitroglycerine takes place, should be constantly cooled externally by cold water.

When the materials are thoroughly mixed, the whole must be left for five or ten minutes; then pour the mixture into five or six times its volume of cold water, to which a rotatory movement must first be imparted. The nitroglycerine precipitates very rapidly under the form of a heavy oil, which is collected by decantation into a vessel; then wash it with a little water which is in its turn decanted, pour the nitroglycerine into bottles, and it is ready for use.

In this state, the nitroglycerine is still slightly acid and watery; but this is of no importance, since, as it is employed soon after its preparation, these impurities in no degree prevent detonation.

II. Properties of Nitroglycerine.—Nitroglycerine is a yellow or brownish oil, heavier than water and insoluble in it, but soluble in ether, alcohol, &c.

Exposed to a prolonged but not intense amount of coldness, it crystallises in long needles. A violent shock best causes it to detonate. The handling of it is now easy and only slightly dangerous. Spread upon the ground it is only with difficulty fired by a body in combustion, and then only burns partially; a flask containing nitroglycerine may be broken upon stones without its detonating; it may be volatilised without decomposition by a regulated heat, but if it boils, detonation becomes imminent.

A drop of nitroglycerine falling on a metal plate moderately heated volatilises quietly. If the plate be red-hot, the drop is immediately fired and burns like a grain of powder, only noiselessly; but if the plate, without being red-hot, is hot enough to make the drop boil immediately, it decomposes suddenly with a violent detonation.

Nitroglycerine, especially when impure and acid, decomposes spontaneously after a certain time, with an escape of gas and the production of oxalic and glyceric acid.

Probably the spontaneous explosions of nitroglycerine, with whose disastrous effects the papers have acquainted us, are owing to the same cause. The nitroglycerine being enclosed in well-corked bottles, the gases produced by its spontaneous combustion cannot escape; they then exercise an immense pressure on the nitroglycerine, and in this state the least shock and the slightest movement will cause an explosion.

The flavour of nitro-glycerine is at once sweet, piquant, and aromatic; it is poisonous, and taken in small doses it produces bad headaches. Its vapour produces similar effects, and this reason might well prove an objection to its use in the subterranean galleries of mines, where its vapours cannot disperse as they do in open-air quarries.

Nitroglycerine is not, properly speaking, a nitrated body, such as nitro- or binitro-benzol, or mono- bi- and trinitro-phenisic acids. Indeed, under the influence of reducing bodies, such as nascent hydrogen, sulphuretted hydrogen, &c., the glycerine is set at liberty, and the caustic alkalies decompose the nitroglycerine into nitrates and glycerine.

III. Modes of employing Nitroglycerine.—Suppose the object is to detach a stratum of rocks. At 2·50 to 3 metres distance from the exterior border sink a mining hole about 5 or 6 centimetres in diameter and 2 or 3 metres in depth.

After having thoroughly cleared all mud, water, and sand out of the hole, pour into it, through a funnel, from 1500 to 2000 grammes of nitroglycerine. Then immerse

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* *Comptes Rendus*, t. lxiii., page 189.

in it a little cylinder of wood, pasteboard, or tin, about 4 centimetres in diameter, and from 5 to 6 centimetres in height, and filled with ordinary powder. This cylinder is fixed to an ordinary mining fuse, which goes down a certain depth to insure the combustion of the powder. The cylinder is lowered by means of the wick or fuse; the moment the cylinder reaches the surface of the nitroglycerine, may easily be known by the touch. When it touches the surface, hold it perfectly still, and pour sand into the hole until it is quite full; there is no need to compress or plug the sand. Cut the wick some centimetres from the orifice of the hole, and then set fire to it. In about eight or ten minutes the match burns down to the powder and fires it. Then ensues a violent shock, which immediately causes the detonation of the nitroglycerine. The explosion is so sudden that the sand is not even projected.

The whole mass of the rock rises, is displaced, then resettles without any projection; only a dull detonation is heard.

Only on examining the spot can an idea be formed of the power of the force developed by the explosion. Formidable masses of rock are slightly displaced and rent in every direction, and ready to be removed mechanically.

The chief advantage is that the stone is only slightly crushed, and there is very little waste.

In the manner we have shown, from 40 to 80 cubic metres of rock may be detached by charges of nitroglycerine.

We trust to have shown by this notice the possibility of reconciling the employment of nitroglycerine with every desirable guarantee for public safety.

PROCEEDINGS OF SOCIETIES.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, by Dr. Percy, F.R.S.

Lecture No. VII.

(Continued from page 57.)

There is one peculiar kind of decomposition, or one singular example of it, to which I must invite your attention—namely, that of the sulphide of silver. Here we have a grey compound consisting of sulphur and silver. If I take those two bodies and melt them together, which I can easily do, they combine, producing this dark grey compound. This is the same stuff which forms the well-known tarnish of silver, which occurs especially in an atmosphere impregnated with animal emanations, as London and elsewhere. Now, if we take this sulphide of silver (AgS), and heat it in a glass tube to a moderate temperature, and then pass steam, the vapour of water, over it, we effect a complete reduction; we remove the whole of the sulphur and obtain the silver in the metallic state. We do not here get oxidised silver. There is no doubt the silver is oxidised first of all, but that oxide is immediately decomposed, because oxide of silver cannot exist even at a red heat. It is decomposed even at the temperature which suffices for the decomposition of the sulphide by means of the steam. Again, if we pass hydrogen over sulphide of silver at a red heat, we can remove the whole of the sulphur, and leave the silver in a metallic state. Well, what is the point of this? It is this: in nature we find that well-known and beautiful ornament of our cabinets—capillary silver. Now, if we reduce sulphide of silver, by the means I have described, at a red heat, we get the metallic silver left precisely in this capillary state. I will effect the decomposition of some sulphide of silver, but I do not intend to do it by means of the vapour of water, as there would be danger of the tube cracking. I will do it by means of hydrogen gas. We are about to liberate hydrogen gas from this flask by means of the action of diluted sulphuric acid upon zinc, and then pass it into a tube containing sulphide of silver. The silver is precipitated, and the gas becomes converted into sulphuretted hydrogen—that fœtid gas which has the odour of rotten eggs. The sulphuretted hydrogen passes on into the adjoining vessel, which contains a salt of lead in solution. The solution is immediately blackened, the lead being precipitated by the sulphur of the sulphuretted hydrogen. Thus we take the sulphur from the silver by means of hydrogen gas, and then we take the sulphur from the hydrogen by means of lead. It is impossible for me to render this fully manifest to you at a distance, but after the lecture you will have an opportunity of inspecting the changes for yourselves. Here are specimens we have prepared presenting beautiful illustrations of the formation of capillary silver in nature. It is suggested by Bischoff that steam has been the agent of the production of this natural capillary silver. A good deal may be said about this matter. We get a similar formation in copper-smelting operations—hair copper, or moss copper, as it is called. Here are specimens, but you will have to examine them with a small lens in order to detect the formation to which I allude. Of course in nature we find very much larger threads than those which I present to you now; that, as usual, is merely a question of time.

Now as to the spontaneous decomposition of some of these sulphides. You will observe that I am dealing with these points now in a most general way, reserving certain specialties for the sequel. Some of these sulphides undergo spontaneous decomposition. One of the best examples is that of iron pyrites, to which I shall invite your special attention directly, as a compound of sulphur and iron in the proportion of one equivalent of iron to two of sulphur. There are well-known crystallographic varieties of that mineral. There is one called white iron pyrites, crystallising in the prismatic system; and there is cubical iron pyrites, crystallising in the cubical system. This it is which is more especially liable to spontaneous decomposition. It becomes oxidised by exposure to moist air; and when it occurs in masses, and is subjected to oxidation in this way, sufficient heat is sometimes generated by the action to ignite surrounding carbonaceous matter. There is no doubt that spontaneous ignition in coal mines has in many cases been due to the heat developed by the slow oxidation of this pyrites. Then as the result of the oxidation, or weathering action, we get certain sulphates of iron—sulphates of the peroxide of iron, several of which occur in nature, and very beautiful, though not very common, minerals they are. We have very fine specimens of some of these sulphates from South America. One of the best examples I can mention is the sulphate resulting from the weathering of these sulphides in coal measures. We shall see that all coal contains iron pyrites, without exception. I think I may state that without fear of contradiction. The pyrites undergoes decomposition by moist air, forming a sulphate of peroxide of iron, of a yellow colour. This is a very important matter, because upon the weathering action often depends the disintegration of coal, and coal which is subject to such disintegration is entirely unfit for steam purposes. It is, therefore, an object to get a coal free from disseminated pyrites to any extent for such use. As another result of weathering action, or oxidation by moist air, I will call your attention to a very beautiful mineral first got in the island of Anglesey, and hence called anglesite. It is a sulphate of lead. In South America some specimens of this have been found, perhaps the finest in the world. Now, there is no difficulty in understanding how we should get sulphate of lead by the oxidation of sulphide of lead. This is an ore of lead, galena, a compound of lead and sulphur. The chemical symbol for lead is Pb, from the Latin *plumbum*. Sulphide of lead is therefore represented by PbS. Sulphate of lead is nothing more than oxide of lead (PbO) and sulphuric acid (SO_3), using the old method of notation to which I adhere in these lectures. You see that by a simple addition of oxygen to these elements PbS, which represent sulphide of lead, you get the mineral in question, $PbOSO_3$, which is sulphate of lead. Sulphate of lead has been found very largely in an ore in Australia. They are receiving hundreds of tons of it at a smelting works in South Wales, the lead existing entirely as sulphate.

There is another point of interest which comes in here. On lead ore which has been exposed to weathering action and oxidised, we find not only sulphate of lead, but carbonate of lead. How are we to account for this carbonate of lead being formed as a result of weathering action? How can we explain the carbonic acid? Well, on thinking on this matter we soon come to the conclusion that there must be a secondary action at work here; and there is a *vera causa* quite ready at hand, which explains the thing at once. In mineral lodes and veins, where this action takes place, there is often water percolating containing carbonate of lime in solution, dissolved by virtue of an excess of carbonic acid. Now, galena frequently occurs in limestone formations, and when we see a piece of carbonate of lead, or white lead, on a piece of galena, that is clearly the result of weathering action, and you may be quite sure that sulphate of lead has been first formed, and has been, perhaps, decomposed, *pari passu*, by the carbonate of lime in the water. We get, then, the conditions under which carbonate of lead may be formed. Sulphate of lead, we know, is immediately decomposed by the action of carbonate of lime, and therefore we are left in no doubt as to the way in which we can account for the natural mineral carbonate of lead.

The formation of the sulphides is a subject of very great interest. We can form them directly in many cases, but not all, by heating sulphur and the metal together. We could not form sulphide of gold in this way, because that compound is decomposed by a gentle heat; but the sulphides of all the metals combining with sulphur we can obtain either directly or indirectly. Here is disulphide of copper, ruthite, obtained by treating the metal with sulphur. We can, in fact, form iron pyrites by an aqueous process, but only at a low temperature and under special conditions. Here is a small specimen of iron pyrites so formed. The crystals are distinct, though their form cannot be recognised except under a magnifying glass. It is formed by a special process; but more of that hereafter. It is a process described by Wöhler, and discovered by him. Here is a sample of bisulphide of tin.

We get sulphides formed in nature by a sort of roundabout way. For instance, there is the beautiful mineral pyromorphite or phosphate of lead, which we find completely converted into sulphide of lead. We know that this conversion has taken place, because such sulphide of lead has the crystalline form of the phosphate of lead, and not that of the sulphide. It has been formed by the action of a sulphur compound upon phosphate of lead, and that compound must be one of two—either a sulphide or a sulphate.

Let us take for special consideration that most interesting sulphide—interesting in the highest degree to the geologist—the bisulphide of iron, iron pyrites. This is composed of one equivalent of iron and two of sulphur, FeS_2. When heated in a close vessel it loses about half its sulphur—not exactly, *about* half, I say; and it then forms very nearly a protosulphide of iron, but not quite. It occurs in nature beautifully crystallised in the cubical system—either in cubes, sometimes of large dimensions, and striated in a curious way, or in some figure derived from the cube. In this form it is known as common yellow iron pyrites. It also crystallises in the prismatic system. There are specimens of both forms before you. Heated with access of air it burns, and when ignited will continue to burn without the further addition of fuel. Sulphurous acid is produced — the sulphurous acid of commerce, which plays so large a part in the history of the world, for all soap is produced by means of it from chloride of sodium, common salt. There is in connexion with the subject of iron pyrites a piece of history which shows what curious mistakes may be made by monarchs. A great many years ago we were very much troubled by the late King of Naples, who possessed a monopoly of sulphur, putting on high prohibitory duties on sulphur exported from his territory. At that time sulphuric acid was made almost entirely from native sulphur obtained from Naples and elsewhere. Well, our people were determined, of course, not to submit to this restriction, and it immediately occurred to chemists that iron pyrites might be a very valuable source of sulphur. Means were taken for its extraction, and this bisulphide of iron has now become the chief source of sulphur for the manufacture of sulphuric acid, or a very large source at all events. You see, people may sometimes outwit themselves in matters of this kind. There is only one drawback to the use of the sulphur of the pyrites: that is it contains not unfrequently a little arsenic, and, of course, that arsenic will get into the sulphuric acid, or it may get there.

Now as to the mode of formation of bisulphide of iron in nature, or, rather, as to the conditions under which it may have been formed. First of all, its association with certain minerals proves to us, in the clearest and most unmistakable manner possible, that it may be formed—nay, *has been* formed very largely—in the wet way, that is, by the agency of liquids, in some way or other, from solutions, without the aid of intense heat. Take this little specimen. How apparently insignificant it is! It is nothing more than a little bit of clay iron ore. Well, what is clay iron ore? Nothing more than carbonate of protoxide of iron mixed with certain other bodies. It is the chief ore of iron in this country, and one occurring especially in our coal measures. Well, we may take a lump of it, break it open, and find a concretion in the centre consisting of a cube of iron pyrites. Now, from certain considerations we are perfectly sure that this carbonate of iron must have been produced from liquids or from solution. It cannot exist at a high temperature. Well, in the centre of this globule we find iron pyrites. I think that can leave no doubt of the fact of the pyrites being formed by the action of water, or, at all events, by the agency of liquids. Well, here is another specimen of common clay iron ore coated with carbonate of iron, and upon these delicate crystals of carbonate of iron I find iron pyrites deposited. We are perfectly certain that the pyrites must have been produced by the agency of liquids, because the carbonate of iron upon which it is found cannot exist at a high temperature. Of that we are perfectly certain. Further, Bischoff tells us that iron pyrites has actually been obtained crystallised artificially from solutions. There is a well-known experiment, or the result of one, very often mentioned in works on chemical geology. I allude to the formation of iron pyrites upon the remains of an unfortunate mouse which happened to tumble into a bottle of sulphate of iron. The animal matter suffered decomposition; certain gaseous sulphurous products were evolved, and by the agency of them sulphide of iron was formed. We have tried to imitate that, but unfortunately the experiment failed. The process was allowed about three years, but the air got access. There seems to be no doubt, however, about the story told by Bischoff. Well, then, here are two kinds of proofs of the production of iron pyrites in the wet way. There is the direct laboratory proof of the formation of it in that way, and there is the indirect proof, if I may call it such—though it is rather direct than otherwise—of the occurrence of this bisulphide of iron with certain mineral matters which never could have been exposed to a high temperature. I may mention these specimens, of which you will find a large quantity at the base of the cliff at Eastbourne. They drop out occasionally from the cliff. They are nodules of iron pyrites.

With regard to the possibility of the occurrence of conditions suitable to the formation of iron pyrites in nature, I will draw your attention hereafter to certain cases put forward by Bunsen. We find in the laboratory that in certain alkaline solutions, when there is a large excess of bisulphide of potassium or sodium, we sometimes get a dark green solution. That is due to a sulphide of iron, apparently dissolved in the alkaline sulphide. In the formation of ultramarine, after washing the product with water, we get this green solution, which lets fall, on standing, bisulphide of iron. No doubt, in the first instance, this was entirely dissolved. Now comes the question, whether in nature we might not meet conditions exactly similar to this, whereby bisulphide of iron may have been generated. There are strong reasons to believe we may.

There are many other sulphides of great interest, but we must pass over them pretty rapidly.

I will next call your attention to another combination of sulphur and iron, magnetic iron pyrites, which occurs rather abundantly in nature, at least in some places. Here is a specimen of it—Norwegian iron pyrites. It occurs in Norway to a large extent. We have it also in Argyle in Scotland. It does not often occur well crystallised. It consists of seven equivalents of iron and eight of sulphur, Fe_7S_8. Or you will find that it can be represented by six equivalents of protosulphide of iron and one equivalent of bisulphide. Suppose we regard it as such—

$$6FeS + FeS_2.$$

I do not for a moment mean to assert that the elements are actually combined in this magnetic pyrites as they are represented in the last formula. All I mean to say is, that by that formula we may represent its rational composition. The chief interest in connexion with this sulphide is the occurrence of sulphide of nickel with it, and accordingly, as nickel is a valuable metal, constituting the whitening agent in the well-known variety of brass called German silver; this magnetic pyrites is a valuable ore, and has been largely worked for the sake of its nickel, though not to the extent that some people may desire. We have the occurrence of nickeliferous pyrites in Scotland. The quantity of nickel varies from two or three to about seven per cent. I call your attention to this fact more particularly because, should any person present, in travelling in different parts of the world, stumble upon magnetic iron pyrites, it is worth while to search for the presence of nickel in it.

The next natural sulphide of which I will speak is galena, sulphide of lead. You have here very fine specimens before you. I have already referred to some of its properties. Sulphide of lead crystallises in the cubical system. It is frequently met with in fine cubes, or in some modification of the cube. We can form it directly by the agency of fire. You see there a specimen of sulphuret of lead beautifully crystallised. You may have mistaken it for bismuth. We can obtain it well crystallised by the operation of heat. I told you that in certain furnace operations I have seen it deposited in the form of crystals, and in roasting furnaces you see it deposited on the surface of the roasting ore. But there is also no doubt whatever that sulphide of lead may be produced crystallised by aqueous action. We can generate it fast enough by passing sulphuretted hydrogen into a salt of lead in solution. The sulphuretted hydrogen becomes decomposed, hydrogen is set free, and sulphide of lead is formed. Take that brownish powder, the sulphide of lead, which is formed: now, can we crystallise that by means of a solvent, or, rather, can Nature do so? Our powers of operating are very limited. We can only use our hands, mixing one substance with another—our power is limited to that. But when we by our spontaneous action have brought the different bodies together, then Nature does her work. Well, here is a specimen of clay iron ore which we know has been deposited from water; and in the centre of that is a lump of galena. I have seen beautifully crystallised masses of this galena in common coal, occurring at Bedworth in Warwickshire. These two specimens alone would render the conclusion perfectly certain that sulphide of lead may be obtained crystallised from solution. There is no doubt whatever on the subject. When we examine mineral lodes too—that is, those cracks in the earth which have been filled up by metalliferous veins—we frequently see galena forming beautiful ribs and strings of crystals; and we are perfectly certain, from the association of other minerals and the conditions under which it is found, that in many cases it has been thrown down crystallised from water. Some persons have supposed that it has arisen in vapour deep down from the bowels of the earth, and been deposited in crystals as we find it; but if you will take the trouble to examine some of the specimens, and especially the associated minerals, you will be perfectly convinced that in many instances it must have gone down from water. It cannot have been deposited from vapour in the way suggested, because the bottom of the lode sometimes contains none of the mineral, but has some other substance there. I do not say that that is so in every case, but it is so in some, and where it occurs it shows clearly that the lead must have gone down from the top, and not have come up from below.

We shall resume our examination of the sulphides in the next lecture.

ACADEMY OF SCIENCES.

July 30.

M. Lionnet presented a note "*On the Natural and Artificial Production of Crystallised Carbon.*" Many persons besides the author of this note have occupied themselves with the endeavour to obtain diamonds by the decomposition of sulphide of carbon. But M. Lionnet's method is peculiar. He takes a sheet of platinum-foil, and a sheet of tin-foil of rather smaller dimensions, and rolls them together loosely. The roll so made he places in a bath of sulphide of carbon. A feeble electric current, the author says, is then set up, the sulphide of carbon is decomposed, the sulphur combines with the tin, and the carbon gathers in crystals which fall to the bottom of the vessel. Time is, of course, required to obtain large crystals!

M. Gernez presented a note "*On the Phenomena of Super-fusion.*" The author, it will be remembered, made the discovery that super-saturated solutions of salts crystallised immediately on contact with a solid particle of the substance in solution, and that no other substance would provoke the crystallisation. The discovery now announced is of a similar character. Phosphorus fuses at 44° C.; but it is well known that with a little care it may be kept in a liquid state considerably below that temperature. But if under these circumstances the liquid is touched with a piece of solid phosphorus, the mass instantly solidifies, and the temperature rises to the fusing point. No other substance, however, but phosphorus will, according to M. Gernez, provoke this solidification. It is the same, he says, with sulphur, naphthaline, sulphuric acid, and some other substances.

M. de Luna presented the Academy with some "*Specimens of Estremadura Phosphate,*" and also crystals of apatite from Jumilla, which he states contain 1·75 per cent. of cerium, lanthanum, and didymium. The mines at Jumilla, we are told, are worked by an English company. The author makes a suggestion that the sulphurous acid now lost at the quicksilver mines of Almaden might be employed in the production of superphosphate, and he expects to connect Estremadura and Almaden soon by a railway. Among the specimens presented to the Academy was one, being, to all appearance, the fossil head of a femur.

A letter from M. H. Baubigny to M. H. St. Claire Deville gave an account of "*Some Derivatives of Camphor,*" or *compound camphors*, as the writer terms them. The first step in the production of these compounds is the action of sodium on camphor dissolved in benzene or toluene. The mixture being carefully heated to 90°, a copious evolution of hydrogen takes place, and the sodium disappears. The liquid on cooling gives crystals which decompose in water or moist air, reproducing camphor. They are very difficult to purify, and have not been analysed, but the author supposes them to be $\text{Ȼ}_{10}H_{15}(Na)\Theta$, or camphor in which Na is substituted for H. By means of this body the author obtains *ethylide of camphor*, or *ethylated camphor*. Iodide of ethyl being heated with the crystals, iodide of sodium separates, and the body $\text{Ȼ}_{10}H_{15}(\text{Ȼ}_2H_5)\Theta$ is left. In like manner a *methylated camphor* may be formed, and also another series with oxygenated radicals, as acetyl and benzoyl. These matters will probably require a further investigation, and in a future number we shall give the author's ideas and processes at length.

NOTICES OF BOOKS.

Alkali Act, 1863.—*Second Annual Report of the Inspector of his Proceedings during the year* 1865. Presented to both Houses of Parliament. 1866.

Much as Government interference with manufacturing industry is to be deprecated upon principle, it cannot, we think, be denied that the Alkali Act has worked well both for manufacturers and the public. It is satisfactory to find that no prosecution has yet taken place under the Act, although it would appear that the escape of vapour has occasionally, at some works, exceeded that allowed by the Act. In all these cases, however, the necessary improvements have been made on the representations of the Inspectors, and thus the necessity of going to law was avoided.

On a former occasion we expressed an opinion that the Act would prove a protection to manufacturers. This Report furnishes a proof that it is so. An action is brought against a manufacturer, and the Report of the Inspector is his defence. "A strange result therefore takes place," says Dr. Smith—"we become defenders of the alkali works." To us this result is not at all strange. It is exactly what we expected; and it is clear that if manufacturers do their best and inspectors are vigilant, there is an end to actions for damages done by the escape of acid. We are therefore greatly astonished to learn that the manufacturers intend to oppose the extension of the Act. It was passed, as our readers will remember, for four years only, and the current year may be considered the last of its operation. Before it expires we hope the manufacturers will more fully consider the matter, and eventually join with us in asking for a permanent instead of a temporary Alkali Act.

Some of our readers will probably feel interested in the account of the magnitude and importance of our soda trade, which can be gathered from this Report. It is with something akin to wonder that we read that over 1000 tons of salt are converted on every working day throughout the year.

In this process, "speaking roughly," over 500 tons of dry hydrochloric acid are evolved daily, and 1 per cent., or 5 tons, escape into the atmosphere. When we calculate this escape for all the salt converted in a year, the amount becomes alarming. Some 315,000 tons of salt are decomposed in the year, and (still "speaking roughly") we may say that half this amount, or 157,500 tons, of dry acid are evolved. One per cent. of this will give 1575 tons, which represents an annual deluge of 4795 tons of commercial hydrochloric acid. Happily this enormous amount is diffused over a very wide area, and falls in a very dilute state; but still the effects of it are perceptible, and should stimulate manufacturers to perfect condensation if possible.

Before leaving the Report we may mention, for the information of those who have not seen it, that Dr. Smith gives the plan of an arrangement by which the escape of vapour when drawing a charge of sulphate of soda is prevented. How far this can be adopted in old works is a practical question we cannot enter upon; but it certainly seems to deserve the consideration of manufacturers.

Journal für praktische Chemie. No. 9. 1866.

This journal contains three contributions to agricultural chemistry by Professor A. Müller, of Stockholm. The first is a paper "*On the Chemical Analysis of Soils,*" which gives a simple scheme for the separation of the mineral ingredients. The next is "*On the Amount of Nitrogen in Soils,*" and gives the proportion in certain soils in Sweden. Then we have a paper "*On the Determination of Quartz in Silicates.*" The author's process for this is not likely to be generally adopted in commercial laboratories. He heats the silicate with phosphoric hydrate until the acid fumes, which, it appears, will decompose any silicate, leaving the silica in a state in which it is easily dissolved by caustic soda, or dried and weighed as usual.

The next paper is by Dr. R. Wagner, "*On the Hydrometallurgical Extraction of Quicksilver.*" The author recommends the treatment of poor cinnabars with a hot solution of sulphide of barium, which dissolves the sulphide of mercury. The subsequent addition of hydrochloric acid precipitates the black sulphide of mercury, to be reduced or used as desired. Dr. Wagner also states that cinnabar digested for a day in an excess of a solution of iodine in iodide of potassium is completely decomposed in accordance with the equation, $HgS + KI,I = HgI,KI + S$. This process may be applied to the valuation of the ore. The difference in the amount of free iodine determined by means of hyposulphite of soda will show the amount combined with mercury, and of course the quantity of mercury.

We have next a paper "*On the Occurrence of Indium in the Flue-dust of some Zinc Ovens.*" The author gives a process by which indium may be separated from a mixture of copper, iron, zinc, cadmium, arsenic, thallium, and other usual constituents of flue-dust. Indium is, perhaps, more widely distributed than has been supposed, and the paper suggests the examination of the produce of other manufactories for this rare metal.

Dr. Boettger's next paper, "*A New Process for giving Brilliant Coatings of Colour to Zinc by Chemical Means*"—which consist in merely dipping the zinc for a longer or shorter time into a warm cupro-sodic solution. Very beautiful colours can be produced in this way, as we found ourselves some time ago in making experiments with Weil's process for covering metals. We shall give the full directions on a future occasion.

The next paper by Dr. Boettger describes "*A Process for Etching in Relief on Zinc.*" It is a slight modification of the process described in the Chemical News, vol. xii., page 24. Instead of removing the zinc, as there directed, by means of nitric acid, the author immerses the plate in a strong solution of sulphate of zinc, connects it with the positive pole of a strongish battery, using as the negative electrode a thin plate of copper of equal size. The action is allowed to proceed until the etching is as high as desired. It is pointed out that the zinc employed must be free from lead.

The remaining papers consist of abstracts from other journals which we have previously noticed. We subjoin the titles of the most important:—"*On the Behaviour of*

Sulphurous Acid to Hydrated Oxide of Iridium." "*On the Alcoholate and Phosphate of Thallium*," by M. Lamy. "*On the Quantitative Estimation of Sulphur, Phosphorus, and the Halogens in Organic Substances*," an abstract of a memoir by Carius. The remainder consists of abstracts of papers by Berthelot, all of which have been noticed, and most published at length, in our columns, and notices of papers by Oppenheim, "*On Allylene Compounds*;" Friedel and Crafts, "*On Silicium Alcohols*;" and Ghirzer and Fittig, "*On the Derivatives of Toluol.*"

NOTICES OF PATENTS.

The first we may notice this week is one the validity of which, we believe, is still in dispute, and, therefore, we only subjoin the complete specification.

The patent was granted to Frederick Tollhausen, and was sealed, after some proceedings, by order of the Lord Chancellor, on March 27, 1866, but dates from the filing of the petition on September 7, 1865. The specification is as follows:—

"This firework is composed of a substance which, on being burnt, developes itself into a snake-like or dendrical tortuous form, producing an extraordinary effect. The matter I use for this purpose is the sulpho-cyanide of mercury, which I obtain by ordinary and known means. This matter being prepared and well dried, I form or mould it into cones or any other convenient shape, which by preference I cover with tin foil or any other matter answering the same purpose. In some cases I shall manufacture these objects in various shapes and without enveloping them in an external covering. When these objects are ready for use, light by the ignition of a match or any other description of flame being applied to the summit of the cones or to any other point that shall be indicated in any of the various forms, will cause the immediate development of the imitation serpents or other similar forms."

Pharaoh's serpents have had their day, and now, probably, Aaron's, in the shape of lawyers, will swallow all the profits of their manufacture.

There appears to be a rage for patenting the use of a solution of caustic soda. In addition to the one mentioned by our correspondent, Dr. Lunge, a week or two ago, we find another provisional specification, filed by Mr. A. Brooman, dated October 13, 1865. It is for a liquid to be used for preventing incrustations in boilers, and also for improving water when used for washing, scouring, and cleaning. It is to be made by taking 2 lbs. of soda crystals, 9 oz. of slaked lime, and 8 lbs. of water. These are to be placed in a pan and boiled for an hour, and after cooling, the clear liquor is to be drawn off for use. The ingenious inventor did not fortunately complete his patent.

Mr. Albert Julius Mott patents (No. 2660) "*Certain Improvements in the Production and Uses of Carbonic Acid Gas.*" The gas is to be evolved from alum in the form of crystals and the solution of an alkaline carbonate, and it is hardly necessary to say that to produce the gas advantageously from these materials a special apparatus is required.

Mr. Henry Ellis, of Bangor, patents (No. 2267, Sept. 2, 1865) "*Improvements in the Production of Compounds of Silica and Silicated Inks and Dyes.*" The directions for the preparation of the inks are as follows:—

"For the manufacture of 'stock ink' I use a solution of soda silicate of iron, formed by adding a solution of sulphate of iron to a concentrated solution of silicate of soda of about specific gravity 1·3, until the whole of the precipitate is thrown down. This precipitate I wash with water, and after pressing I add it in the moist state to as much solution of commercial silicate of soda of specific gravity 1·5 or thereabouts, as will dissolve the whole. I then take one part of the said solution and two parts of the archill of commerce, and after mixing them together I add as much solution of silicate of soda of specific gravity 1·3 to 1·5 as will dissolve the whole of the precipitate. This I call 'stock ink,' the colour and consistency of which may be varied in the manner already described, and which may also be converted into a copying ink by the addition thereto of a solution of silicate of soda of specific gravity 1·5 in various quantities, and by preference a solution containing an excess of alkali.

"Thus copying inks may be produced that will give a copy immediately after writing, or within a few hours, or even days, and either with or without a copying press. The inks containing an excess of silica will dry quickly, and will soonest become unfit for taking a copy after being written with; whilst those silicates containing an excess of alkali in solutions of high specific gravity, say, 1·5, will remain fit for copying for some days after they are written with.

"I do not confine myself to any strict limits in the quantities of colouring matters to be added to the soluble silicates, and, as before described, I use other compound silicates besides that of iron for the production of 'stock ink,' and soluble potash silicates may be used instead of the soda silicates.

"An useful compound for varying the consistence of the 'stock ink' will be equal quantities of archill and a solution of hydrate of soda or of potash containing 15 parts of either caustic alkali in 100 parts of water. This may be added to the 'stock ink' at discretion to suit various purposes of writing fluids.

"Various forms of carbon may also be used to vary the tint of the archill ink, and also aniline black may be so employed, either of them being added at discretion. The latter colour may be produced by the addition of a solution of magenta to a liquid paste of aniline green, or the various aniline blacks of commerce may be used for the same purpose.

"For red ink and for silicated aniline colours, magenta or other aniline colours may be used in the dry state or in the state of solution; but as dry aniline colours will not directly combine with the soluble silicates, it is necessary to use intermediate bodies, such as resins or gum resins, to effect a combination. Gamboge is well adapted for this purpose, for at the same time that it makes the magenta soluble in a solution of alkaline silicate, it also modifies the colour so as to produce a red silicated ink. Other gums, resins, or gum resins possessing analogous properties may be used in the same way with magenta and other dry aniline colours, and thus a large variety of silicated aniline colours may be produced. In some cases a solution of cochineal and other colouring matters in ammonia or other alkaline solutions may be advantageously used to vary the tint of the original ink or dye.

"The liquid aniline dyes I treat as follows:—For red ink I take aureine one measure, and add it to an equal measure of commercial silicate of soda in solution of specific gravity 1.5. After stirring or agitating the mixture I let it stand, and then pour out the liquid part for use, leaving the sediment. By varying the quantity of either the silicate or the dye various shades of red may be produced, and gamboge or other gums, resins, or gum resins may be added at discretion, as with the dry aniline colours. Various other liquid aniline dyes may be treated in the same manner, thereby producing a great variety of solutions suitable for writing fluids of great permanency, and which will produce no corrosive action on steel or other metallic pens, and which fluids may also serve for other purposes already named.

"Documents written with inks prepared as herein mentioned may be rendered still less delible by means of a coating of a solution of supersilicate or compound silicate of potash or of soda, and paperhangings coloured with any of the dyes made in accordance with this invention may in the same manner be rendered washable without the colours becoming altered. The silicated dyes obtained by means of the before-mentioned processes may be used either singly or in combination with each other, or with other dyeing substances, and the desiccated colours may be powdered and mixed with such of the mineral, artificial, and other colouring matters as will not be affected by the solutions of alkaline silicates, and used for colouring paperhangings or other purposes."

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

1881. W. Tongue, Wakefield, Yorkshire, "Improved methods and apparatus for steeping, boiling, bleaching, and dyeing fibrous materials."

1885. R. Irvine, Magdalen Bridge, Midlothian, N.B., and P. Brash, Leith, N.B., "Improvements in the treatment of certain residues in order to obtain fatty acids therefrom."—Petitions recorded July 19, 1866.

1905. J. Leach, Franklin Place, Hatcham, Surrey, "Improvements in refining paraffin wax."

1915. G. Mountford, Grasscroft, near Greenfield, Yorkshire, and G. L. Loversidge, Hayes Street, Manchester, "Improvements in the tanning of hides and skins."—July 23, 1866.

1933. J. Livesey, Park Street, Westminster, "Improvements in refining cast-iron."—A communication from T. Blair, Pittsburg, Penn., U.S.A.

1937. W. E. Newton, Chancery Lane, "Improvements in dyeing and hardening dyed woods, and also in preparing wood to be used in the manufacture of the cylinders of carding engines."—A communication from B. H. Jenks, Bridesburgh, Penn., U.S.A.—July 25, 1866.

Invention Protected by the Deposit of a Complete Specification.

1971. G. T. Bousfield, Loughborough Park, Brixton, Surrey, "Improvements in the manufacture of fuel from peat and such like vegetable matter."—A communication from L. Elsberg, New York, U.S.A.—Petition recorded July 31, 1866.

Notices to Proceed.

863. C. E. Amos, Southwark, Surrey, and W. Anderson, Erith, Kent, "An improved mode of treating waste liquors for the dissipating or utilising of the same.—Petition recorded March 23, 1866.

1403. J. Thomas, Battersea, and A. Prince, Trafalgar Square, Middlesex, "Improvements in the means of treating scoria or slag of copper ores, iron pyrites, or scoria from other ores containing iron, and of reducing titanic iron ore for the purpose of extracting the iron therefrom."—May 17, 1866.

1720. B. F. Weatherdon, Chancery Lane, "Improvements in apparatus for preventing incrustation in steam boilers."—A communication from J. Toth, Kecskernés, Pesth, Hungary, Austria.—June 27, 1866.

1442. J. J. Marçais, Paris, "Certain improvements in the treatment of slags, ores, and compounds of tin."—May 22, 1866.

CORRESPONDENCE.

Disinfection.

To the Editor of the Chemical News.

Sir,—The remarks contained in your number of the 20th July, on the London Cowkeepers, and their petition have just been brought to my notice, as one of the signers of that petition, I beg leave to reply to your observations.

The point of complaint of the Petition was that the Royal Commission had done wrong in referring the subject of disinfection to the patentee of a disinfectant like Dr. Angus Smith, and not that that gentleman after having been appointed the referee had recommended his own invention. the third report of the Commissioners could not possibly have been seen by the signers of the petition for the simple reason that it had not been published at the time when the petition was written and signed. But they and the public in general had seen the previous report. which contained the very distinct recommendation of his copatentee's goods by Dr. Smith, which they quoted in their petition namely:—

"The experiments of Dr. Angus Smith show that the best disinfectants are carbolic acid (or Macdougall's powder) and chloride of lime For washing purposes Dr. Angus Smith recommends Macdougall's disinfecting soap which contains crude carbolic acid" That Dr. Smith subsequently altered his tone in the third report of the Commission was very probably due to the criticisms evoked by his previous proceedings, it was unnecessary to deny that Dr. Smith was a partner in the firm of Macdougall and Co because the petition did not say so, but merely that he was a partner with Macdougall in the patent, which has not yet been denied.

As to the character of the experiments detailed in the reports, it is but too certain that those in which carbolic acid was used were practical experiments on a large scale, but is beyond contradiction that those in which other substances were employed were laboratory experiments and nothing more. The circumstance that Carbolic Acid was allowed the advantage of large trials whereas other disinfecting agents were confined to laboratory experiments only bring out more distinctly the one-sided character of the pretended investigation.

I am, &c., Thos. Cross.

[Our correspondent is mistaken in supposing that no other substance but carbolic acid was submitted to extended trials. The last Report of the Commissioners is decisive on this point; and whether it was wrong or not (we believe it was not) to refer the matter to Dr. Smith, of one thing we feel certain—viz., that carbolic acid is the best disinfecting agent to use in cattle plague. We do not deny the value of others, but simply assert our conviction that carbolic acid is the best. The reasons we share in common with Dr. Smith are stated at length in our Report, and the facts on which they are founded are incontrovertible.—Ed. C. N.]

Action of Water on Glass.

To the Editor of the Chemical News.

Sir,—The lecture by Dr. Percy on Silicates, which appeared in the Chemical News of July 27, reminds me of one or two facts which have come under my own observation, and which may possibly prove interesting to your readers.

With regard to the action of water on glass, I may mention that for about eighteen months I had a washing bottle which was in constant use with hot distilled water, when, having broken the flask, I intended to adapt the tubes, which were quite unchanged in appearance, to another purpose; but on applying heat to the longer one it became quite white and opaque, was traversed by innumerable fissures, and, in fact, became completely devitrified. The change extended exactly as far as the cork, the portion above being quite unaltered. It was impossible to preserve the specimen, as it soon fell almost to powder.

Any one who has been accustomed to burn "shoddy" and similar substances with soda-lime for the estimation of the nitrogen will probably have noticed the fine blue colour of the tube after the ignition; and it is worthy of notice that we have in such cases all the conditions necessary for the formation of ultramarine, to which I believe the blue colour to be due. I am, &c.

Alfred H. Allen.

1, Surrey Street, Sheffield, August 4.

Chloropal in Cornwall.

To the Editor of the Chemical News.

Sir,—Some of your readers may be interested to know that chloropal occurs abundantly in a granite quarry close to the old tin mine known as Carclase. This mine, now worked mainly for china-stone and china-clay, is not far from St. Austell, in Cornwall. The chloropal occurs with fluor in the fissures of the granite, and resembles that variety of chloropal which has been termed "gramenite," from Menzenberg, near Bonn. I am, &c.

A. H. Church.

Starch.

To the Editor of the Chemical News.

Sir,—In your report of Dr. Percy's sixth lecture the following statement occurs:—"Smalts is still used to colour starch. Starchmakers have tried to substitute the artificial ultramarine, but in vain." This is altogether incorrect; smalts are quite superseded by ultramarine, which is now generally, I believe universally, used for the purpose. Any one may prove this for himself by treating the starch of commerce with a little dilute acid, which will quickly discharge the colour. I am, &c.

C. H. B.

London, N.E., August 7.

MISCELLANEOUS.

The Purification of Water.—Dr. Frankland has made the following communication to the Registrar-General:—

"Royal College of Chemistry, August 4, 1866.

"Sir,—In compliance with your request I have made a special analysis of the water supplied by the East London Company, and collected on the 1st instant. The following are the results, together with those yielded by the water supplied by the same company on July 1, and on the average of a whole year:—

	Solid matter in 100,000 parts.	Organic and other volatile matter in 100,000 parts.	Oxygen required to oxidise the organic matter	Degree of hardness.
East London Company's water, collected August 1, 1866 . .	26·14	1·44	·0328	Deg. 17·7
East London Company's water, collected July 1, 1866 . . .	24·18	1·94	·0344	16·6
East London Company's water (average of one year) . . .	27·98	1·62	·0504	21·12

"It is the amount of organic matter contained in this water which is of especial importance in connexion with the outbreak of cholera in the district supplied by this company. The above results that, in this respect, the water supplied on August 1, is considerably better than that supplied on July 1, when the amount of this ingredient was markedly above the average. Chemical analysis, therefore, although it shows a larger quantity of organic matter than ought to be contained in water used for drinking purposes, does not reveal any exceptional degree of pollution in this water. It must be borne in mind, however, that chemical investigation is utterly unable to detect the presence of choleraic poison amongst the organic impurities of water, and there can be no doubt that this poison may be present in quantity fatal to the consumer, though far too minute to be detected by the most delicate chemical research.

"It is thus that the occurrence of cases of cholera, or of choleraic diarrhœa, upon the banks of any of the streams, from which the water supply of London is so largely [illegible] may at any moment diffuse this poison over large areas of the metropolis. For the prevention of such a catastrophe there is a method which deserves considerable confidence. In my last three monthly reports to you on the metropolitan waters I have shown that filtration through animal charcoal (boneblack) removes practically the whole of the organic matter from the New River water; and in numerous other experiments I have ascertained that this process is equally efficient even when applied to the foul waters of ponds and ditches. I have also proved that its action continues unimpaired for three months, and will probably last for a year, even when very large volumes of water are passed through it. Animal charcoal alone has this power, vegetable charcoal being perfectly inert.

"I would, therefore, most earnestly recommend that during the prevalence of cholera the whole of the water supplied to the metropolis should be passed through animal charcoal immediately before transmission to consumers from the reservoirs of the respective companies. For this purpose 300 tons of bone-black, in the condition in which it is used by sugar refiners, would be required to purify the total supply of the metropolis, as I find that water passed at the rate of 1,000,000 gallons in twenty-four hours through three tons of bone-black, is completely purified. This operation, even when performed upon the water supply of London (100,000,000 gallons daily), would be neither formidable nor expensive. Three or four days would suffice to fix the necessary filtering boxes, whilst the animal charcoal, being an article which is now manufactured on a very large scale, can be had on the shortest notice. It is scarcely necessary to add that the water should be passed through the animal charcoal after it has undergone the usual process of filtration.—I have, &c.,

"E. Frankland."

In another letter addressed to the Secretary of the East London Water Works Company, Dr. Frankland has recommended the immediate use of permanganate of potash to be applied after filtration, and immediately before the water is transmitted to the consumer.

British Pharmaceutical Conference.—We may call attention to the admirable arrangements made at Nottingham for the members of the Pharmaceutical Conference. A large private hotel has been engaged for the sole use of the members. In a town affording but limited accommodation like Nottingham, this will be thoroughly appreciated, especially when we add that we have been asked for private apartments in the town rather more than six times the amount we paid for the same accommodation at Birmingham last year.

Royal Polytechnic Institution.—The annual meeting was held on Saturday last, and a very favourable report and balance-sheet were presented. The attractions of the entertainment would appear to increase, and the directors were able to declare a dividend at the rate of 6 per cent. per annum. Professor Pepper was present, and we are happy to receive the announcement that his recovery from a long and very severe illness is now nearly complete. In view of the coming winter season, we may ask again, would it not be possible to give a more definitely instructive character to the lectures?

Working of the Atlantic Telegraph.—The following information will no doubt be of interest to all our readers. It is supplied by Mr. Philip Crookes in a letter to the Editor, dated Valentia, August 1:—"On Thursday we took the instruments to Foilhummerum, and on Friday got a preliminary test sufficient to say that all was right and they might go on working. On Saturday we commenced testing regularly (stopping now and then to enable them to forward messages), and on Sunday we finished the tests. It was tested at each end, Mr. Laws being at one (the Newfoundland) end, and Mr. Clark and I at the other. It has improved in insulation about six times since it was laid, owing to the lower temperature and the pressure; altogether it is perfect. You ask me about the messages: at present they are read on a Thompson's reflecting galvanometer, worked with ten Daniell's cells, and so arranged as to limit the deflections to about a quarter of an inch on each side, the right hand being *dashes*, the left *dots*. They work about six words per minute (or at about the rate you and I can send when our instruments are in order), but it requires great experience to send well on such a long submarine line, and a great deal depends on the signallers. With two of their best men yesterday they sent eighty-three words in eleven minutes without a single repetition or misunderstanding, while at other times they may not get more than five per minute. During the tests we could communicate at once with Mr. Laws and give and receive directions as required. I will give a few extracts:—Valentia to Newfoundland: 'Will now take tests in order as arranged: send length of cable laid.' Newfoundland: 'Length of cable laid = 1852·115 knots.' Valentia: 'Look out for time signal at 9·12.' Directions as to tests follow. Newfoundland: 'Put end to earth till 12·10, and then insulate till 12·35.' Valentia: 'That is only 25 minutes' insulation.' Newfoundland: 'Yes.' Valentia: 'Good.' And so on, which shows the ease with which people can converse at a distance of nearly 2000 miles from each other."

Sodium Amalgam in the Colorado Gold Mines.—An extract from the *Colorado Journal*, quoted in the *American Journal of Mining*, for July 14, informs us that by the use of sodium amalgam the yield of the Narrragansett mill has been increased more than 30 per cent. The same journal for July 21 quotes as follows:—"Mr. John P. Bruce is running his old twelve stamp mill, two batteries, six stamps in each. For four days last week he used the mercury treated by sodium amalgam in one battery, and common mercury in the other. He got one ounce and nineteen dwts. more gold in the former than in the latter. Mr. Emery also tried some of it in the Narragansett mill just before it shut down. In one section of twenty heavy stamps he used the sodium amalgam for two batteries, and the common mercury for the other two during a run of three days, obtaining from the former five ounces of amalgam more than from the latter, which retorted $6·50 an ounce, or $32·30 in all. At the same rate the use of it in the forty stamps of the Narragansett mill for a week would increase the yield by $260. Probably this result would be even better with more experience."

Coal Oil in S. Paulo.—To-day Captain R. Burton, H.B.M. Consul at Santos, appeared at our office, and showed us the results of his late valuable discovery. We congratulate the concessionists of the S. Paulo and Parahyba Valley Railroad; this "find" will have an excellent effect upon the market. The first step would be to send up a sound working engineer, not one of the theoretical gentlemen in whom Brazil is unfortunately so rich, but a man who has practically learned the art and mystery of "striking ile." The traveller who has lately been studying the analogies of the African and South American continents was struck by the fact that the great coal field which Dr. Livingstone visited in his first exploration to the valley of the Zambezi was on the second exploration discovered near the Rufuma River, and afterwards Mr. Morewood, now resident at Taubaté, found it extending over the north of Natal. Captain Burton had seen specimens from the province of Rio Grande and had heard of the fields of Santa Catharina. Looking, therefore, at the basins of the Parahyba River and the Ribeira do Iguape, he was persuaded by their geological formation that the deposit would run northward to the province of S. Paulo; and he has succeeded in establishing the fact. When riding across the country from S. Paulo to Rio, Captain Burton was accompanied by a party of friends, Senor Moreira de Barros, the local deputy, Lieut.-Col. José Francisco Monteiro, and others, to the village-town of Bom Jesus de Tremembé. Here, on the southern bank of the Parahyba, he was shown a so-called "pissarra" (hard clay) in which he at once recognised the bituminous shale which overlies the true coal measures, and in which petroleum almost necessarily exists. After ascertaining that this shale bed extends along the Parahyba River for many leagues, Captain Burton proceeded to seek for the sandstones which characterise the deposits of Rio Grande. On the next day he succeeded. Lieut.-Col. Monteiro guided him to the rolling ground south of the river, and showed him at the distance of a league (= 4 miles) a red hill upon which appeared rocks of sandstone, many of them heavy with hæmatite. This was decisive. Another league to the south a fine deposit of lime was found, varying in quality from the rough material for burning to a fair saccharine marble. Lieut.-Col. Francisco Antonio Monteiro, of Taubaté, asked the traveller to secure the services of some working engineer who can build for him kilns of the very latest and most economical plan, and capable of burning at a time from 8000 to 10,000 bushels. Captain Burton has requested us to give publicity to this desideratum. The Lieut.-Colonel is a wealthy landed proprietor who will liberally reward success. Captain Burton placed upon our table the three little parcels which will show the way to many a fortune. Here are limestone, ironstone, and coal, all lying within the space of 8 miles. The position, about halfway between S. Paulo and the Barra do Pirahy, is upon the line that must be taken by the Pedro Segundo Railroad in case it runs west, or by the new branch of the Santos and S. Paulo which proposes to run east. The country offers no obstruction whatever to a light line of rails upon the American backwoodsman principle, and the expense might easily be reduced to half of what is usually lavished upon Brazilian railways. The first step, we have said, would be to send up some practical man for the purpose of ascertaining the presence of oil. Boring tools are to be found at Rio, even for making artesian wells, one of which was lately attempted upon the Morro do Castello. We strongly urge this measure upon the Government, and more especially upon those of the Ministry who are patriotically interested in the province of S. Paulo. His Excellency Senor Paula Sousa cannot better serve his native land. When oil is struck, then coal excavations may be made.—*The Anglo-Brazilian Times, July 2.*

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. XIII. 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., II., and VII. are out of print. All the others are kept in stock. Vol. XIV. commenced on July 7, and will be complete in 26 numbers.

T. R. P. will find his question answered at length in the paper by M. Kopp.

T. C.—After the chlorine liquor, boil with a small quantity of the stone, and the iron should be precipitated.

R. M.—Carbonate of zinc is obtained by precipitating sulphate of zinc with carbonate of soda, but is always combined with hydrated oxide. The mixture would answer your purpose. The precipitated blue and precipitated zinc should be mixed in the moist state, and then moulded and dried. Soda crystals are obtained by simply boiling down the solution to the proper point and cooling it. You have probably dried yours too much.

F. S. J.—The proportion will be found in the patent. The properties of the sulphites are briefly described in most books on chemistry. Nothing definite is known of the salts of carbolic acid. There are no reliable reagents for its detection.

L. T.—We believe the first announcement was made by Professor Stokes in 1853, and his several papers on the subject will be found in the *Proceedings of the Royal Society* for that and subsequent years. The best form of apparatus for exhibiting the fluorescence is a vessel of the solution, in which is placed a Geissler's tube illuminated by a Ruhmkorff coil. We have not seen Mr. Scott's artificial quinine.

Received.—Mr. W. N. Hartley's Notes shall be published next week.

Books Received.—On Epidemic Diarrhœa and Cholera; their Nature and Treatment. By Geo. Johnson, M.D. Lond.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

A Few Notes on Magnesium, by WALTER NOEL HARTLEY.

BEFORE the publication of M. Roussin's paper (CHEM. NEWS, p. 27) I had made the experiments which form the substance of the following notes. My results, with one exception, confirm his statements.

Magnesium decomposes perfectly pure cold water slowly, but evolves hydrogen more briskly from saline solutions, especially if a little chloride of platinum be added. The disengagement of gas is very active in a dilute solution of this salt, probably on account of electrolytic action between the precipitated platinum and the magnesium. Similar cases are well known—*e.g.*, the addition of sulphate of copper to the contents of a Marsh apparatus, and chloride of platinum to tin and hydrochloric acid when hydrogen is made by this method. No hydrogen is evolved from solutions of phosphate of ammonia, the nitrates and sulphides of the alkalies and alkaline earths, permanganate of potash, and peroxide of hydrogen; the two latter probably exert an oxidising influence on the metal. To the nitrates the ammonia salt is an exception, the evolution of gas being as brisk as from other salts. It has been stated (Miller's "Chemistry," vol. ii.) that magnesium takes fire when thrown on to strong hydrochloric acid; but with the strongest possible acid, either hot or cold, I found nothing take place beyond a very violent disengagement of hydrogen.

Most metals are precipitated by magnesium from their solutions, but I could not succeed in precipitating iron; the magnesium becomes blackened, probably from a deposition of metallic iron, but the deposit disappears again as the magnesium is dissolved. I did not get satisfactory results with cobalt. I was induced to try the precipitation of iron by the thought that it would lead to a good method of separating phosphoric acid from iron and alumina. The plan proposed was to add some magnesium to the acidulated solution, filter off the precipitated iron, add tartaric acid, chloride of ammonium, and ammonia, and filter, the precipitate being phosphate of magnesia and ammonia. Magnesium is to be preferred to zinc in some analytical operations—for instance, for the precipitation of copper in a platinum vessel, the most accurate way of estimating it; also in the reduction of per- to prot-oxide of iron, the metal being always pure, and requiring so little acid for its complete solution.

Magnesium may be amalgamated like zinc by shaking in a bottle containing mercury covered with a layer of dilute sulphuric acid; when so treated it possesses the property of the amalgam described by Messrs. Wanklyn and Chapman—viz., of decomposing water violently. I made use of this amalgamated magnesium instead of sodium amalgam, to act on an organic substance with nascent hydrogen, as the liquid was not so intensely alkaline as it would otherwise have been. In testing for nitric acid by boiling cadmium with the solution, and after addition of acid testing with iodide of potassium and starch-paste, magnesium may be used with advantage; but a modification of this method is really the best test for traces of nitrates—for instance, in drinking waters. If a small battery be made of a piece of magnesium ribbon and platinum foil, and this be placed in the water very faintly acidulated, without the joining of the platinum and magnesium being immersed, the presence of nitric acid may be shown by its conversion into nitrous acid and the consequent coloration of ozone papers when dipped in the acidified liquid. Should the trace of nitric acid be very small, the action must go on slowly for several hours, in which case the liquid should be neutral when acting on the magnesium. I found sulphate of iron and sulphuric acid did not give trustworthy results when a solution contained $\frac{1}{10000}$th of a nitric salt, while distinct indications were obtained on ozone papers in the way above mentioned in presence of 35,000 parts of water.

A convenient way of testing is to wrap an ozone paper round a platinum spatula, and wrap over this magnesium tape and connect at the top with the spatula; where the magnesium touches, the paper remains white; where exposed, it becomes tinged purple. I wished to try the value of this test by many more experiments than those already made, and to find the cause of there being no evolution of gas from alkaline nitrates in contact with magnesium (it is probably from a process of reduction to nitrites going on), but I now judge it best to make known the few facts here stated, as at present I have not an opportunity of continuing my experiments.

Note.—I may state that boiling magnesium in a solution containing a trace of a nitrate is not so delicate a test as the sulphate of iron one.

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

PART III.

CONNEXION BETWEEN ORGANIC AND INORGANIC CHEMISTRY.

SECTION III.—*Combinations of Multiple Radicals.*

(*Continued from page 63.*)

MANY other basic compounds of inorganic chemistry possess an analogous constitution. We will mention some from the different kinds of salts. We must first remark that these basic salts always contain a polyatomic metal; the well-defined monatomic metals—such as potassium, sodium, and even silver—not forming basic salts properly so called.

Basic Nitrates.

$\left.\begin{matrix}\mathrm{Pb}_3\\(\mathrm{N}\Theta_2)_2\end{matrix}\right\}\Theta_4$	$\left.\begin{matrix}\mathrm{Hg}_3\\(\mathrm{N}\Theta_2)_2\end{matrix}\right\}\Theta_4$	$\left.\begin{matrix}(\mathrm{Hg}_2)_2\\(\mathrm{N}\Theta_2)_2\end{matrix}\right\}\Theta_3+\mathrm{aq.}$	$\left.\begin{matrix}\mathrm{Pb}_2\\\mathrm{N}\Theta\\\mathrm{N}\Theta_2\end{matrix}\right\}\Theta_3$
Triplumbic dinitrate. (Berzelius.)	Trimercuric dinitrate. (Kane.)	Dimercurous dinitrate; yellow crystalline salt. (Kane).[*]	Nitrosonitrate of lead. Basic hyponitrate of lead of M. Peligot.

Basic Sulphates.

$\left.\begin{matrix}\mathrm{Cu}_4\\\mathrm{S}\Theta_2\end{matrix}\right\}\Theta_5+4\ \mathrm{aq.}$	$\left.\begin{matrix}\mathrm{Hg}_3\\\mathrm{S}\Theta_2\end{matrix}\right\}\Theta_4.$
Brochantite.	Turbith mineral.

Basic Carbonates.

Carbon being a tetratomic element, like silicium, the composition of the normal carbonic hydrate should be—

$$\left.\begin{matrix}\mathrm{C}^{\mathrm{iv.}}\\\mathrm{H}_4\end{matrix}\right\}\Theta_4,$$

and the normal carbonates should contain—

$$\left.\begin{matrix}\mathrm{C}^{\mathrm{iv.}}\\{}_4\mathrm{R}'\end{matrix}\right\}\Theta_4 \quad \text{or} \quad \left.\begin{matrix}\mathrm{C}^{\mathrm{iv.}}\\{}_2\mathrm{R}''\end{matrix}\right\}\Theta_4.$$

These carbonates Dr. Odling has called *orthocarbonates*;[†] but we know that the most numerous and best defined carbonates belong to the type—

$$\left.\begin{matrix}\mathrm{C}^{\mathrm{iv.}}\\{}_2\mathrm{R}\end{matrix}\right\}\Theta_3;$$

or, in other words, that in these carbonates the ratio of

---

[*] Polymere of the soluble mercurous nitrate of Gerhardt (p. 15).

[†] *Philosophical Magazine*, vol. xviii., p. 368.

the oxygen of the acid to that of the oxide is 2 : 1. It seems then natural to consider these latter carbonates as neutral or normal. Their constitution may be expressed by the formula—

$$\left.\begin{matrix}(\text{Ꞓ}\Theta)''\\ 2\text{R}'\end{matrix}\right\}\Theta_2;$$

and the orthocarbonates may be considered as basic carbonates of the formula—

$$\left.\begin{matrix}2\text{R}''\\ (\text{Ꞓ}\Theta)''\end{matrix}\right\}\Theta_3,$$

derived from the type

$$\left.\begin{matrix}2\text{R}''\\ \text{H}_2\end{matrix}\right\}\Theta_3$$

That being laid down, we may admit the existence of basic carbonates belonging to several types, and in which the oxygen of the oxide Oo is to the oxygen of the acid Oc in the following ratios:—

Oo : Oc : : 2 : 2 bibasic carbonates.
Oo : Oc : : 3 : 4 sesquicarbonates.
Oo : Oc : : 3 : 2 carbonates of the sesquioxides.

Bibasic Carbonates.	*Sesquicarbonates.*	*Carbonates of the Sesuqioxides.*
$\left.\begin{matrix}2\text{Ꞓu}\\ \text{Ꞓ}\Theta\end{matrix}\right\}\Theta_3+\text{aq.}$[‡] Malachite.	$\left.\begin{matrix}3\text{Ꞓu}\\ 2\text{Ꞓ}\Theta\end{matrix}\right\}\Theta_5+\text{aq.}$ Azurite.	$\left.\begin{matrix}\text{Ꞙe}_2{}^{\text{vi.}}\\ \text{Ꞓ}\Theta\end{matrix}\right\}\Theta_4$ Ferric carbonate. (Parkmann.)
$\left.\begin{matrix}2\text{Ꞓu}\\ \text{Ꞓ}\Theta\end{matrix}\right\}\Theta_3$ Mysorine?	" "	$\left.\begin{matrix}\text{Ʉr}_2{}^{\text{vi.}}\\ \text{Ꞓ}\Theta\end{matrix}\right\}\Theta_4$ Uranic carbonate. (Ebelmen.)
$\left.\begin{matrix}2\text{Ᵽb}\\ \text{Ꞓ}\Theta\end{matrix}\right\}\Theta_3+\text{aq.}$ Subcarbonate of hydrated lead. (Bonnsdorff.)	$\left.\begin{matrix}3\text{Ᵽb}\\ 2(\text{Ꞓ}\Theta)\end{matrix}\right\}\Theta_5+\text{aq.}$ Dutch whitelead. (Hochstetter.)	$\left.\begin{matrix}\text{Ꞓr}_2{}^{\text{vi.}}\\ \text{Ꞓ}\Theta\end{matrix}\right\}\Theta_4$[§] Chromic carbonate. (Parkmann.)
$\left.\begin{matrix}\text{Ƶn}_2\\ \text{Ꞓ}\Theta\end{matrix}\right\}\Theta_3+2\text{aq.}$ Subcarbonate of hydrated zinc. (Schindler.)	$\left.\begin{matrix}2\text{Bi}'''\\ 2\text{Ꞓ}\Theta\end{matrix}\right\}\Theta_5+\text{aq.}$ Carbonate of bismuth.	

There exist basic silicates. Thus staurotide may be looked upon as a basic compound of the form—

$$\left.\begin{matrix}4\text{Al}_2{}^{\text{vi.}}\\ 3\text{Si}\end{matrix}\right\}\Theta_{18},$$

in which the sixth part of the aluminium is replaced by ferricum.

In the inorganic compounds that we have just reviewed we see polyatomic elements accumulate in one and the same combination, uniting one with another doubtless by the intervention of atoms of oxygen (page 61). We find this property in other organic and inorganic compounds, in which we see the radicals of polyatomic acids accumulated in one and the same combination. Let us investigate this point.

By the oxidation of diethylenic alcohol there is formed a compound which I have called diglycolic acid,[‖] and in which the two ethylene radicals of the alcohol are replaced by two glycolyl radicals.

$$\left.\begin{matrix}2(\text{Ꞓ}_2\text{H}_4)\\ \text{H}_2\end{matrix}\right\}\Theta_3, \qquad \left.\begin{matrix}2(\text{Ꞓ}_2\text{H}_2\Theta)\\ \text{H}_2\end{matrix}\right\}\Theta_4.$$

Diethylenic alcohol. Diglycolic acid.

M. Friedel and I have described the ethers of a dilactic and of a trilactic acid which possess a constitution analogous to that of diglycolic acid.[¶]

$$\left.\begin{matrix}2(\text{Ꞓ}_3\text{H}_4\Theta)\\ \text{H}_2\end{matrix}\right\}\Theta_3, \qquad \left.\begin{matrix}3(\text{Ꞓ}_3\text{H}_4\Theta)\\ \text{H}_2\end{matrix}\right\}\Theta_4.$$

Dilactic acid Trilactic acid.

In a very important article, M. H. Schiff[**] has lately made known a ditartaric acid—

$$\left.\begin{matrix}2(\text{Ꞓ}_4\text{H}_4\Theta_4)''\\ \text{H}_2\end{matrix}\right\}\Theta_3.$$

Analogous combinations exist in inorganic chemistry. I may mention disulphuric (Nordhausen acid), dichromic, and diphosphoric acids, whose salts are represented by the following formulæ:—

$$\left.\begin{matrix}2(\text{S}\Theta_2)\\ \text{K}_2\end{matrix}\right\}\Theta_3 \qquad \left.\begin{matrix}(\text{Ꞓr}\Theta_2)''\\ (\text{Ꞓr}\Theta_2)''\\ \text{K}_2\end{matrix}\right\}\Theta_3 \qquad \left.\begin{matrix}(\text{P}\Theta)'''\\ (\text{P}\Theta)'''\\ \text{Na}_4\end{matrix}\right\}\Theta_5$$

Disulphate of potassium (anhydrous). Dichromate of potassium. Pyrophosphate of sodium.[††]

We know that MM. Maddrell[‡‡], Fleitmann, and Henneberg have described a series of acids polymeric with metaphosphoric acid, and which may be looked upon, in common with all the compounds here referred to, as anhydrides formed by the condensation of several molecules of phosphoric acid with elimination of water.

$$2\left[\left.\begin{matrix}(\text{P}\Theta)'''\\ \text{H}_3\end{matrix}\right\}\Theta_3\right] = \left.\begin{matrix}2(\text{P}\Theta)'''\\ \text{H}_2\end{matrix}\right\}\Theta_4+2\text{H}_2\Theta$$

Phosphoric acid. Dimetaphosphoric acid.

$$3\left[\left.\begin{matrix}(\text{P}\Theta)'''\\ \text{H}_3\end{matrix}\right\}\Theta_3\right] = \left.\begin{matrix}3(\text{P}\Theta)'''\\ \text{H}_3\end{matrix}\right\}\Theta_6+3\text{H}_2\Theta$$

Trimetaphosphoric acid.

$$4\left[\left.\begin{matrix}(\text{P}\Theta)'''\\ \text{H}_3\end{matrix}\right\}\Theta_3\right] = \left.\begin{matrix}4(\text{P}\Theta)'''\\ \text{H}_4\end{matrix}\right\}\Theta_8+4\text{H}_2\Theta, \text{ \&c.}$$[§§]

Tetrametaphosphoric acid.

M. Friedel and I[‖‖] have made known the ether of a mixed acid formed by the union of one molecule of lactic acid with one molecule of succinic acid, with elimination of water—

$$\left.\begin{matrix}(\Theta_3\text{H}_4\Theta)''\\ \text{H}_2\end{matrix}\right\}\Theta_2+\left.\begin{matrix}(\Theta_4\text{H}_4\Theta_2)''\\ \text{H}_2\end{matrix}\right\}\Theta_2=\left.\begin{matrix}(\text{Ꞓ}_3\text{H}_4\Theta)''\\ (\Theta_4\text{H}_4\Theta_2)''\\ \text{H}_2\end{matrix}\right\}\Theta_3+\text{H}_2\Theta$$

Lactic acid. Succinic acid. Lacto-succinic acid.

Lacto-succinic acid, whose ether we have analysed—

$$\left.\begin{matrix}(\Theta_3\text{H}_4\Theta)'\\ (\Theta_4\text{H}_4\Theta_2)''\\ (\text{Ꞓ}_2\text{H}_5)_2\end{matrix}\right\}\Theta_3$$

contains both the radical of lactic acid and that of succinic acid, and these radicals are probably united one to the other by an atom of oxygen. A certain number of other organic and inorganic acids are formed in a like manner, and possess an analogous constitution. Thus M. Bolley's chromosulphuric acid contains—

$$\left.\begin{matrix}(\text{Ꞓr}\Theta_2)''\\ (\text{S}\Theta_2)''\\ \text{H}_2\end{matrix}\right\}\Theta_3$$

[‡] $\text{Aq}=\text{H}_2\Theta$.

[§] The chromic dicarbonate analysed by M. Parkmann (*Bulletin de la Société Chimique*, vol. v., p. 551)—

$$\left.\begin{matrix}\text{Ꞓr}_2{}^{\text{vi.}}\\ 2\text{Ꞓ}\Theta\end{matrix}\right\}\Theta_5 \quad \text{or} \quad \left.\begin{matrix}\text{Ꞓ}_2\\ \text{Ꞓr}_2\end{matrix}\right\}\Theta_7$$

may be compared to a disilicate (p. 62). In general the carbonates may be referred to the type

$$\left.\begin{matrix}\text{Ꞓ}^{\text{iv.}}\\ 2\text{R}'\end{matrix}\right\}\Theta_3$$

which corresponds to the first carbonic anhydride—

$$\left.\begin{matrix}\text{Ꞓ}^{\text{iv.}}\\ \text{H}_2\end{matrix}\right\}\Theta_3=\left.\begin{matrix}\text{Ꞓ}^{\text{iv.}}\\ \text{H}_4\end{matrix}\right\}\Theta_4-\text{H}_2\Theta.$$

[‖] *Annales de Chimie et de Physique*, 3rd series, vol. lxix., p. 344.

[¶] *Annales de Chimie et de Physique*, 3rd series, vol. lxiii., p. 112.

[**] *Ibid.*, vol. lxix., p. 257.

[††] *Annalen der Chemie und Pharmacie*, vol. lxi., p. 53.

[‡‡] *Ibid.*, vol. lxv., p. 304, and vol. lxxii., p. 232.

[§§] We may foresee the existence of anhydrides

$$\left.\begin{matrix}3(\text{P}\Theta)\\ \text{H}\end{matrix}\right\}\Theta_5 \quad \text{and} \quad \left.\begin{matrix}4(\text{P}\Theta)\\ \text{H}_2\end{matrix}\right\}\Theta_7$$

formed according to the principle of *successive dehydrations*, as shown at page 61 and the following pages.

[‖‖] *Annales de Chimie et de Physique*, 3rd series, vol. lxiii., p. 122.

M. Friedel and I have compared sphene, or silico-titanate of calcium, to the lacto-succinate of ethyle—

$$\left.\begin{matrix}(\mathrm{Si\Theta})'' \\ (\mathrm{\bar{T}i\Theta})'' \\ \mathrm{\bar{C}a}''\end{matrix}\right\}\Theta_3\text{¶¶}$$

Other inorganic kinds are formed by the condensation of the elements of two acids with elimination of water. This is the case with the borosilicates. The hydrate corresponding to datholite would be formed by the combination of 2 molecules of boric acid and 2 moleonles of silicic acid, with elimination of 5 molecules of water—

$$2\left[\left.\begin{matrix}\mathrm{Bo}''' \\ \mathrm{H}_3\end{matrix}\right\}\Theta_3\right]+2\left[\left.\begin{matrix}\mathrm{Si}^{\mathrm{iv.}} \\ \mathrm{H}_4\end{matrix}\right\}\Theta_4\right]=\left.\begin{matrix}2\mathrm{Si}^{\mathrm{iv.}} \\ 2\mathrm{Bo}'' \\ \mathrm{H}_4{}'\end{matrix}\right\}\Theta_9+5\mathrm{H}_2\Theta$$

$$\left.\begin{matrix}\mathrm{Si}_2 \\ \mathrm{Bo}_2 \\ \mathrm{\bar{C}a}_2\end{matrix}\right\}\Theta_9+\mathrm{aq.}$$

Datholite.

(To be continued.)

New Researches on the Law of Chemical Proportions and on Atomic Weights and their Mutual Relations, by J. S. Stas.*

The following is the introduction to the new researches recently published by M. Stas. A full abstract of the researches themselves will follow in our pages:—

I have the honour to present to the Academy three memoirs, containing a detailed exposition of the labours I have undertaken on the subject of the law of chemical proportions and on atomic weights and their mutual relations. These have been prosecuted as a new control of the results first made known in 1860 in my "*Researches on the Reciprocal Relations of Atomic Weights*," and at the same time to reply to the objections raised against the conclusions with which, after mature reflection, I terminated that memoir. As far as has been possible, I have in this introduction brought together the questions of which I treated, the results I arrived at, and the consequences that flowed from them. I have done this in order to give those who are not interested in analytical details a general idea of my labours, and the train of thought that guided me.

Prout laid down the principle that the atomic weights of all simple bodies are multiples in whole numbers of that of hydrogen. I have said in my former memoir that the uniformity admitted by Prout was soon shown to be incorrect; but the law which he had propounded was still regarded by a great number of chemists as perfectly founded on fact. M. Dumas, in particular, profoundly convinced of the truth of Prout's law, believes that all atomic weights are multiples of that of hydrogen by 1·00 or by 0·50 or by 0·25. My own researches on nitrogen, chlorine, sulphur, potassium, sodium, lead, and silver, published in 1860, led me to the contrary conclusion—"that there exists no common divisor between the weights of simple bodies which unite with each other to form definite compounds." I have considered, therefore, the hypothesis of Prout as a pure illusion, and have regarded all the reputed undecomposable bodies as distinct entities, having no simple relation of weight one to another.

These conclusions, however positive they may seem, have been accepted by a great number of chemists in Germany, England, and Italy, but not in France. The reason for this difference is to be found in the profound conviction produced in the minds of most French chemists by the works of my illustrious teacher (M. Dumas) on the same subject.

However delicate may be my position in this matter, I must seek out the foundation for this conviction. To this end I propose to examine the objections brought against the conclusions of my work. I shall then examine the idea that inspired Prout when he enunciated his hypothesis, and lastly I shall bring together the different investigations I have undertaken to answer objections, to control previous researches, and some entirely new.

My memoir had scarcely appeared when M. Marignac hastened to give an analysis of it in the *Bibliothèque Universelle de Genève*, following it up with some objections against the conclusions I had deduced, which he considered too positive. I pass over the compliments of the celebrated Genevese chemist to come at once to his objections.† I shall quote them for the most part *in extenso*, that every one may understand them. "When," says M. Marignac, "I place beside the numbers of M. Stas those I formerly obtained myself, it is not with the single object of pointing out the close approximation; it seems to me that an important consequence may be drawn. On studying the great work of M. Stas, I have seen that in his experiments he has taken infinitely more minute care than I thought it necessary to take, either for the purification of the bodies submitted to experiment, or to insure the accuracy of the weighings, or in all the precautions that could be imagined to remove every cause of error. His results offer much stronger guarantees for accuracy than mine, and yet it is seen how little they differ, and it will be particularly remarked that they are on the average nearer than mine to the numbers calculated according to Prout's law.

"It seems to me that we may conclude that if, after still further improvements in the means of purification of bodies and in experimental methods, any future chemist goes through the same series of experiments with even greater guarantees of accuracy, the difference that might be manifested between his results and those of M. Stas would probably be of the same kind as those that exist between mine and M. Stas', and would show a closer agreement with the law of Prout. My opinion being thus stated, it may be wondered why I do not entirely agree with the conclusions of M. Stas, and regard Prout's law as a pure illusion. Allow me," adds M. Marignac, "to make some observations on these conclusions, which appear to me too absolute; they will bear on two distinct points:—

"First, I must avow that I shall only be convinced of the exactness of an atomic weight when that weight has been obtained by several methods absolutely independent of one another, and resting on the analysis of several compounds quite distinct."

I perfectly agree with M. Marignac on this point, as is proved by the fact that in my researches on the reciprocal relations of atomic weights I have given absolutely independent elements for the calculation of the atomic weight of silver, although, however, the principal object of my experiments was to determine the relations of the atomic weights and not the atomic weights themselves. For the rest it will be seen further on that I have endeavoured to satisfy the desire expressed by M. Marignac.

"I expressly add," continues M. Marignac, "that I

¶¶ Or, $\left.\begin{matrix}\mathrm{Si}^{\mathrm{vi.}} \\ \mathrm{\bar{T}i}^{\mathrm{vi.}} \\ \mathrm{\bar{C}a}''\end{matrix}\right\}\Theta_5$

Annales de Chimie et de Physique, 3rd series, vol. liii., p. 124.

* *Memoirs of the Royal Academy of Belgium.*

† These will be found at p. 57, vol. v., of the Chemical News.

understand by different methods those that rest on the analysis and synthesis of absolutely distinct compounds, and not those alone which only differ in the manner the same compounds are made to react. Thus, when M. Stas quotes as a control of the synthesis of nitrate of silver the experiments by which he determined the proportional relation between this salt and chloride of potassium, I see only a proof of the accuracy of the experiments themselves, and by no means of the experimental method."

On this point I do not share the opinion of my celebrated opponent. The agreement of the results obtained by the aid of the control proves not only that the experiments were made with exactitude, but further that the synthesis of nitrate of silver, as well as the normal composition of that salt, is not reconcilable with the law of Prout. To escape, indeed, from this consequence, M. Marignac is obliged to resort to an hypothesis which is *a negation of the principle on which the determination of atomic weights rests.*

"If from any cause whatever," he says, "nitrate of silver most carefully prepared does not contain its elements in their rigorous atomic proportions, the most accurate methods applied to its analysis or synthesis will only give the relations of the atomic weights with the same inaccuracy.

"Here, in fact, is the principal cause of the doubt that reigns in my mind. It is not absolutely proved to my satisfaction that many compound bodies do not constantly and normally contain an excess (very small, no doubt, but still appreciable in very delicate experiments) of one of their elements."

The objection of M. Marignac means that it is not demonstrated that in stable chemical combinations (and I suppose that sulphide and nitrate of silver are such) the elements which constitute them are exactly and invariably in the relation of their atomic weights. It seems to me that this opinion, if it is founded on fact, tends to upset all our fundamental notions; the law of definite proportions, the law of multiple proportions cease to be mathematical laws; they necessarily become only limited laws. The hypothesis of the existence of atoms has no longer any scientific foundation; in fact, it has no other solid foundation than *the real and never virtual constancy* of combinations, and *the real and never virtual invariability* of the proportions by weight of the elements which constitute them.

I do not conceal from myself that among the fundamental notions of chemistry there are a number, as in all other sciences, which we admit as demonstrated, but which are far from being so. Let us examine, then, how it is with the law of definite proportions. It rests on analysis and synthesis. These two data seem to leave no doubt even in the most exacting mind of the generally admitted law of the constancy of all combinations. But the constancy of composition of every combination does not prove that the relations in weight that their elements observe must be maintained absolutely in combinations with other bodies. Thus the composition of sulphide and sulphate of barium may be constant; but it does not follow from that that the relation by weight of sulphur to barium in the sulphide must be absolutely identical with the relation that these same bodies present to each other in the sulphate of barium. The fundamental character observed in certain double decompositions—that is to say, the *maintenance of the neutrality of the liquid* in which the reaction takes place, and which led Wenzel nearly a century ago to suppose the existence of a law—does not rigorously demonstrate that the relative proportions of the alkaline and earthy metals which replace each other in a given quantity of the same acid are the same for all acids, any more than a change in this neutrality demonstrates that the relative proportions are not the same.

The labours of Wollaston and Gay-Lussac, on which we have relied from the beginning of the century, never offer the degree of precision necessary to be able to deduce from them with certainty that the hypothesis of Dalton known as *the law of multiple proportions* is a *mathematical law*, and not simply a *limited law.*

When we weigh well all the reasons that have led chemists to consider the law of Wenzel and the hypothesis of Dalton as demonstrated truths, we are convinced that they are based rather on the constancy of composition in combinations than on a rigorous experimental demonstration of these laws. We may then question whether it is proved that compound bodies produced under the normal conditions of their formation do contain their elements in the exact proportions of the weights of their atoms. The moment the laws of chemical proportions are regarded as limited laws, the partisans of Prout's hypothesis may suppose, as M. Marignac does, that if the atomic weights determined by experiment do not exactly coincide with the hypothesis, the error arises from the compound not containing its elements in the exact proportions of their atomic weights. In this case we have no means of submitting Prout's law to an experimental verification. The determination of atomic weights equally loses the importance it had while we considered these weights as *natural constants,* because we have the certainty, *a priori,* that the most accurate experiment can only furnish us with *mean* or *limited atomic weights,* and not the true relations of the weights of atoms.

(To be continued.)

TECHNICAL CHEMISTRY.

The Manufacture and Properties of Aniline Colours, and the Bodies used in their Preparation, by MM.* DEPOULLY *Brothers.*

I. Oils used in making Commercial Aniline.—The source which furnishes oils containing benzol and toluol is coal tar, which is produced in making coal gas.

In the distillation of these tars the first product is an oil lighter than water, commercially called "light oil," and containing—

1st. Neutral liquid hydrocarbides, benzol, toluol, cumol, &c., and a little solid hydrocarbide naphthaline.

2nd. Phenols, bodies holding at the same time both alcohols and acids, phenic and cresylic acids.

3rd. Very small quantities of alkaloids, aniline, picoline, quinoline.

To extract from these oils the principles used in making aniline colours, it is first necessary to separate the phenols; this result is obtained by agitating the oils with small quantities of caustic soda at 40° Baumé, or even more concentrated. If we separate the watery layer containing the phenols in combination with soda, this operation twice repeated completely frees the oils from phenols.

Sometimes, before this operation, the alkaloids are removed from the oils by being rapidly agitated with a small proportion of sulphuric acid.

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* Memoir presented to the *Société Industrielle de Mulhouse* at the meeting of May 31, 1865.

These washings should be terminated before new rectifications are commenced, for the naphthaline separates much more readily by a redistillation when neutral oils are operated upon.

It then merely remains to separate the benzol and toluol from their homologues, the other liquid hydrocarbides.

We generally operate by fractional distillation—that is to say, by collecting all that is distilled between 80° and 120°, and this portion is sold under the name of benzol, and serves in the making of aniline.

Benzol is usually sold with a standard of distillation fixed beforehand, either at 90 per cent. or 60 per cent.—that is to say, 90 or 60 per cent. distilling below 100° C.

During the last few years benzol at 90 per cent. has been most in demand, but it has lately been found that aniline made with benzol at 60° gives the greatest yield of colouring matters.

These benzols are composed almost exclusively of two bodies—benzine and toluol.

Benzine, $C_{12}H_6$, distils at 80°; treated by nitric acid it gives nitrobenzine $C_{12}H_5NO_4$, distilling at 213°, which by reducing agents gives aniline $C_{12}H_7N$, distilling at 182°.

Toluol, $C_{14}H_8$, distils at 114°; by nitric acid it gives nitrotoluol, $C_{14}H_7NO_4$, which forms toluidine, $C_{14}H_9N$, distilling at 198°.

In this series of homologous hydrocarbides, benzol, toluol, xylol, cumol, cymol, the densities dimiminish in proportion as the equivalent and the boiling-point rise; and this law holds not only for hydrocarbides, but for their nitrogenised derivatives, for the alkaloids derived from them, and also for the corresponding phenols.

Thus a hydrocarbide distilling at 80° will have a density of 0·885; of another, distilling at 110° or 114°, the density will be only 0·870.

The density of a nitrobenzol distilling at 213° to 220° would be 1·200 to 1·210, while that of a nitrotoluol distilling at 220° to 230° would be 1·180 to 1·190.

Pure aniline, $C_{13}H_7N$, distilling at 182°, would have a density of 1·028; pure toluidine, $C_{14}H_9N$, distilling at 198°, would have a density of 1·001 to 1·002.

Phenic phenol, $C_{12}H_6O_2$, is denser than cresylic phenol, $C_{14}H_8O_2$.

Neither pure aniline nor pure toluidine produces colouring matter.

The best results, both as to beauty and quantity, and with both red and violet, have been obtained with a mixture of 70 per cent. of toluidine and 30 per cent. of aniline—that is to say, 2 equivalents of the one, and 1 equivalent of the other. These proportions agree perfectly with the formula ascribed by Dr. Hofmann to rosaniline. The object in view is then to obtain a commercial aniline thus composed.

The fractional distillation of commercial aniline for this purpose is a difficult operation. The distillation of nitrobenzol is not only dangerous, but expensive. It is better to endeavour to separate the hydrocarbides serving for the fabrication of aniline. Though this is not the usual operation, it appears to us the only rational one if aniline with an unvarying composition is desired.

The first method of separating hydrocarbides is due to Mansfield, who, in 1848 and 1849, produced the hydrocarbides of coal-tar and their derivatives, and indicated a great many applications for them. This work cost him his life. Proposing to separate benzol from the light coal oils, Mansfield heated these oils in a still with the head kept surrounded with water. The vapours ascending into the head became condensed, and fell back into the still; and after a time the water surrounding the head, not being renewed, was heated to the boiling-point. From the time the water in the open jacket reaches a temperature of 80° the benzole no longer condenses, but passes on into the worm, while the other oils fall back into the still. When the water arrives at the boiling point, only benzole passes over; after a time nothing passes, and all the benzole is separated.

This complete separation is founded on the boiling-point of water, intermediate between that of benzol, 80°, and that of toluol, 114°.

Mansfield tried to separate only benzol. The operation might easily be modified so as to separate toluol in a similar manner; it would suffice, the benzol once separated, to replace the water by some liquid—a saline solution, for instance—maintained at a constant level, and with a boiling-point intermediate between that of toluol and that of xylol.

Mansfield also tried to separate benzol with the apparatus used for the rectification of alcohol. Several patents have been taken out with the same idea, amongst which we will mention only M. Ch. Coupier's, who has effected the separation of benzol and toluol by means of an ingenious apparatus patented by him. We have seen various products from his works at Poissy, consisting of pure benzol and aniline, and nearly pure toluol and toluidine.

Some researches, for the purpose of previously separating the oils of coal-tar in an exact and economical manner, are much required, and would lead to great progress in the fabrication of aniline colours.

Another reason for insisting on this point is the considerable difference in the manner in which toluol and benzol behave with regard to nitric acid, when it is desired to transform them into nitrobenzol.

Toluol is attacked with greater difficulty; mixtures of sulphuric and nitric acids must be modified before treating this body.

In this series, in proportion as the equivalent is raised, the action of nitric acid becomes more violent, especially more oxidising, more destructive, forming nitrogenised bodies more easily; indeed, great precautions are necessary in obtaining nitrogenised derivatives from the higher hydrocarbides.

Here, then, is a cause of loss, and of the formation of secondary products. In a mixture of benzol with other oils, there is a risk of destroying a part of these oils or of leaving part of the benzol unattacked.

Moreover, is toluol a perfect homologue of benzol? The action of chlorine on these two bodies is not the same; with benzol it produces chlorides without eliminating hydrogen; with toluol it produces chlorinated toluols, the chlorine substituting itself for one or more atoms of hydrogen.

(To be continued.)

PHARMACY, TOXICOLOGY, &c.

*On the Mutual Action of the Elements of Soluble Salts without and within the Animal Economy,** *by M.* Melsens.

The experiments already made by the author, he considers, justify him in formulating the following proposition:—

Two soluble salts which are without apparent mutual action, and which may be given separately to animals

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* *Bulletin de la Soc. Chim. de Paris*, July, 1866. Abstract from the *Bull. de l'Acad. Royale de Belgique*, 1866.

without producing any disturbance in the body, may, when administered together, act as a poison.

Facts of this kind, proved by experiment, have a great importance, both from physiological and therapeutical points of view.

The two salts more especially experimented with by the author are chlorate of potash and iodide of potassium. These two salts in solution together crystallise separately under whatever conditions they may be placed. Their mixture in solution in equivalent proportions undergoes no mutual decomposition either at the ordinary temperature, on boiling, or under the pressure of 10 atmospheres at 185° C. It can be proved by means of sulphydric acid that no iodate of potash is formed.

But when the two salts are heated together in the dry state, decomposition takes place at the point of fusion, and iodate of potash is formed.

When a certain quantity of mineral acid is added to a mixed solution of the two salts, iodine is set at liberty, and the solution behaves towards sulphydric acid as though iodic acid had been produced.

When the mixed solutions are submitted to electrolysis, hydrogen is disengaged at the positive pole, and the liquor appears to contain both iodide and iodate.[†]

We come next to the effects of the before-mentioned salts on animals. Seven grains of chlorate of potash were given to a bitch weighing eleven kilos. every day for a month; the animal did not at all suffer. Afterwards five grammes of iodide of potassium were given daily for the same period. The animal suffered a little during the first days, but at the end of the month was perfectly well.

If, on the contrary, we administer to a dog daily seven grammes of a mixture of iodide of potassium and chlorate of potash in equivalent proportions, the animal languishes and dies about the twenty-fifth or twenty-eighth day. On commencing the experiment one dog weighed 16·5 kilos., at the moment of its death it weighed only 11·5 kilos. The experiment repeated on several dogs gave similar results. Death often supervened about the fifth day.

Post-mortem examinations revealed changes similar to those observed by the author when iodate of potash was administered, especially in the liver and intestines, but it is necessary to make a series of comparative experiments with the iodate, free iodine, and mixtures of the two salts.

The author has shown in previous memoirs that the iodate of potash acts as a poison. This salt, given in doses of one or two grammes daily, will kill a small dog in a few days. A mixture of the two salts cannot be so active as the iodate, since both unchanged iodide and chlorate may be found in the urine. The author is therefore brought to the conclusion that the mutual action of the two salts in the economy takes place with the greatest facility. It may be supposed that the acids of the stomach and the electrolytic actions which take place in the organism play an important part in bringing about this decomposition. But beyond all hypothesis it is necessary to admit that changes take place in the animal system which cannot be realised in the laboratory under ordinary conditions, or with the assistance of a high temperature, strong acids, or even the electric current.

PROCEEDINGS OF SOCIETIES.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology,
by Dr. Percy, F.R.S.

Lecture No. VIII.

I have some further remarks to make concerning the sulphides. Having made them, I shall proceed to consider the subject, coal.

I was speaking to you, on the last occasion, of the sulphide of lead, galena, and I showed you a specimen of it beautifully crystallised by the agency of heat alone. I also gave you, I think, conclusive reason to infer that sulphide of lead may be crystallised, and very well crystallised too, by the action of liquids. The proof consisted in the fact of galena occurring in nodules of clay iron ore —a condition under which it is impossible that it can be the result of igneous action.

There are one or two other points concerning the sulphide of lead which are very interesting. I refer to the constant association therewith of certain very important metals: I mean silver and gold. It may be laid down as a universal proposition, without any exception so far as is known, that all galena contains silver—*all.* There are varieties which contain a very small quantity of silver, and which are therefore said to be "poor:" still, if search be made for the metal, even in the poorest kinds you never fail to obtain not only traces, but far more than traces, of silver. The silver in the sulphide of lead must, of course, exist as sulphide of silver. Galena is a source of a very large supply of silver in different parts of the world. It may be laid down also, not merely as a general rule, but, I believe, as a universal proposition, that all galena contains gold—*all* galena. Some years ago my friend on my right, Mr. Smith, and myself set to work to examine this point, and we made a great many determinations with respect to the presence of gold in the ore of lead and in various commercial compounds of lead. Forty specimens or more were examined, and every one yielded palpable, visible, unmistakable traces of gold. Still, the quantity of gold is so small as to be utterly worthless in a commercial point of view. Here are the evidences of these facts. Every single specimen of gold extracted in these experiments has been carefully preserved in hermetically sealed tubes, and the condition specified. It requires rather careful manipulation. In these experiments there was no possibility of error. There was nothing added in the way of chemical re-agent, which might vitiate the result. The process consists of taking the compound of lead and simply submitting it to the well-known operation called cupelation by which silver is extracted from lead. There remains behind a very small globule of silver, and in that globule we are enabled to detect the gold by the simple action of a solvent of silver, nitric acid, which leaves the gold. It has to be taken up with great care and transferred to a piece of blotting-paper. It is afterwards gummed on to a piece of paper and then burnished, when the characteristic colour of gold immediately appears. It is a remarkable circumstance not only that gold is detected in the ore of lead, but also in the various commercial compounds of lead—white lead, red lead, sugar of lead: nay, we have even gone farther, and found it in lead fume, that is, the smoke that is volatilised from lead in the process of its extraction. We may, then, I think, safely conclude that lead contains always silver and gold. Perhaps you may object to the deduction with regard to gold as not being sufficiently supported. It is founded on forty examinations under various conditions. At all events the proof is strong, if not conclusive.

The next sulphide to which I will advert for a few moments is one of great importance. It is sulphide of zinc. It is called blende, from the German word signifying

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[†] To avoid the action of chlorine, iodine, and oxygen, the author employed retort coke as the positive electrode. The carbon was previously treated with aqua regia, and then ignited in a current of chlorine. The carbon employed in the above experiment was disaggregated, and in part burnt to carbonic oxide and acid, and at the same time a soluble black carbonaceous matter was obtained, similar to the ulmic product which the author obtained by the action of chlorine on the carbon contained in the lungs in *melanosis.*

to dazzle by light. It is a compound of sulphur and zinc in the proportion of atom for atom. It is to be seen in mineralogical cabinets presenting various colours and magnificently crystallised. Here, in this specimen, it is of a dark colour, but that is owing to the association of other matters. Sometimes it is light brown, and very rarely it is found perfectly colourless. I have seen only one or two specimens of white, colourless blende, and then only in small quantity. As thrown down from solution it forms a white powder. Here is a solution from which we can obtain it. You see it there goes down as a white precipitate, which might be collected in a filter, washed, and then dried. Now, that is the pure sulphide of zinc. It is very difficultly fusible. When heated for a long time to a high temperature it contracts very much and becomes to a certain extent fused, but not perfectly so. It is a fixed body. You may expose it to almost any degree of heat you like in a close vessel, and it will remain without being volatilised—at all events in sensible proportion. I know that it may be volatilised, but under special conditions—not under those to which I now direct your attention. Practically speaking, it cannot be volatilised. We can form sulphide of zinc (this is the point of geological interest) by heating sulphur and zinc together; but then there is a difficulty. The sulphur is very easily volatilised, and the zinc easily burns; and the misfortune is that sulphide of zinc is very infusible. Hence, what is done by this attempt to form sulphide of zinc by direct combination is to produce a sulphide on the surface of the solid zinc, which protects the mass beneath from further combination. In most other cases the formation of sulphide by direct means is not so difficult, because the sulphide very easily melts. There can be no doubt, from the same reason which I have given with regard to sulphide of iron, that in nature sulphide of zinc has been generally, if not always, produced by aqueous action. If we inspect mineral lodes containing sulphide of zinc, we may be quite certain, from the association of other minerals, that igneous action of itself could not have been employed, and that the compound has been generated by liquid reagents. Take, for example, the case of clay iron ores—a very simple and homely illustration indeed. In these ores we frequently find sulphide of zinc. Here it is, in the very centre of one of these specimens, which, I have said over and over again we have certain proof, can only have been produced by aqueous agency. Sometimes we find a large mass or nodule of clay iron ore, and it shall present numerous radiated fissures or cracks, and in the cracks of that nodule we shall find this blende; and you will always find it on the exterior first—a mass here and there. It may creep on to the very interior, but sometimes you find it confined to the exterior, showing clearly that the blende has been introduced into that globule through the agency of liquid reagents *from without*. No evidence, I take it, can possibly be clearer than that.

We will take next copper pyrites. This is a well-known mineral, and one of the most important with reference to the production of copper. It is a yellow mineral, sometimes mistaken for, and confounded with, iron pyrites, yet very different indeed from the latter. We have very fine specimens of it in the Museum, which you can examine at your leisure. We may regard this copper pyrites as composed of one equivalent of bisulphide of copper, and one of sesquisulphide of iron, $CuS_2 + Fe_2S_3$. The bisulphide of copper is the compound which is produced when copper and sulphur are heated together, and which is represented by the formula CuS_2. Copper pyrites, which is accurately represented by the formula I have given, contains, when pure, about 34 per cent. of the metal. There can be no doubt that copper pyrites has been formed in nature, frequently at all events, by aqueous action. We find it frequently in the nodules of clay iron ore. When we examine mineral lodes, metalliferous veins, we may be quite certain that the copper pyrites frequently found therein has been the result of aqueous action only. I do not mean to say that under special circumstances it cannot have resulted from igneous action, but I do say that in most instances liquid reagents have been concerned in its formation. Now for the proof. For this we are indebted to Senarmont. He made it by heating at 250° Centigrade a mixture of protochloride of iron and chloride of copper with a solution of persulphide of potassium in insufficient quantity to decompose the chlorides, and with a great excess of carbonate of soda. He obtained it by this means in a crystallised state.

I might call your attention to various other sulphides. Here is one of great interest in a mineralogical point of view, also found in our clay iron ore. It is that delicate hair-like stuff which you see here. It is sulphide of nickel. It is called millerite, after Professor Miller, of Cambridge. There is no doubt that this has been formed by the agency of liquids.

Now, be careful not to mistake what I have said with regard to the formation of these sulphides. I am not prepared to say that Nature has resorted exclusively to one mode of formation. She has doubtless availed herself of other modes than one; but there is no doubt whatever that in the majority of cases—with regard, for example, to the ordinary sulphides, iron, copper, lead, and zinc—she has employed aqueous agency for their production. I shall have more to say with respect to iron pyrites when I come to deal with the subject of iron, which I shall bring before your notice in the course of another lecture or so. So much, then, for these general remarks concerning the sulphides.

We will next take up a subject of high interest, especially at the present day: I mean that of coal. We shall consider the nature of coal, its composition, its varieties, its mode of occurrence, and other circumstances connected with coal.

In the first place, there is no doubt whatever that all coal has been derived from vegetable matter of some kind or other. The geological proof is amply sufficient to justify this conclusion. No one doubts it now. We find frequently, either in coal itself or associated therewith, the remains of the identical plants which have concurred in its formation. We can trace the formation of coal step by step from woody tissue on the one hand, to anthracite on the other hand, which is most removed from wood in composition; and on the lecture table I present you with a large series of specimens illustrating the transition as perfectly and gradually as one might desire.

I shall begin on this occasion with the consideration of the matter from which coal has been produced—woody tissue—and then proceed gradually till we get to anthracite, which, I say, is farthest removed from coal, consisting principally of carbon. After that, we shall take up the subject of graphite, a variety of carbon termed an allotropic variety, and we shall conclude by a consideration of the diamond. I am indebted to my friend Professor Tennant for a very beautiful series of illustrations of the diamond, some of which are here.

You will allow me, then, to take it for granted, without further question, as you may with reason, that coal has been formed from vegetable matter. The essential tissue of which all plants are composed is the same. It has the same chemical composition, whether we take it out of lignum vitæ or willow wood. The fundamental tissue of which the plant consists is essentially the same, and is identical in all respects wherever we find it. You will say, "But is not one wood different from another?" Doubtless it is, but that is due, not to a difference of composition in the tissue, but to the association of other matters with that tissue; and hence the variety of all the wood we find in nature.

This vegetable matter, or woody tissue (I will henceforth use that expression, woody tissue) consists essentially of what is termed organic matter (cellulose. organic matter, if you please) and water and ash, this ash being certain saline ingredients. Now, we can take the tissue, and deprive it completely of this water and of the ash. We are therefore justified in regarding the water and the ash as nothing more than mechanically present. You all know that if you take a piece of wood, ignite it, and burn it completely, an ash always remains, generally containing more or less of charcoal from imperfect combustion. That ash, I say, consists of certain saline ingredients which are always present in wood. Potash, silica, and lime may be regarded as the chief constituents. All tissue contains hygroscopic water: by that I mean water which is contained in the wood just as water is contained in the pores of a sponge. You can displace that water from the wood by just exposing it to a gentle heat. Then the wood, upon being exposed to the atmosphere, will reabsorb the water. The driest table or piece of furniture contains about 18 per cent. of this mechanically associated water. The cracking of furniture is due to the variation of the quantity of water, corresponding with certain variations of the temperature of the air. You will see the bearing of this, because I shall show you that certain varieties of coal are very analogous to wood in this property of containing hygroscopic water—the water which I told you is always mechanically present. Wood, when freshly felled, contains a much larger quantity of water than wood which has been felled a greater length of time. Under certain conditions fresh wood contains quite half its weight of water. There are many kinds of wood used for mechanical purposes, many of which are quite familiar to you, but I have not to deal with these things specifically, but generally.

Now, all wood consists essentially of carbon, hydrogen, oxygen, and a little nitrogen. Then there is the ash and the hygroscopic water. I have made a calculation from a great number of careful analyses of wood made by French and German observers, and have got the mean result from two extensive series. The results do not exactly coincide, but still they are sufficiently near for our purpose. It is important that you should note the composition of this woody tissue, because it is the source of all our coaly matter. Here is the mean composition, calculated from the experiments to which I have referred:—

	Per cent.
Carbon	51·215
Hydrogen	6·237
Oxygen	41·449
Nitrogen	1·098
Ash	1·772

Such, then, is the ultimate composition of all woody tissue. You will find by calculation that the hydrogen is practically a little in excess of the oxygen. I say practically. I do not mean to say theoretically; but regarding the oxygen here as in combination wholly with the hydrogen. I do not mean for one moment to say that it is actually so in the wood, but for our purpose we may so regard it. This being the case, then, wood may be regarded as composed of carbon plus water, and a little hydrogen in excess. Now, it is a singular thing that in burning that wood and estimating the whole of the heat evolved therefrom by perfect combustion, as we can readily do by means of the apparatus called the calorimeter, we find actually that all this oxygen is combined with a corresponding amount of hydrogen—that is to say, an atomic proportion, or may be so regarded. It there represents so much water, and therefore causes a great loss of heat; because in the burning of that wood the whole of that water, which is there in a solid state, has first to be liquefied, and then to be converted into vapour. Now, this is a practical remark which applies to all fuels, and is of great consequence commercially and economically. Generally speaking, just in proportion to the amount of oxygen present in a fuel, it is deprived of heat-giving power, for the simple reason that that oxygen may be regarded as so much water, being combined with hydrogen, a little hydrogen always being in excess. We get, then, in the burning of wood, heat simply from the combustion of the carbon present.

With regard to the nature of the ash I do not think I need trouble you. There are many analyses given, but they are not so satisfactory as might be desired. Potash, for example, is obtained by the incineration of woody matter, hence the name of "potash." Then there is soda present, especially in plants dwelling near the sea. There is lime also in large quantity, and magnesia. Alumina is a doubtful thing. It has been found, or is said to have been found, but possibly there has been an error in the determination. It is difficult to understand how the alumina could get into the plant. The potash in the wood ashes is combined with carbonic acid, but this base is not so combined in the tissue of the plant itself. Then there is also a little phosphoric acid.

A great deal of high interest might be said of the rapidity of the growth of wood, but I have hardly time to dwell upon that point now.

From wood we pass on to peat. That is the first step in the conversion of wood into coaly matter. I do not mean to say that it is the first actual step, because between wood on the one hand, and peat on the other, there is a pretty wide difference; still that is the first decided step. I could supply you with a series of specimens illustrating the transition perfectly. We go to a peat bog and examine it: the upper part of the bog is covered with moss, chiefly of the order called sphagnum, a very beautiful kind of moss. This goes down lower and lower, and is gradually decomposed and converted into a substance called peat. This peat consists of the identical woody tissue—cellulose—which occurs in large trees. Now, considering the growth of a moss like this, diving downwards as it extends upwards, you can conceive there is a complete transition from the unchanged moss at the top right away down to the carbonised and black stuff forming peat at the bottom. Hence, in the examination of a peat bog, you will always find that the upper part will be the least removed from the woody tissue in composition, and that which occurs deepest in the bog will be most decomposed, farthest removed from wood, and most allied to coal. These peat bogs we find not only in our own country, and in other parts of Europe extensively, but even in hot and tropical regions—there not generally on the surface, but up high hills where we get a climate resembling that of Scotland. In North Carolina there is a large quantity of peat occurring, according to Sir Charles Lyell, to the depth of fifteen feet or so. There is one point of interest with regard to the source of peat. While that which is found in Europe has been derived almost entirely from mosses—these sphagnums, associated, it is true, with a variety of other plants, but only to an insignificant extent—the peat in India has been, in several cases at all events, formed from plants of a totally different nature. According to my late friend Dr. Falconer, peat occurs on the banks of the Hooghly, at Calcutta. These peat bogs occur in various parts of India. I have here a statement taken from the *Journal of the Asiatic Society* of Bengal concerning peats in Bengal derived entirely from the wood rice or *Oryza silvestris*. I have here a peat from the Neilgherry Hills in India not formed from mosses: it is important to bear that in mind. We have, as every one knows, very large deposits of peat in Ireland. That peat has been carefully examined under Sir Charles Keen's direction, and the result published in a blue-book. On comparing his analyses together, we get, first of all, the least changed kind of tissue, which has very nearly the composition of woody tissue before the process of decomposition commences, and then we have a gradual series of peat until we come to that which is most changed and most removed from woody tissue, and nearest in its resemblance to coal. This is called brown coal, of which I will speak hereafter.

The ash of peat contains, as you might expect, the same elements, for the most part, as the ash of ordinary plants. Still, there are certain differences. Consider the mode in which the peat bog is formed, then the rushing in of water from time to time, streams flooding it, and so on, and the carrying in of various matters by these sometimes turbulent streams—such as sand, clay, and other things foreign to the peat itself. You can easily see how peat may thus get intermingled with a large amount of what may be perfectly well called foreign matter. That has a very important bearing especially in relation to the association of copper and other mineral matters. There was a peat bog in Wales some time ago, in which a large quantity of copper was found and profitably extracted. Iron pyrites was also met with.

You know the antiseptic property, or preserving power, which peat has—how pieces of wood have been preserved by it, though darkened in colour.

Peat contains water, as water is contained in a sponge, which may be expelled either by pressure or by desiccation.

(To be continued.)

ACADEMY OF SCIENCES.

August 6.

M. P. Truchot presented a note "*On the Combinations of Chlorhydric Glycide with Acid Chlorides and Anhydrous Acids.*" A mixture of epichlorhydrine and acetic chloride heated for thirty hours to 100° in a sealed tube yields two new bodies, which can be separated by distillation under pressure. The first is the *acetotrichlorhydrine* of diglyceric alcohol, and the second the *acetoquadrichlorhydrine* of triglyceric alcohol. By heating chlorhydric glycide and anhydrous acetic acid in the same way to 200°, diacetochlorhydrine was obtained.

The same author presented a note "*On the Oxidation of the Radicals of Diatomic Alcohols by Permanganate of Potash.*" Ethylene, the author states, and its homologues decolorise a solution of permanganate, and give rise by direct oxidation to acids of the series of fatty acids. A carbide C_nH_{2n} gives all the fatty acids corresponding to the terms below it in the series. At least, the author thinks he may safely conclude so, from his experiments with ethylene, propylene, and amylene. With ethylene he obtained formic acid; with propylene, formic and acetic acids; and with amylene, formic, acetic, propionic, and butyric acids. In each case the author proved the absence of the acid corresponding to the carbide of hydrogen employed. In these experiments crystallised permanganate was employed, an excess of alkali being objectionable.

M. C. Davaine presented a note "*On the Rotting of Fruits.*" The natural rotting of fruits, the author states, is due ordinarily to the development of two microscopic fungi, *Mucor mucedo* and *Penicillum glaucum*. The thicker the epidermis of a fruit, the longer it will keep. The author points out some difference in the progress of the change under the influence of the two fungi; that produced by *Mucor* being much more rapid than that set up by *Penicillum*. The whole paper is of considerable interest to naturalists.

NOTICES OF BOOKS.

Bulletin Mensuel de la Société Chimique de Paris, &c., &c. July, 1866.

The proceedings of the Chemical Society of Paris at the last two meetings do not offer much of interest. M. Berthelot on June 15 described the experiments on the action of sodium and potassium on the carbides of hydrogen, which we have already laid before our readers. It will be remembered that the carbides experimented with were only attacked by the alkaline metals at a red heat. In sealed tubes they may be fused under benzine without any gas being disengaged, and the metals will preserve their metallic lustre for any length of time. M. Berthelot points out a source of error in all experiments of the kind made with potassium. However short a time this metal may be exposed to the air, a small amount of carbonate is formed on the surface, and the decomposition of this produces a small quantity of acetylide.

On July 6 M. Melsens, of Brussels, communicated an important note "*On the Mutual Action of Chlorate of Potash and Iodide of Potassium within the Animal Economy.*" It will be found at length in another place. Chemists and medical men are too apt to regard the human stomach and organism as a sort of laboratory, the processes going forward in which are to be as easily controlled and directed as those carried on in beakers and flasks. In this paper, most important to physiology and therapeutics, M. Melsens shows that two salts which have no action on each other without the body do react when introduced into the animal economy. Whether there is such a thing as *vital force*, which here becomes superadded to chemical force, or whether the reaction can be accounted for by the more intimate contact into which the salts are brought in the course of their passage through animal membranes, we must leave for the present to conjecture.

On July 6 M. Berthelot addressed the Society on the subject of M. Stas' last determinations of atomic weights, and gave his reasons for believing them to furnish a conclusive answer to the objections raised by Marignac to the first series. In the introduction by M. Stas, the publication of which we commence in this number, our readers will see the answer of M. Stas himself, and will probably agree with M. Berthelot in regarding it conclusive.

We give here the titles of the papers presented to the Society now published: "*On Isomerism in the Allylic Series,*" by M. A. Oppenheim, and "*On Allyl-ethylic Ether,*" by the same author. The former paper we have already noticed; in the second the author mentions that when allyl-ethylic ether is treated with a strong solution of hydriodic acid, iodide of allyl, iodide of ethyl, and water are produced.

The usual analysis of foreign papers contains a number of useful abstracts from the German journals. We give the titles of the more important: "*On Erbia and Yttria,*" by MM. Bahr and Bunsen; "*Researches on Tantalum, Niobium, and Ilmenium,*" by R. Hermann; "*On the Tantalic Group,*" by M. Bloxam (probably a misprint for Blomstrand); "*On Sulphocyanacetic, Thioglycolic, and Thiodiglycolic Ethers*" by Heintz; "*Researches on the Aromatic Combinations,*" by Kékulé; "*On some Substitution Products of Phenylic Alcohol,*" by Koerner; "*On some Substitution Products of Benzine,*" by A. Mayer; "*On some Sulphuretted Derivatives of Toluene,*" by C. Maercker; "*On a New Class of Organic Compounds in which Hydrogen is replaced by Nitrogen,*" by P. Griess. The shorter notices will furnish us with a few miscellaneous paragraphs. Two errata in the memoir of M. Weltzien "*On Peroxide of Hydrogen and Ozone,*" one of which was transferred to our pages, are here corrected: at page 39, line 29, column 2, for "*does not ignite spontaneously inflammable phosphuretted hydrogen,*" read "*ignites non-spontaneously inflammable phosphuretted hydrogen.*" The second erratum was so obvious that we corrected it in our translation.

Journal de Pharmacie et de Chimie. July, 1866.

This Journal contains a paper, by M. Leon Soubeiran, "*On the Mineral Substances of the Chinese Materia Medica.*" It is accompanied by a plate giving the Chinese characters and names for all the remedies. A note, by M. J. Nicklès, "*On the Pretended Wide Distribution of Copper,*" points out that the source of traces of copper in ashes is often the Bunsen's burner used for the incineration, and of course suggests that only the steatite burner should be employed in these operations. A note, by M. Filhol, "*On the Preparation of Medicinal Tinctures*," contains an observation or two which may be worthy of attention. The author notices that tinctures prepared by displacement give, in a day or two, a deposit which may or may not be inert matter, but which deserves an examination. He remarks, also, that the density of a tincture is no certain test of its value, which should be determined by the amount of active matter in solution. According to M. Filhol, alcohol is not so good a preserving agent as is generally supposed, and tinctures ought to be used as soon as possible after their preparation. There are some other remarks which, coming from such an authority as M. Filhol, may deserve the attention of pharmaceutists, and we shall give the note at length.

A number of papers from the *Comptes Rendus* follow, which we need not notice.

The usual Pharmaceutical Review contains a short paper "*On Crystallised Citrate of Magnesia*," by M. Morelli. The author mixes proper proportions of crystallised citric acid and freshly precipitated carbonate of magnesia with a small quantity of water, and stirs frequently. When, he says, the carbonic acid ceases to be disengaged, the whole is suddenly transformed into a crystalline mass resembling moist barley-sugar, which has only to be dried. The mass is composed of small crystals, which easily dissolve in four times their weight of water. The salt has an acid taste, and forms an agreeable drink with a little flavoured syrup.

There is also a note by Dr. De Vrij "*On the Purification of Quinoidine*." Commercial quinoidine contains a good deal of lime, which the author removes by boiling with a solution of oxalate of ammonia. The quinoidine dissolves and ammonia is disengaged, the foreign matters falling to the bottom. The solution is poured off, diluted if necessary, and filtered, and the quinoidine is then precipitated by means of caustic soda, drained, and dried.

A note by M. Stanislas Martin "*On Liquid Kino*" recommends pharmaceutists to buy only the liquid juice and evaporate it for themselves. The solid extract, the author states, is adulterated with catechu.

The next paper is by M. Besson, "*On Liquid and Dried Pepsine*." The author states that in the course of drying pepsine loses the greater part of its digestive power, and details an experiment which goes to prove the assertion.

The proceedings of the Paris Pharmaceutical Society offer but little of interest. M. Rouher made a communication "*On the Blue Colouring Matter of Urine, Urocyanine*," which he isolates by adding to the urine first its volume of alcohol, and then one-fifth of sulphuric or hydrochloric acid. Chloroform shaken up with the mixture removes all the colouring matter, forming a pure blue or violet solution. It is better in the first place to treat the urine with subacetate of lead.

M. Robinet told the Society that it was better to use pounded glass than shot in cleansing bottles.

The usual abstracts from foreign journals contain a few notes which we transfer to our miscellaneous columns.

Annalen der Physik und Chemie. No. 5. 1866.

This number of Poggendorff's *Annalen* is mainly devoted to physics. We have, however, "*A Contribution to the Knowledge of Axinite*," by G. Vom Rath; a short paper "*On the Behaviour of Glauber Salt Solution at Low Temperatures*," by Dr. F. Lindig; a paper "*On the Composition of Wiserin*," by Dr. Wartha; "*On Isomorphous Mixtures of Perchlorate and Permanganate of Potash*," by Rammelsberg; and "*On Crystallised Sulphide of Sodium*," by the same author. We have a paper by Bunsen, "*On the Absorption Spectrum of Didymium*," illustrated by excellent diagrams; and also a learned contribution by C. Eckhard "*On Hydrodiffusion through Animal Membranes*."

NOTICES OF PATENTS.

Mr. Isham Baggs' (No. 2719, Oct. 21, 1865) patents "*Improvements in the Manufacture of Inflammable Gases and in their Application to Useful Purposes*." The inflammable gas is hydrogen, which is produced by passing steam over red-hot iron. The oxide is then reduced in the following way:—

"Carbonic acid gas, however derived or produced, is passed through or over red-hot or ignited coke or carbon, arranged in suitable retorts or receptacles (as is well understood by persons acquainted with such operations and with the chemistry of the gases and the materials in question), and the same is then conveyed through the retort or vessel containing the oxidised iron, from which retort or vessel the hydrogen has been eliminated. The result of this operation is that one volume of carbonic acid gas in passing through or over the ignited coke or carbon takes up an additional equivalent of the latter, and is thereby converted into two volumes of carbonic oxide gas, which latter gas then passing on through the retort or vessel containing the oxidised iron takes up the oxygen from the same, and is thereby again converted into carbonic acid, restoring at the same time the iron to its normal or metallic condition, capable of decomposing steam again."

This is another case of patenting well-known chemical processes.

Carl Gustav Lenk (No. 2674, Oct. 17, 1865) patents "*An Improved Process for Purifying and Preserving Water*." This is a combination of well-known processes. The inventor makes use of a solution of alum and carbonate of soda, and a solution of iron or permanganate of potash, and adds such a mixture to the water. What the patentee hopes to secure it is hard to see.

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

Notices to Proceed.

927. R. Hineson, Manchester, "An improvement in aërated waters."—Petition recorded March 31, 1866.

941. E. Brooke, jun., Huddersfield, "Improvements in the construction and arrangement of apparatus and material for effecting the deodorising of noxious gases arising from sewers and drains, and for the more effectual ventilation of such sewers and drains."—April 2, 1866.

952. J. Robey, Newcastle-under-Lyne, Staffordshire, "Improvements in reburning animal charcoal."—April 3, 1866.

959. W. Betts, City Road, Middlesex, "Improvements in colouring capsules."

960. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of sugar."—A communication from F. J. Chauvin and F. M. Légal, jun., Paris.—April 4, 1866.

1049. A. Swan, Kircaldy, Fife, "Improvements in apparatus for evaporating or recovering lees."—April 13, 1866.

1102. R. Hamilton, St. Helen's Place, London, "An improved composition for coating or covering ships' bottoms and other surfaces subjected to the action of seawater."—A communication from J. Beeston, Table Bay, and J. Spence, Cape Town, Cape of Good Hope.—April 19, 1866.

MISCELLANEOUS.

Death of Mr. Hadow.—It is with much regret that we announce the death of Mr. Edward Ash Hadow, for many years Demonstrator of Chemistry in King's College, London. Wholly absorbed in the study of chemistry, Mr. Hadow was personally known to but few who had not the advantage of his assistance in the laboratory. But his labours in photography, and his admirable researches upon the composition of gun-cotton and the platinum bases, will secure for him a wide reputation. As yet the scientific public have not had full opportunity of judging of the value and extent of his researches respecting the constitution of the platinum salts, for these were embodied in a paper and presented to the Chemical Society only a few weeks ago. While his colleagues lament the loss of a much-esteemed friend, we feel that death has deprived the science of chemistry of one whose singular devotion to its study, and whose clearness and originality of thought and mature experimental knowledge, promised to do much for its advancement. Mr. Hadow died of pleuropneumonia on the 11th inst., after a prolonged illness, in the 35th year of his age.

Nitroleum, the New Substitute for Gunpowder.—A highly interesting official report has just been made by Colonel Shaffner of a series of experiments conducted by him at Washington, for demonstrating the use of nitroleum (which it should be explained is the new and far preferable name by which the Colonel designates the compound which has hitherto been called nitro-glycerine) in the explosion of mines. The results fully confirm the fact that the explosive qualities of nitroleum are far in advance of gunpowder. Two similar cast-iron pieces, weighing each 300 lbs., had a hole one inch diameter and fifteen inches deep bored in them, and were charged one with powder and the other with "nitroleum." The powder discharged through the fuse-vent three-sixteenths inch diameter did no injury. The nitroleum tore the iron to pieces, the force extending downward from the bottom of the charge, leaving a cone with its apex at the bottom of the drill-hole. Four musket-barrels were placed in wrought iron cylinders, two filled with gunpowder and two filled one-third full with nitroleum. The musket-barrels charged with powder were exploded by electricity; they burst open, tearing the iron to pieces. The explosion of the barrels charged with nitroleum produced a very different effect; they were flattened, and not so much broken to pieces; the force was so sudden and great that after the barrel had irregularly broken up and down the iron appeared like rolled plate—even and polished. The experiments appear to demonstrate that nitroleum can, with ordinary precautions, be handled and employed without greater danger than is common to gunpowder, and for blasting operations, at least, it presents undoubted advantages.—*American Artisan.*

Composition and Quality of the Metropolitan Waters in July, 1866.—The following are the Returns of the Metropolitan Association of Medical Officers of Health:—

Names of Water Companies.	Total solid matter per gallon.	Loss by ignition.*	Oxidisable organic matter.†	Hardness.	
				Before boiling.	After boiling
Thames Water Companies.	Grains.	Grns.	Grains.	Degs.	Degs.
Grand Junction	17·49	0·70	0·60	13·0	2·5
West Middlesex	16·77	0·80	0·76	12·5	2·0
Southwark & Vauxhall	17·10	0·58	0·49	13·0	3·5
Chelsea	16·60	0·68	0·60	13·0	2·5
Lambeth	18·39	0·75	0·72	13·0	2·5
Other Companies.					
Kent	27·86	1·00	0·02	18·0	8·5
New River	17·16	0·90	0·20	13·0	3·0
East London	18·16	0·80	0·40	13·5	3·5

* The loss by ignition represents a variety of volatile matters, as well as organic matter, as ammoniacal salts, moisture, and the volatile constituents of nitrates and nitrites.

† The oxidisable organic matter is determined by a standard solution of permanganate of potash, the available oxygen of which is to the organic matter as 1 : 8; and the results are controlled by the examination of the colour of the water when seen through a glass tube two feet in length and two inches in diameter.

H. Letheby.

The analysis of the metropolitan waters during the month of July shows that in every case there is less than the average proportion of saline and organic matters, and the reduction of the latter, which is the most important constituent of potable water, is most marked in the waters derived from other sources than the River Thames; for while the amount of organic impurity in the latter has ranged from 0·49 to 0·76 of a grain per gallon, that of the former has been from 0·2 to 0·4 per gallon. Indeed, the quantity of organic matter in the Kent water has fallen from an average of 0·2 of a grain to 0·02, that of the New River from 0·46 to 0·2, and that of the East London from 0·53 to 0·4. These reductions in the quantity of organic matter are chiefly due to the care with which the processes of filtration are conducted; and if these analytical results are compared with those of a few years ago, the improvement is still more remarkable. It is very probable, however, that the most perfect processes of purification, so far as they can be used at the works of the water companies, will never be sufficient to insure such a purity of water as the complete removal of those subtle agents of disease, which even the most refined appliances of the chemist have failed to discover. It may, therefore, well be that all discoverable traces of organic matter may be removed from water, and yet it may still contain enough of the minute germs of disease to manifest its morbific action wherever it is used. Experience, indeed, teaches us that it is not the quantity of organic matter in water so much as its quality which determines its dangerous properties; and if it is true, as modern pathological science has almost demonstrated, that the real agent of such diseases as infectious fevers, cholera, the rinderpest, and other allied zymotic maladies, are living germs, and not a gas, or vapour, or dead organic miasm, it must rest with the physiologist, rather than with the chemist, to decide on the means which are best suited for their destruction; and it is more than probable that the chemist would be putting forward very dangerous propositions, if by relying on his science alone he ventured to dogmatise on so difficult a subject. That which has been abundantly proved in respect of smallpox and some other infectious diseases is very applicable to the present inquiry in so far as it relates to the more than possible existence of choleraic germs in the water we drink. The agents of those diseases are unquestionably living germs, capable of remaining dormant for an uncertain, but nevertheless not indefinite period, and then springing into activity and multiplying themselves without limit, directly they find the condition necessary for their active development. But whether these germs are susceptible of oxidation, like common dead organic matter passing through its final stages of decay, is more than chemical science alone can determine. The analogies in physiology are against such a supposition, and they warn us not to receive it even as a possible fact. That which we do know, however, is that these germs are destroyed by the temperature of boiling water; that they are killed by all caustic substances, as chloride of zinc, chloride of iron, &c.; and that they cannot resist the action of certain agents, as sulphurous acid and its salts, carbolic acid, which act on them after the manner of specific poisons. We must, therefore, look to these agents rather than to processes of oxidation for reliable prophylactics; and in the case before us, the only agent on which we can confidently rely is heat; for if the infected water be boiled the choleraic germs will be rendered innocuous. That the destruction of decaying organic matter in water is of the greatest importance there can be no doubt, for experience has proved that it also is productive of disease. It is, moreover, certain that organic matters of this description are rapidly oxidised by permanganate of potash and by filtration through animal charcoal and charcoal mixed with certain compounds of iron; but it is more than doubtful, even if it were practicable, whether such processes of purification should be used by the water companies at the sources of supply—seeing how many causes of pollution exist between those sources and the consumer. Besides which, it must not be forgotten that only a very small part of the water delivered by the companies is used for primary domestic purposes—the great bulk of it being employed for flushing closets, drains, and sewers, for watering streets, and for various manufacturing operations. It would, therefore, manifestly be an unnecessarily wasteful application of a tedious and expensive process, to do that at the works which can be so easily, so surely, and so much more economically done at the point of consumption. But, after all, the most important consideration at the present time is the means of obtaining a constant water supply, so that the prolific sources of contamination and of real danger to the community, the filthy butts and cisterns, may be entirely abolished. The very first step towards the attainment of this object must be made by the public themselves; for it is idle to expect a constant supply while there is the present imperfect condition of almost every household service. If, indeed, such a supply were at once given to us, it would assuredly fail, for all the water of the Welsh hills would be insufficient to maintain it. The daily supply of water to London is at the rate of about thirty gallons per head, whereas experience has proved in many instances that with a well-regulated constant service it need not exceed twenty gallons a head. As a matter of economy, therefore, as well as of public health, it is high time that the consumer should make preparation for such a supply in the way that the Act of Parliament directs, and then there would be no difficulty in applying processes of purification at every point where the water is used for domestic purposes. At the present juncture it is advisable that all water stored in butts or cisterns should be boiled before it is drunk, and where it is practicable, it should be previously filtered through animal charcoal, or charcoal associated with proper compounds of iron; and failing this, it may be treated with a little of Condy's solution of permanganate of potash until it retains a very pale but decided tint of rose red. In all cases, however, it should be boiled.

Rhœadine.—Hesse, looking for morphia, has discovered a new alkaloid in the red poppy; it is also to be found, he says, in good opium. It is soluble in water, alcohol, and ether, crystallising from the last in white prisms. Ammonia precipitates it in white crystalline flocculi, bichloride of mercury gives a white amorphous precipitate, chloride of gold a yellow precipitate. Strong acids decompose it in the cold, giving a purple solution. The author promises to publish his method of extracting *Rhœadine.*

Condy's Fluid and Carbolic Acid.—All London is now smelling of carbolic acid. Placards recommending disinfectants are affixed to every wall, and in the parish in which we live men are going round the houses of the poor with instructions to put a dose of carbolic acid into every sink and closet, and to put half an ounce of Condy's red fluid into every water receptacle that is made of wood. These measures are taken in the belief that something dangerous lurks in dirty drains which carbolic acid can destroy, and something in suspicious drinking water which Condy's fluid can destroy, leaving the water fit for use. So far as regards cholera, the dangerous matter may be of three kinds: either living matter of some low sort, as held by Dr. Beale, and rendered most highly probable by the Cattle Plague Reports; or an alkaloid, as held by Dr. Richardson; or, lastly, matter in a state of change, according to Liebig's theory, which last hypothesis is not inconsistent with the first. Let us suppose a water of a bad, or at least a suspicious marshy smell; the addition of one or more drops of "Condy," or of one of the finer solutions of permanganate, will speedily remove that smell and taste, and make the water fresher and nicer. The quicker the decoloration, the greater the need of it. If water so treated, with a slight pink colour remaining, be passed through a filter, it comes out perfectly clear and colourless; but without filtering may be used for cooking or making tea and coffee after the brown sediment has settled. Most assuredly any one thirsty enough to drink raw London water just now had better use the permanganate and filter too. It seems generally agreed that the gases of decomposition are very quickly neutralised by this means, and that organic matter actually decomposing very quickly decolorises the liquid also. But this is not the case with *stable* organic matter. Water coloured with Condy so as not to be drinkable with pleasure, yet may contain animalcules in the most lively state. Nay, the amœba, paramœcium, colpods, and other disgusting broods are not in the least affected by water too reddened to be drinkable. The same with regard to minute plants. Give *quantity* enough and *time* enough, and all will be destroyed—first, the stinking gases; next, the decaying organic matter which evolves them; then the microscopic animalcules which feed on it, and which, if not destroyed by the Condy, would die of starvation; and the plants last. Time and quantity also are required for the destruction of such a substance as the bitter extract which is diffused into water from quassia; this may be got rid of in twelve hours. The resistence of strychnia is much greater; still a very weak solution may be deprived of all bitter taste by excess of permanganate in twenty-four hours. Matters having organic form and firmness, as starch, &c., if not decomposing, are very slowly acted on. Animalcules of the kinds indicated may also live in water just containing carbolic acid enough to be smelt and tasted. The conclusions we would draw from the above remarks are that when we employ the carbolic acid for the disinfection of drains, sinks, etc., it ought to be employed in a state of pretty high concentration and large quantity, so as, above all things, to purify the aperture out of which the dangerous emanations would come. Likewise in the use of Condy's fluid for purifying water-butts, enough should be used, but we should take care also that the butts themselves are cleansed, and pitched or charred inside, for it is a waste of force to use the permanganate to do what might be done by a handful of lighted shavings and a brimstone match.—*Medical Times and Gazette.*

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. XIII. 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., II., and VII. are out of print. All the others are kept in stock. Vol. XIV. commenced on July 7, and will be complete in 26 numbers.

To Medical Officers of Health and Others.—The Editor will feel greatly obliged if Medical Officers of Health, and others in authority in any part of the kingdom, will forward to him, at the office of this paper, any printed papers or directions which they may have issued in their respective districts, having reference to the precautions recommended to be taken during the present prevalence of cholera.

Un Ami is requested to send his name and address.

E. O. F.—You had better apply at once to the medical officer for your district. The handle should be removed immediately: the water is dangerously impure.

F.C.S.—The practice is, to say the least, unprofessional and undignified, and we must express our regret that any Fellow of the Society should adopt it. As put before us in its present shape, however, the matter is not ripe for publication.

Y. H.—We were not aware of the existence of the battery. The *rationale* is not difficult to understand. When the circuit is closed the copper dissolves in the sulphuric acid, whilst the hydrogen evolved at the carbon pole is instantly oxidised by the oxygen of the chromic acid it there meets. The objections appear to be (1) the necessity of a porous cell, and (2) the expense of consuming copper instead of zinc.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Researches on the Volatile and Fixed Oil of the Fruit of Samphire (Crithmum maritimum), by M. HÉROUARD.

THE samphire is an umbelliferous plant growing abundantly on the rocky coasts of France and England. All parts of the plant are aromatic, and it is used as an ingredient in flavouring pickles, etc. The most favourable time for the extraction of the volatile oil is from September 10 to October 15, and the fruits yield 1·5 to 1·6 per cent. of the oil.

The oil of samphire is composed of a light and a heavy oil, the latter separating from the milky distilled water on standing, the former, which is the aromatic oil of the plant, floating on top. This is limpid and mobile when recent, has a sweet odour and hot aromatic taste. It boils at about 350° Fahr. Its specific gravity is 980° at 55° F. It is oxidised by the air, becomes thick and heavier than water; when recent it remains fluid at 49° Fahr., but the old oils deposit silky needles when cooled. Further investigation found this body to be a result of oxidation, and to be an acid, and the oil itself to yield, by the action of weak nitric acid, a hydruret of a compound radical parallel with benzyl, which the author calls "crithmyle," and which forms combinations with chlorine, bromine, and iodine. The acid by oxidation is crithmic acid.

Hydruret of crithmyle is an oily brown liquid of specific gravity 1·07, has an aromatic odour of the plant; its taste acrid and burning, affecting the throat strongly; it is insoluble in water, but readily soluble in alcohol and ether, and burns with a sooty flame.

Crithmic acid presents the form of colourless brilliant prismatic needles which resemble those of benzoic acid, a taste lightly acid, no odour, volatile without decomposition. Slightly soluble in cold water, more soluble in hot water, and readily in alcohol and ether and in the oil of samphire, from which it is derived.

The fixed oil of the fruit is siccative, of an orange yellow colour, and oxidises readily in the air to a brown soft solid.—*Jour. de Pharm.*, May, 1866, 324.

On a Process of Organic Elementary Analysis, by Combustion in a Stream of Oxygen Gas, by C. M. WARREN.

THE process in general use for ultimate organic analysis had seemed to me so nearly perfect as to leave little room for any very marked improvement. Like all other processes of analysis, however, it has its own peculiar sources of error, inherent in the nature of the substances employed, and in the manipulations to be performed. But these appear to have been reduced to a minimum; so that, with great care and the necessary skill, there can be no reason to doubt that that process, with the various modifications which have been proposed to meet special cases, is capable of affording as accurate results, in a majority of instances, as can, perhaps, be claimed for any other analytical process. Nevertheless, there are instances, and they are doubtless numerous, where so satisfactory a solution of the question which may be under consideration as would be highly desirable, cannot be attained by that process. It was after repeated unsuccessful efforts, in a case which appeared to be of this kind, that I was led to conceive the idea of making the combustion in oxygen gas alone, and to devise the method which I am about to describe.

Were it not for the danger of explosions in the combustion tube, the occurrence of which would, at least, render its use fruitless of good results, the employment of pure oxygen, as a combustion agent in analysis, would seem, of all substances, the one most naturally suggested. This apparent difficulty is probably the chief reason it has not long ago been brought into general use; its employment since the time of Prout, so far as I am informed, having been mostly confined to the combustion of the residual carbon of highly carbonaceous substances, after the other decomposition products, containing the hydrogen, had been burnt at the expense of oxide of copper.

By a very simple device I entirely obviate the danger of explosion—viz., the combustion tube is closely packed with asbestos, or other inert substance,* and yet so loosely as to leave free passage for gases through the interstices. The packing of the tube requires some care. This, however, may be readily accomplished, giving great uniformity to the mass of asbestos, by having the latter carefully broken into small loose pieces, which are gradually added to the tube, and arranged in position by means of a stiff iron wire. Little attention need be had to the packing of the centre of the tube, as this will come right of itself, if the packing against the sides is properly done. It will be found convenient and expeditious to turn the tube continuously in the hand, and cause the end of the iron rod to follow around against the sides of the tube, placing the asbestos, by gentle taps, alongside its inner surface, so that only very small open spaces may be seen.

In the experiments which I have made I have generally had about ten or twelve inches in length of the tube filled with asbestos. As the combustion takes place within a very short space, it seemed at first that the tube might be reduced considerably below the ordinary length; it was found, however, that shortening of the tube below a certain limit made it difficult to control the distillation of volatile substances and prevent too rapid combustion; it being essential in this, as in other processes, that the combustion should proceed slowly, and with a good degree of regularity; otherwise it would be difficult to regulate the supply of oxygen to meet the demand of the burning substance. By having the column of asbestos of considerable length, the anterior end of which only is ignited, the substance, if volatile, becomes diffused through a large space, and the distillation thereby easily controlled; as only a small portion of the substance need then be heated at a time. Doubtless a shorter tube would answer equally well for many non-volatile substances. It will be observed that the asbestos packing is but another application of the principle involved in the use of wire gauze in Davy's safety-lamp.†

In order to obtain perfect control of the analysis, and

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* I have used only asbestos in my experiments thus far, and in every instance with perfect success. Quartz sand, selected with care as to the size of the grains, had suggested itself, on account of greater convenience in filling the tube, as it would properly arrange itself on simply being poured into the tube. It would, however, be liable to the objection, that any jarring of the tube, while lying upon the combustion furnace, would be likely to settle the particles more closely together and form a channel along the top, in which an explosion might take place which would spoil the analysis. I therefore prefer asbestos to anything which I have thought of; and any apparent inconvenience in preparing a tube with this substance will pass into insignificance, if the precautions which I advise for protecting the tube from breakage are observed, as then the same tube may be made to last for a long time.

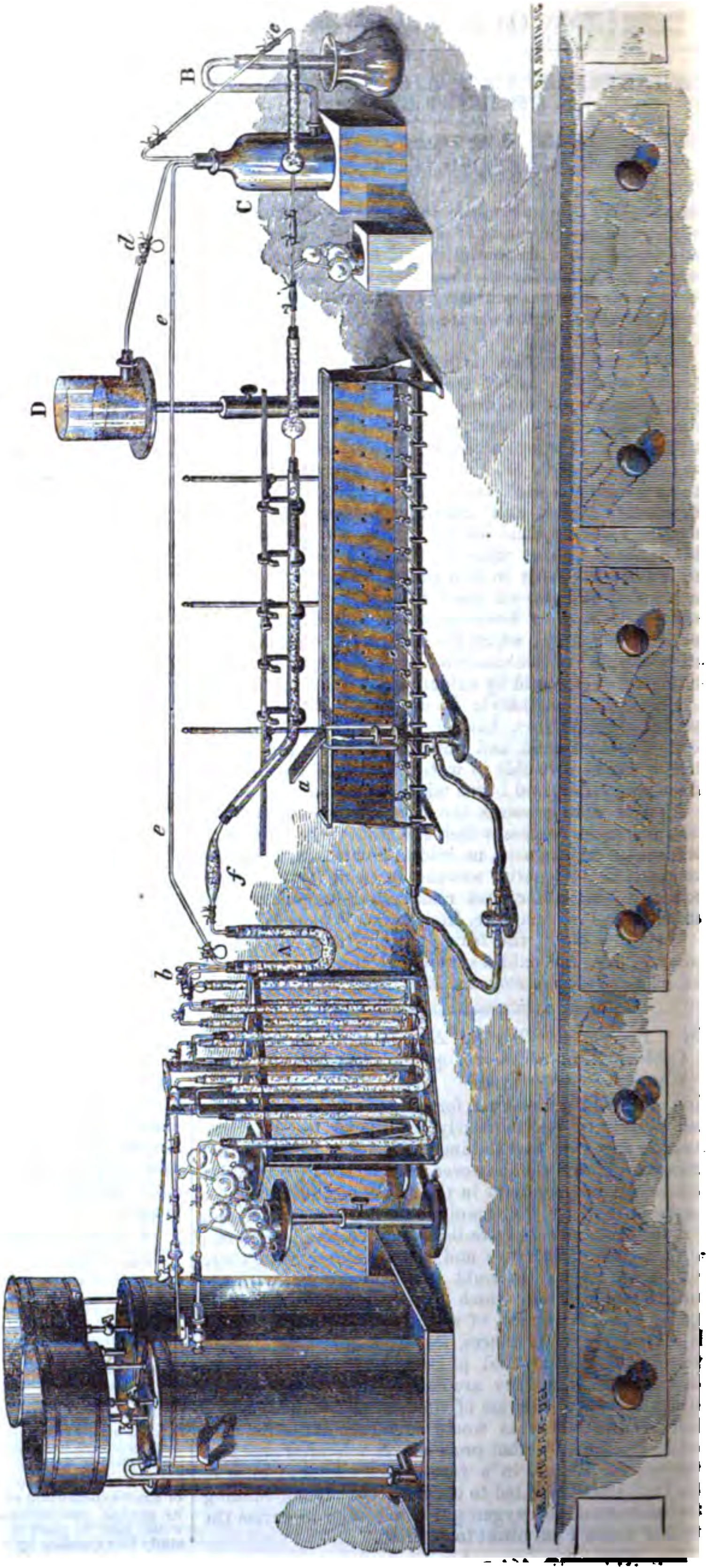
† It has occurred to me that my safety-tube may serve as the basis of a more simple and equally accurate process for the analysis of gases, by gradual combustion, instead of explosion, in which weighing would take the place of measurement. I propose, at an early day, to study this question by a series of experiments.

to be always certain that the requisite quantity of oxygen is being admitted, I have adopted certain simple expedients, enumerated below, which have been found fully adequate to that end.

1. The distillation of the substance, if volatile, is effected by means of a bar of copper placed over and attached to one of Bunsen's burners, as shown at *a* in the accompanying figure.

This bar, having first been brought to the maximum temperature which the lamp is capable of producing, is placed near or under the bulb containing the substance; applying that part of the bar nearest or most remote from the flame, or an intermediate point, according to the temperature required.

The steadiness of the heat thus applied, and the facility with which it may be regulated by simply moving the bar, render it decidedly preferable to any other means which I have employed for that purpose. I had for a long time used such a bar for the same purpose in the old process with extreme satisfaction. In some cases a bar of copper laid on the combustion furnace,‡ one end pro-



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‡ As there are those, and probably there are many, who still persist in the use of charcoal in place of the more modern gas furnaces for generating heat for combustions, I desire here to say that I have in use one of Baumhauer's gas furnaces, procured a few years ago from Luhme and Co., in Berlin, which seems to me to have no fault. It is impossible for me to conceive what objection one could have to it, unless it be that a naked tube might become overheated along the bottom; and this would be a valid objection if the remedy were not so simple. If the tube be laid in a trough of sheet iron (brass is objectionable, in my process, on account of its obscuring the tube with oxide of zinc), with a thin layer of asbestos between, and fastened together with wire, no harm can ever occur from overheating. A tube of Bohemian glass, thus protected, may be used for a large number of analyses; and, indeed, become almost a permanent fixture upon the furnace. The asbestos prevents the glass and metal from adhering together — which is probably the chief or only cause of breakage of wrapped tubes—so that sudden cooling and reheating may take place with perfect security. It is important that the iron trough should not extend much backward of that part of the tube where it is desired that the combustion should take place, so that the temperature of the principal part of the column of asbestos may remain under the control of the operator, by means of the heated copper bar, or otherwise. Independent of the use of a metallic bar, as described above, or any novel appliance, the heat can be regulated by this furnace with as great or even greater nicety than by the use of coal. The partitions in this furnace between the cocks are two inches apart; so that the gas from one of the jets ignites about two inches of the tube. To rely, therefore, alone upon the cocks for regulating the heat in burning the substance would doubtless often lead to bad results; but the heat may be made to approach the substance in the most gradual manner—next to that of conduction by a metallic bar—by making use of a piece of thin brass plate, about two inches long, and half an inch wider than the top of the furnace, the edges of which are turned down against the sides. If this plate is laid on the wire gauze covering the furnace, and

jecting into the flame by which the tube is being heated, and the other end raised and extending towards the substance, has been found to answer a good purpose.

2. In the case of volatile bodies (I have not yet analysed any others by this process), I have found the combustion to proceed most satisfactorily when, having first heated about four or five inches of the anterior portion of the tube, which includes the oxide of copper, and started the flow of oxygen, I apply the heated bar to the bulb containing the substance, and immediately expel the whole of the liquid—which becomes at once absorbed by the asbestos—and then, if necessary, gradually move the heated bar forward, driving the substance towards the ignited portion of the tube, until it shall have reached that point in the tube where the temperature is just sufficient to cause the oxygen to take up the vapour in suitable proportion; indicated by the bubbles of oxygen and carbonic acid, as will be described below —a point as easily found as to find, in the old process, the requisite temperature for proper distillation of the substance. When this is accomplished, which will occupy but a short time, the heat in front of and behind the substance being constant and uniform, no further manipulation of the heat is required, the supply of oxygen only requiring attention. In the ordinary way, on the contrary, in which the heat is applied only on one side of the substance, the latter, if volatile, is constantly changing position backward in the tube, necessitating a corresponding movement of the heat in the same direction; which requires constant care and considerable skill.

This procedure—referring to the immediate expulsion of liquid from the bulb, etc.—implies that that portion of the tube immediately forward of the bulb should not already be too warm, which might easily be the case with a body of very low boiling-point. It would then be necessary to expel the substance from the bulb no faster than the oxygen would absorb it in the proper proportion; which, as experience has shown, may be easily accomplished.

With a body of extreme volatility it may be also necessary to place a dish containing pieces of ice under the bulb; as even the temperature of the surrounding air might in such a case cause the substance to pass forward too rapidly.

3. The oxygen is admitted through Liebig's potash bulbs containing sulphuric acid; and the carbonic acid formed is absorbed by similar bulbs with potash; to which is attached a tube filled with soda-lime and chloride of calcium, as recommended by Mulder,[§] to take up any traces of carbonic acid which may escape absorption in the bulbs, and the trace of moisture which is invariably carried forward from the latter. Special care should be taken to select both sets of bulbs with the view to have the openings in the one as nearly as may be of the same size as those of the other, so that the bubbles of oxygen, considered as representing volumes, entering the sulphuric acid bulbs, may be readily compared with the bubbles or volumes of carbonic acid entering the potash bulbs; these bubbles may then serve as a valuable index by which to regulate the supply of oxygen. Especially is this true in cases where the composition of the body to be analysed is pretty nearly known, as then the number of bubbles of oxygen required for every bubble of carbonic acid produced may be readily calculated.

But as it is, in any case, advisable to conduct the experiment so that there shall always be an excess of oxygen passing unabsorbed through the potash bulbs, and as this excess would seldom be large even if a sufficiency of oxygen were admitted to burn the most richly hydrogenised body known, it may generally be well to admit enough for such a case.

The volume of oxygen actually consumed in burning the lightest liquid known—probably of the formula C_8H_{10}—which I have separated from petroleum, and which contains a larger percentage of hydrogen than any other non-gaseous body, as compared with the volume of carbonic acid formed, is 1·62 : 1; the fraction representing the oxygen which is taken up by the hydrogen of the body, and which of course becomes condensed and disappears from the volume of carbonic acid. In burning this body with just the equivalent quantity of oxygen—assuming that the combustion would be complete under such circumstances—we should have one bubble or volume of carbonic acid entering the potash bulbs for every 1·62 bubbles or volumes of oxygen entering the sulphuric acid bulbs. A sufficient excess of oxygen would be secured in this case, and a simple ratio obtained, if 2 bubbles of oxygen were to be admitted for 1 bubble of carbonic acid appearing in the potash bulbs. The case would then be further simplified by having the openings in the sulphuric acid bulbs of such size as would give bubbles twice as large as those from the potash bulbs; as then, when the bubbling should be equally rapid in both, the relation between the volumes of the gases would still be maintained—viz., 2 vols. of oxygen to 1 vol. of carbonic acid. Such bulbs would be highly desirable, but would probably have to be made expressly for the purpose.

(To be continued.)

New Researches on the Law of Chemical Proportions and on Atomic Weights and their Mutual Relations by J. S. Stas.*

(Continued from page 76.)

But if on my own part I submit to a rigid examination the basis on which the hypothesis of Prout rests, and the probability of its correctness, I arrive at doubts other than those a strictly scientific method raises with regard to the fundamental laws of chemical combinations. M. Marignac reminds us that the idea Prout had in his mind, and which led him to enunciate his theory, was that of the unity of matter. Prout regarded hydrogen as the unit. I have already said that Dr. Penny, of Glasgow, and M. Marignac have both proved that it is at least one-half too great so far as chlorine is concerned. M. Marignac and M. Dumas have shown the same fact as regards barium; their researches have further shown that it is four times too great for strontium; and lastly, I believe I have demonstrated that it is eight times too great for potassium, and at least sixteen times too great for nitrogen.

I know that an error in the choice of the unit by Prout does not necessarily overthrow his hypothesis; for, as M. Marignac has observed, Prout's idea is independent of the size of the unit. In fact, the hypothesis remains whether applied to existing bodies, known or not, or even to primordial matter no longer in existence. And admitting these conclusions as well founded, I am naturally led, upon principle, to examine the right of

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pressed down so as to fit closely enough to prevent the gas from igniting under it, the gas escaping from the cock underneath may all be made to burn at one end of the plate, and to extend the heat along the tube as gradually as the plate itself is capable of being moved.

[§] Liebig and Kopp's *Jahresbericht*, 1858, p. 588.

* *Memoirs of the Royal Academy of Belgium.*

chemists who rely upon experiment to consider the hypothesis as the expression of a probable natural law.

When we go back to the origin of the theory, we immediately see that it owes its conception to a prejudice, or, if you will, a preconceived opinion, regarding *the simplicity of the laws of nature*. For a long time chemists, like physicists, from the moment they saw certain facts reproduced with apparent regularity, believed in the existence of a natural law capable of being expressed by a simple mathematical relation. They further contracted a habit of considering the law as demonstrated as soon as they had executed weighings or measurings which did not come very wide of it. The confidence in the prejudice was such that they invariably attributed the differences either to the method of observation or to unavoidable error in the experiment. This tendency in the mind, and I willingly say the greatest minds, has led men to consider as rigidly demonstrated mathematical laws the law of Boyle or of Mariotte, the law of Gay-Lussac concerning the expansion of gases by heat, and the law of Dulong and Petit regarding the specific heats of bodies; we know, however, to-day, beyond doubt, that these are limited laws, if, indeed, even so much can be said for the relation established by Dulong and Petit between specific heats and atomic weights.

It is to this very natural tendency that we owe the hypothesis of Prout. I think it would be very easy to prove that the English chemist was contented with the *very nearly*, authorised, perhaps, by his time, to conclude that the facts were reconcilable with his opinion. I willingly render homage to the great aim of Prout; but to-day we have the right and even the duty to be more exacting with the partisans of his hypothesis. Although this article is intended as a reply to the objections of M. Marignac, I shall not further examine whether his admirable labours justify us in accepting the probability of the accuracy of Prout's law. It would be bad taste to do so, since M. Marignac no more believes than I do that experiment can be reconciled with the hypothesis.

There only remain for examination, then, the researches published by M. Dumas, upon which, indeed, all the partisans of the hypothesis of the unity of matter base their belief that it expresses a natural law. I proceed to the examination with a reservation that every chemist, I hope, will appreciate if the results contained in the memoir of M. Dumas "*On the Equivalents of Simple Bodies*" prove the law or render it probable.

With one or two exceptions, all the determinations to be found in that work are based on the atomic weights of silver and chlorine, represented respectively by 108 and 35·5. Neither of these two values was fixed experimentally by M. Dumas. He deduced them from the results of M. Marignac, who, bringing together silver and chlorine directly by the synthesis of the chloride and the analysis of chlorate of silver, and indirectly by the chloride and chlorate of potassium, arrived at from 107·91 to 107·92 for the atomic weight of silver and 35·455 for the atomic weight of chlorine. In truth, my illustrious teacher sought to discover whether the composition of chloride of silver can be represented by the proportion of 108 to 35·5, and he found that it might be; but even admitting this fact (which is, however, open to dispute), does it follow that the atomic weights of silver and chlorine are respectively 108 and 35·5? Clearly not, for all the atomic weights of these bodies, which are in exactly the same proportion to each other, agree with the composition.

In order that the consequences drawn from the proportion of 108 to 35·5 may be legitimate, it was necessary to have demonstrated *a priori* that these figures represent the real atomic weights of silver and chlorine. But neither the works of M. Marignac, nor those of other chemists published since, allow us to consider the fact as proved. Indeed, the determinations that merit the most confidence do not even render it probable.

When M. Marignac effected the synthesis of the chloride and the analysis of the chlorate of silver, in order to deduce from these two data the atomic weights of their elements functioning as oxygen, he remarked a cause of error in the analysis of the chlorate, the effect of which is rather to augment than diminish the atomic weight. I have remarked the same cause of error, as I shall describe further on. The result is exactly the opposite of that the cause of error ought to produce; instead of leading to a number higher than 108, it gives 107·91. Thus, the labours of M. Marignac, interpreted in the sense of his own observations, do not authorise us to believe it to be demonstrated, or even made probable, that the atomic weight of silver is 108 and that of chlorine 35·5. But I will suppose for a moment that I am mistaken; the basis on which M. Dumas has founded his determinations being admitted, do his researches prove that the atomic weights of the bodies on which he operated are really multiples by 1·00 or 0·50 or 0·25? I do not think it. In fact, whatever may have been his acuteness in discovering and avoiding causes of error, the quantities of matter he employed were in no case sufficiently great for the results obtained to contain in themselves the elements of a demonstration. My opinion on this point, after mature reflection, has never varied. When we wish to demonstrate that the atomic weights are multiples by 1·00 or 0·50 or 0·25, it seems to me evident that in the results the decimals of each of the factors should be constant. To make my meaning more evident, I will say before we can consider it as proved that certain atomic weights are multiples of 0·25, it is necessary that in the experiment the second decimal of the value of the atomic weight should remain constant; otherwise we infer the law of the hypothesis, and not of the experiment. But on examining the determinations made by M. Dumas from this point of view, we remain convinced that, however admirable for their precision, they do not satisfy us on this point. In my opinion they never could; for, supposing the matters operated upon to be absolutely pure, how can we reconcile the natural fact or the law, and the error of observation, when this error is as great in the majority of cases as the difference it is required to establish?

We cannot, then, found upon these determinations a belief in the hypothesis of Prout as the expression of a probable natural law, and still less as a demonstrated law, for the bodies to which the determinations apply.

(To be continued.)

On the Absorption and Dialytic Separation of Gases by Colloid Septa, by THOMAS GRAHAM, *F.R.S.*

IT appears that a thin film of caoutchouc, such as is furnished by varnished silk or the transparent little balloons of india-rubber, has no porosity, and is really impervious to air as gas. But the same film is capable of liquefying the individual gases of which air is composed, while oxygen and nitrogen in the liquid form are capable of penetrating the substance of the membrane (as ether or naphtha does), and may again evaporate into a vacuum and appear as gases. This penetrating power of air becomes more interesting from the fact that the gases are unequally absorbed and condensed by rubber, oxygen 2½ times more abundantly than nitrogen, and that they penetrate the rubber in the same proportion. Hence the rubber film may be used as a dialytic sieve for atmospheric air, and allows very constantly 41·6 per cent. of oxygen to pass through, instead of the 21 per cent. usually present in air. The septum keeps back, in fact, one half of the nitrogen, and allows the other half to pass through with all the oxygen. This dialysed air rekindles wood burning without flame, and is, in fact, exactly intermediate between air and pure oxygen gas in relation to combustion.

One side of the rubber film must be freely exposed to the atmosphere, and the other side be under the influence of a vacuum at the same time. The vacuum may be established within a bag of varnished silk or in a little balloon, the sides being prevented from collapsing by interposing a thickness of felted carpeting between the sides of the varnished cloth, and by filling the balloon with sifted sawdust. For commanding a vacuum in such experiments, the air exhauster of Dr. Hermann Sprengel[*] is admirably adapted. It possesses the advantage that the gas drawn from the vacuum can also be delivered by the instrument into a gas receiver placed over water or mercury. The "fall tube" has merely to be bent at the lower end.

The surprising penetration of platinum and iron tubes by hydrogen gas, discovered by MM. H. Sainte-Claire Deville and Troost, appears to be connected with a power resident in the same and certain other metals to liquefy and absorb hydrogen, possibly in its character as a metallic vapour. Platinum in the form of wire or plate at a low red heat may take up and hold 3·8 volumes of hydrogen, measured cold; but it is by palladium that the property in question appears to be possessed in the highest degree. Palladium foil from the hammered metal, condensed so much as 643 times its volume of hydrogen, at a temperature under 100° C. The same metal had not the slightest absorbent power for either oxygen or nitrogen. The capacity of fused palladium (as also of fused platinum) is considerably reduced; but foil of fused palladium, for which I am indebted to Mr. G. Matthey, still absorbed 68 volumes of gas. A certain degree of porosity may be admitted to exist in these metals, and to the greatest extent in their hammered condition. It is believed that such metallic pores, and indeed all fine pores, are more accessible to liquids than to gases, and in particular to liquid hydrogen. Hence a peculiar dialytic action may reside in certain metallic septa, like a plate of platinum, enabling them to separate hydrogen from other gases.

In the form of sponge, platinum absorbed 1·48 times its volume of hydrogen and palladium 90 volumes. The former of these metals, in the peculiar condition of platinum black, is already known to take up several hundred volumes of the same gas. The assumed liquefaction of hydrogen in such circumstances appears to be the primary condition of its oxidation at a low temperature. A repellent property possessed by gaseous molecules appears to resist chemical combination as well as to establish a limit to their power to enter the minuter pores of solid bodies.

Carbonic oxide is taken up more largely than hydrogen by soft iron. Such an occlusion of carbonic oxide by iron at a low red heat appears to be the first and a necessary step in the process of acieration. The gas appears to abandon half its carbon to the iron, when the temperature is afterwards raised to a considerably higher degree.

Silver has a similar relation to oxygen, of which metal the sponge, fritted but not fused, was found to hold in one case so much as 7·49 volumes of oxygen. A plate or wire of the fused metal retains the same property, but much reduced in intensity, as with plates of fused platinum and palladium in their relation to hydrogen.—*Proceedings of the Royal Society.*

TECHNICAL CHEMISTRY.

The Manufacture and Properties of Aniline Colours, and the Bodies used in their Preparation,[*] *by MM.* DEPOULLY *Brothers.*

(*Continued from page 77.*)

II. Nitrobenzols.—Practice has rendered easy the manufacture of nitrobenzol, which at first was dangerous. The precautions by which all chance of accident is avoided are precisely those which are necessary for obtaining good results. As of the first importance must be ranked the purity of the benzols, perfect washing, and careful fractional distillation.

Phenols render the attack by acids dangerous, and give offensive nitrogenised products. Naphthaline gives nitronaphthalines, which destroy the beauty of the nitrobenzol, and afterwards, at the transformation into aniline, produce alkaloids which become resinous in the air, and still more during the manufacture of colouring matters. In short, the hydrocarbides above toluol are partially oxidised by too strong acid mixtures, and the portion transformed into nitrogenised bodies gives alkaloids distilling above 200°, and which have hitherto been of little use, either as regards the quantity of the matter obtained or the beauty of its colour.

The use of pure benzols dispenses with an expensive and dangerous operation, involving considerable loss of material—namely, the distillation of nitrobenzol.

Another precaution, essential for avoiding a conflagration, is never to place in contact a large mass of acid and of unattacked hydrocarbides. Take, for instance, a mixture of benzol and toluol.

Various processes are still in use for their transformation into commercial nitrobenzol.

All rest on the same principle; never put a fresh quantity of benzol in contact with acid until the preceding portion is almost entirely transformed into nitrobenzol. Accidents are thus avoided, and also too great heat, which would give secondary products in presence of an excess of acid.

Fuming nitric acid almost instantaneously transforms benzol into nitrobenzol. By causing benzol to fall slowly into a vessel containing fuming nitric acid, placed in cold water, and leaving the mixture for twenty-four hours, the transformation will be complete provided the quantity of acid be sufficient.

There are various inconveniences in this method. In the first place the strength, and consequently the action, of the acid are constantly decreasing; then a portion of the oil remains untransformed at the close of the operation, unless there be a large excess of acid, which is out of the question at the present prices. Moreover, nitrobenzol may change to solid binitrobenzol, in presence of this mass of strong acid, while toluol may oxidise or give binitrotoluol.

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[*] Chemical Society's *Journal*, ser. 2, vol. iii., p. 9 (1865).

[*] Memoir presented to the *Société Industrielle de Mulhouse* at the meeting of May 31, 1865.

An earthenware worm has been much used, placed in a basin full of water. Into the upper part of the worm we caused a fine stream of fuming acid and one of benzol to flow regularly; these two currents mingled, and the reaction was almost finished by the time the mixture arrived at the lower part; small basins or depressions arranged along the line of the worm were found to favour the action.

The flowing being so regulated that one equivalent of benzol flows at the same time as one equivalent plus a small excess of acid, the reaction took place under favourable conditions, and the yield was large, and the quality of the product good.

One advantage of fuming nitric acid is that the nitrobenzol and acid remain dissolved, one in the other, forming but one liquid, which helps to complete the reaction. But the necessary apparatus is costly and fragile; and, above all, fuming nitric acid is dangerous to handle.

Many manufacturers use a mixture of nitric and sulphuric acid at 66° (1·847), varying in its proportions according to the strength of the nitric acid. The quantity of sulphuric acid must always be sufficient to bring the nitric acid to 1 or 2 equivalents of water; th nitric acids used must be rather above than below 40° (1·38).

The benzol may be added gradually to the acid mixture, a small quantity each day, care being taken to stir it often; for here the products form two layers, and the stirring is necessary to bring all the matters in contact. Two or three weeks are frequently required to effect a complete transformation; and there must be a sufficient excess of acid.

However, this method on a large scale gives satisfactory results, both as regards quality and quantity.

In England, and lately in France, this process has been modified by performing the operation in closed apparatus, of the kind also used in England in the manufacture of aniline.

The benzol and the acid mixture arrive in two regulated streams, a mechanical stirrer unceasingly places the matters in perfect contact, the heat of the reaction is allowed to act partially, and highly concentrated nitric acids are used. The reaction is very rapidly effected, and the amount of acid required is about the theoretical quantity. A worm receives the benzol which escapes during the reaction.

Whatever may be the method employed when the reaction is at an end—which is easily ascertained by the decoloration of the products—the acid remaining must be diluted with water to arrive at the complete separation of the nitrobenzol; but the degree of concentration may be low enough to admit of the acids being utilised for certain purposes; thus, the concentration of the sulphuric acid, more or less charged with nitric acid, may be kept at 50° to 55° (1·53 to 1·61).

The nitrobenzol and diluted acid form two layers, which may be separated by decantation. The nitrobenzol must then be washed with water, then with very weak carbonate of soda, and then again with water.

Great care is needed in the washing, as here the greatest losses are to be feared, and moreover inefficiently washed nitrobenzols, retaining acids and nitrous vapours, produce impure anilines; the nitrous vapours react on the portion of the aniline formed and give tarry products.

A method of washing, which we have found very successful, consists in neutralising the decanted nitrobenzols by a slight excess of ammonia, when sulphates, nitrates, and nitrites of ammonia are formed. By heating to 105° or 110° centigrade, the nitrite is decomposed into nitrogen and water vapour, and the nitrates and sulphates remain insolnble; it is then only necessary to filter. In this way nitrobenzols are obtained in a very favourable state for the manufacture of aniline.

The yields of aniline now obtained in wholesale manufacture are considerable, varying from 130 to 135 per cent. of the weight of benzol, about 10 per cent. below the theoretical quantity for a mixture of one part of benzol and two of toluol.

It is probable that both the yield and the purity of the products might be improved by operating separately on the benzol and toluol; for they are not equally sensitive to the action of nitric and sulphuric acids. Nitric acid attacks toluol much more quickly than benzol. In proof of this we will mention the presence, in acids which have served in the fabrication of commercial nitrobenzols, of nitrodracylic acid, isomeric with nitrobenzoic acid $C_{14}H_5(NO_4)O_4$, evidently derived from the oxidation of nitrotoluol $C_{14}H_7(NO_4)$, and not of nitrobenzol $C_{12}H_5(NO_4)$.

Moreover, toluol is acted on by sulphuric acid at 66 degrees, even unassisted by heat; while benzol is not attacked. It would then be advisable to act on each of these substances separately, by acid mixtures suited to their nature.

To test a commercial nitrobenzol, before transforming it into aniline, first ascertain its density, which will be so much higher, as it contains more nitrobenzol and less nitrotoluol. The density of nitrobenzol at 15° C. is 1·209, that of nitrotoluol 1·180. But should the nitrobenzol contain unattacked hydrocarbides, or binitrogenised bodies, the density would be less low or too high; recourse must then be had to distillation. Nitrobenzol distils at 213°, nitrotoluol at 225°, of which all that passes before 213° must be rejected. A good nitrobenzol, to make good aniline red and violet, should distil between 215° and 230°, the greater part between 220° and 227°; this will contain the two bodies in the proportions best adapted to the production of a good aniline. No more than traces of nitrous or acid vapours should be produced during the distillation.

(To be continued.)

PHYSICAL SCIENCE.

On the Connexion between the Physical Properties of Chemical Bodies and their Atomic Composition, by T. A. GROSHANS.

THE problem "Are all the so-called chemical elements really simple bodies?" does not appear to me to be one of those of which we have no hope to find the solution; and perhaps that solution will be found much sooner than is expected.

I published in the *Archives des Sciences Physiques et Naturelles*, Genève, Mai 1863, a paper, containing a list of twenty-five bodies, which agree in this most important particular:—

That their vapour-densities (taken at 0·76 m. and the respective temperatures of ebullition) are nearly in the same ratio as the numbers of atoms of carbon, hydrogen, and oxygen, which these bodies contain.

I give here this list or table, which I have modified as to the adoption of the atomic weights (H = 1, C = 12, O = 16) and the methods of notation which are at present in general use.

No.	Names.	Chemical Formulæ.	Atomic Weights.	Mean Boiling Points.	Calculated Vapour Densities, *d*.	Numbers of Atoms of C, H, & O.
1.	Water. . .	H_2O	18	100	3	3
2.	Ethylic gas . .	C_4H_{10}	58	—14	13·9	14
3.	Ether . . .	$C_4H_{10}O$	74	35·2	14·9	15
4.	Oxide of ethyl-allyl	$C_5H_{10}O$	86	64·0	15·9	16
5.	Propionic ether .	$C_5H_{10}O_2$	102	96·8	17·1	17
6.	Carbonic ether .	$C_5H_{10}O_3$	118	125·5	18·4	18
7.	Allyl . . .	C_6H_{10}	82	59·0	15·3	16
8.	Oxide of allyl (metaceton) .	$C_6H_{10}O$	98	84·2	17·0	17
9.	Anhydrous propionic acid .	$C_6H_{10}O_3$	130	165·0	18·4	19
10.	Oxalic ether .	$C_6H_{10}O_4$	146	184·6	19·8	20
11.	Anhydrous lactic acid. . .	$C_6H_{10}O_5$	162	200·0	21·3	21
12.	Allylic alcohol .	C_3H_6O	58	93·0	9·8	10
13.	Propionic acid (hydrate). .	$C_3H_6O_2$	74	141·2	11·1	11
14.	Oxalic allyl-oxide	$C_8H_{10}O_4$	170	206·5	22·0	22
15.	Butyl-aldehyd .	C_4H_8O	72	70·5	13·0	13
16.	Acro-aldehyd .	$C_4H_8O_2$	88	110·0	14·3	14
17.	Toluol. . .	C_7H_8	92	109·2	14·9	15
18.	Anisol. . .	C_7H_8O	108	150·0	15·8	16
19.	Pyromucic ether .	$C_7H_8O_3$	140	209·0	18·0	18
20.	Phenol. . .	C_6H_6O	94	186·8	12·6	13
21.	Benzoic acid .	$C_7H_6O_2$	122	250·0	14·5	15
22.	Cinnamen . .	C_8H_8	104	146·0	15·4	16
23.	Benzoic methyl-ether . .	$C_8H_8O_2$	136	198·8	17·9	18
24.	Salicylic methyl-ether . .	$C_8H_8O_3$	152	222·0	19·1	19
25.	Methylic alcohol.	CH_4O	32	64·0	5·9	6

This table is constructed upon the well-known principle that when of two bodies, A and B, we call—

	Of A.	Of B.
The atomic weights	a	a'
The points of ebullition . . .	s	s'
The vapour-densities at 0·76 m. and s, s'.	d	d'

we have the following equation:—

$$\frac{d}{d'} = \frac{a}{a'} \times \frac{273+s'}{273+s}$$

Now, when we take for the body B water H_2O, we have:—

$$\begin{array}{lll} 273+s' & = 273 + 100 & = 373 \\ a' & & = 18 \\ d' & = \begin{array}{c} 2\,H \\ 1\,O \\ \hline 3 \end{array} & = 3 \end{array}$$

and the equation becomes:—

$$d = \frac{a}{18} \times \frac{373}{273+s} \times 3$$

By this last equation all the vapour-densities *d* of the preceding table have been calculated.

As for the points of ebullition mentioned in the table, I have used generally all the observations which were published in 1863. The following may be taken as a specimen of the method used:—

5, Propionic ether, $C_5H_{10}O_2$.

The following observations refer not only to this ether, but also to its isomers, as butylic methyloxide, acetic propyloxide, &c.

	°		°
Delffs . . .	93·0	Berthelot . .	90·0
Favre and Silbermann	93·0	Pelouze and Giles .	102·0
H. Kopp . . .	95·0	T. Pierre . .	102·1
,, . . .	95·1	Wurtz . . .	100·0
,, . . .	96·9	Limpricht and Uslar	101·0

Mean (used in the table), 96·8°.

From the results contained in the table I have drawn several consequences, which have been subsequently found true by later observations:—

1. As a great many bodies, consisting of C, H, and O, could not be placed in the table, it was probable that they could be assembled in analogous tables, in which the bodies were not compared to water, but to some other body, as, for example, ethylic alcohol, propylic alcohol, etc. I have been able to construct many tables in this manner.

2. All bodies consisting of C, H, and O, may be placed in one or the other of such tables.

3. Different tables are connected with each other by some constant numbers; these numbers I have been able to calculate.

4. It may be then expressed as a general fact:—The vapour-densities (at the same pressure and at corresponding temperatures) of bodies consisting of C, H, and O, are in the same ratio as the numbers of atoms which these bodies contain, provided that they belong to the same group.

We have here an analogous phenomenon to that of the specific heats, which (being multiplied by the atomic weights) are also the same for bodies belonging to the same group.

5. As for other elements than C, H, and O, a way is opened by which we can determine the exact number of atoms which they contain. I have hitherto found that sulphur (S = 32) contains two atoms, and chlorine (Cl = 35·5) four atoms.[*]

Rotterdam, August 9.

PROCEEDINGS OF SOCIETIES.

BRITISH ASSOCIATION, NOTTINGHAM.

Address of WILLIAM ROBERT GROVE, *Esq., Q.C., M.A., F.R.S., President.*

[THE Address of the President is too long for insertion *in extenso*, so we follow our usual custom of giving a series of extracts relating to those sciences with which the CHEMICAL NEWS is specially occupied.]

In a series of papers recently communicated to the French Academy, M. Daubrée has discussed the chemical and mineralogical character of meteorites as compared with the rocks of the earth. He finds that the similarity of terrestrial rocks to meteorites increases as we penetrate deeper into the earth's crust, and that some of the deep-seated minerals have a composition and characteristics almost identical with meteorites (olivine, herzolite, and serpentine, for instance, closely resemble them); that as we approach the surface rocks having similar components with meteorites are found, but in a state of oxidation, which necessarily much modifies their mineral character, and which, by involving secondary oxygenised compounds, must also change their chemical constitution. By experiments he has succeeded in forming from terrestrial rocks substances very much resembling meteorites. Thus close relationship, though by no means identity, is established between this earth and those wanderers from remote regions—some evidence, though at present incomplete, of a common origin.

Surprise has often been expressed that, while the mean specific gravity of this globe is from five to six times that of water, the mean specific gravity of its crust is barely half as great. It has long seemed to me that there is no ground for wonder here. The exterior of our planet is to a considerable depth oxidated; the interior is in all pro-

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[*] Should the formerly used atomic weights ($C=6$, $H_2=1$, $O=8$) be the true ones, then chlorine consists of 8 atoms.

bability free from oxygen, and whatever bodies exist there are in a reduced or deoxidated state; if so, their specific gravity must necessarily be higher than that of their oxides or chlorides, &c. We find, moreover, that some of the deep-seated minerals have a higher specific gravity than the average of those on the surface; olivine, for instance, has a specific gravity of 3·3. There is, therefore, no *à priori* improbability that the mean specific gravity of the earth should notably exceed that of its surface; and if we go further, and suppose the interior of the earth to be formed of the same ingredients as the exterior, minus oxygen, chlorine, bromine, &c., a specific gravity of 5 to 6 would not be an unlikely one. Many of the elementary bodies entering largely into the formation of the earth's crust are as light or lighter than water—for instance, potassium, sodium, &c.; others, such as sulphur, silicon, aluminium, have from two to three times its specific gravity; others again, as iron, copper, zinc, tin, seven to nine times; while others, lead, gold, platinum, &c., are much more dense, but, speaking generally, the more dense are the least numerous. There seems no improbability in a mixture of such substances producing a mean specific gravity of from 5 to 6, although it by no means follows; indeed, the probability is rather the other way, that the proportions of the substances in the interior of the earth are the same as on the exterior. It might be worth the labour to ascertain the mean specific gravity of all the known minerals on the earth's surface, averaging them in the ratios in which, as far as our knowledge goes, they quantitatively exist, and assuming them to exist without the oxygen, chlorine, &c., with which they are, with some rare exceptions, invariably combined on the surface of the earth. Great assistance to the knowledge of the probable constitution of the earth might be derived from such an investigation.

While chemistry, analytic and synthetic, thus aids us in ascertaining the relationship of our planet to meteorites, its relation in composition to other planets, to the sun, and to more distant suns and systems, is aided by another science—viz., optics.

But the most remarkable achievement by spectrum analysis is the record of observations on a temporary star which has shone forth this year in the constellation of the northern crown about a degree S.E. of the star ε. When it was first seen (May 12) it was nearly equal in brilliancy to a star of the second magnitude; when observed by Mr. Huggins and Dr. Miller, May 16, it was reduced to the third or fourth magnitude. Examined by these observers with the spectroscope, it gave a spectrum which they state was unlike that of any celestial body they had examined. The light was compound, and had emanated from two different sources. One spectrum was analogous to that of the sun—viz. formed by the light of an incandescent solid or liquid photosphere which had suffered absorption by the vapours of an envelope cooler than itself. The second spectrum consisted of a few bright lines, which indicated that the light by which it was formed was emitted by matter in the state of luminous gas. They consider that, from the position of two of the bright lines, the gas must be probably hydrogen, and from their brilliancy, compared with the light of the photosphere, the gas must have been at a very high temperature. They imagine the phenomena to result from the burning of hydrogen with some other element, and that from the resulting temperature the photosphere is heated to incandescence.

It would seem as if the phenomenon of gradual change obtained towards the remotest objects with which we are at present acquainted, and that the further we penetrate into space the more unlike to those we are acquainted with become the objects of our examination—sun, planets, meteorites, earth, similarly, though not identically, constituted, stars differing from each other and from our system, and nebulæ more remote in space and differing more in their characters and constitution.

While we thus can to some extent investigate the physical constitution of the most remote visible substances, may we not hope that some further insight as to the constitution of the nearest—viz. our own satellite—may be given us by this class of researches? The question whether the moon possesses any atmosphere may still be regarded as unsolved. If there be any, it must be exceedingly small in quantity and highly attenuated. Calculations, made from occultation of stars, on the apparent differences of the semidiameter of the bright and dark moon, give an amount of difference which might indicate a minute atmosphere, but which Mr. Airy attributes to irradiation.

Supposing the moon to be constituted of similar materials to the earth, it must be, to say the least, doubtful whether there is oxygen enough to oxidate the metals of which she is composed; and, if not, the surface which we see must be metallic, or nearly so. The appearance of her craters is not unlike that seen on the surface of some metals, such as bismuth, or, according to Professor Phillips, silver, when cooling from fusion and just previous to solidifying; and it might be a fair subject of inquiry whether, if there be any coating of oxide on the surface, it may not be so thin as not to disguise the form of the congealed metallic masses, as they may have set in cooling from igneous fusion. M. Chacornac's recent observations lead him to suppose that many of the lunar craters were the result of a single explosion, which raised the surface as a bubble and deposited its *débris* around the orifice of eruption.

It would be out of place here, and treating of matters too familiar to the bulk of my audience, to trace how, by the labours of Oersted, Seebeck, Faraday, Talbot, Daguerre, and others, the way has been prepared for the generalisation now known as the correlation of forces or conservation of energy, while Davy, Rumford, Seguin, Mayer, Joule, Helmholtz, Thomson, and others (among whom I would not name myself, were it not that I may be misunderstood and supposed to have abandoned all claim to a share in the initiation of this, as I believe, important generalisation) have carried on the work; and how, sometimes by independent and, as is commonly the case, nearly simultaneous deductions, sometimes by progressive and accumulated discoveries, the doctrine of the reciprocal interaction, of the quantitative relation, and of the necessary dependence of all the forces, has, I think I may venture to say, been established.

If magnetism be, as it is proved to be, connected with the other forces or affections of matter, if electrical currents always produce, as they are proved to do, lines of magnetic force at right angles to their lines of action, magnetism must be cosmical, for where there is heat and light there is electricity and consequently magnetism. Magnetism, then, must be cosmical, and not merely terrestrial. Could we trace magnetism in other planets and suns as a force manifested in axial or meridional lines—*i.e.*, in lines cutting at right angles the curves formed by their rotation round an axis, it would be a great step; but it is one hitherto unaccomplished. The apparent coincidences between the maxima and minima of solar spots, and the decennial or undecennial periods of terrestrial magnetic intensity, though only empirical at present, might tend to lead us to a knowledge of the connexion we are seeking; and the President of the Royal Society considers that an additional epoch of coincidence has arrived, making the fourth decennial period; but some doubt is thrown upon these coincidences by the magnetic observations made at Greenwich Observatory. In a paper published in the *Transactions of the Royal Society*, 1863, the Astronomer Royal says, speaking of results extending over seventeen years, there is no appearance of decennial cycle in the recurrence of great magnetic disturbances; and Mr. Glaisher last year, in the physical section of this Association, stated that after persevering examination he had been unable to trace any connexion between the magnetism of the earth and the spots on the sun.

Mr. Airy, however, in a more recent paper, suggests that currents of magnetic force having reference to the solar hour are detected, and seem to produce vortices or circular disturbances, and he invites further co-operative observation on the subject, one of the highest interest, but at present remaining in great obscurity.

One of the most startling suggestions as to the consequence resulting from the dynamical theory of heat is that made by Mayer, that by the loss of *vis viva* occasioned by friction of the tidal waves, as well as by their forming, as it were, a drag upon the earth's rotatory movement, the velocity of the earth's rotation must be gradually diminishing, and that thus, unless some undiscovered compensatory action exist, this rotation must ultimately cease, and changes hardly calculable take place in the solar system.

M. Delaunay considers that part of the acceleration of the moon's mean motion which is not at present accounted for by planetary disturbances, to be due to the gradual retardation of the earth's rotation; to which view, after an elaborate investigation, the Astronomer Royal has given his assent.

Another most interesting speculation of Mayer is that with which you are familiar, viz., that the heat of the sun is occasioned by friction or percussion of meteorites falling upon it; there are some difficulties, not perhaps insuperable, in this theory. Supposing such cosmical bodies to exist in sufficient numbers, they would, as they revolve round the sun, fall into it, not as an aërolite falls upon the earth directly by an intersection of orbits, but by the gradual reduction in size of the orbits, occasioned by a resisting medium; some portion of force would be lost, and heat generated in space by friction against such medium; when they arrive at the sun they would, assuming them, like the planets, to have revolved in the same direction, all impinge in a definite direction, and we might expect to see some symptoms of such in the sun's photosphere; but though this is in a constant state of motion, and the direction of these movements has been carefully investigated by Mr. Carrington and others, no such general direction is detected; and M. Faye, who some time ago wrote a paper pointing out many objections to the theory of solar heat being produced by the fall of meteoric bodies into the sun, has recently investigated the proper motions of sun-spots, and believes he has removed certain apparent anomalies, and reduced their motions to a certain regularity in the motion of the photosphere, attributable to some general action arising from the internal mass of the sun.

It might be expected that comets, bodies so light and so easily deflected from their course, would show some symptoms of being acted on by gravitation, were such a number of bodies to exist in or near their paths, as are presupposed in the mechanical theory of solar heat.

Assuming the undulatory theory of light to be true, and that the motion which constitutes light is transmitted across the interplanetary spaces by a highly elastic ether, then, unless this motion is confined to one direction, unless there be no interference, unless there be no viscosity, as it is now termed, in the medium, and consequently no friction, light must lose something in its progress from distant luminous bodies, that is to say, must lose something as light; for, as all reflecting minds are now convinced that force cannot be annihilated, the force is not lost, but its mode of action is changed. If light, then, is lost as light (and the observations of Struvé seem to show this to be so, that, in fact, a star may be so far distant that it can never be seen in consequence of its luminous emissions becoming extinct), what becomes of the transmitted force lost as light, but existing in some other form? So with heat: our sun, our earth, and planets are constantly radiating heat into space, so in all probability are the other suns, the stars, and their attendant planets. What becomes of the heat thus radiated into space? If the universe have no limit, and it is difficult to conceive one, there is a constant evolution of heat and light; and yet more is given off than is received by each cosmical body, for otherwise night would be as light and as warm as day. What becomes of the enormous force thus apparently non-recurrent in the same form? Does it return as palpable motion? Does it move or contribute to move suns and planets? and can it be conceived as a force similar to that which Newton speculated on as universally repulsive and capable of being substituted for universal attraction? We are in no position at present to answer such questions as these; but I know of no problem in celestial dynamics more deeply interesting than this, and we may be no further removed from its solution than the predecessors of Newton were from the simple dynamical relation of matter to matter which that potent intellect detected and demonstrated.

Passing from extra-terrestrial theories to the narrower field of molecular physics, we find the doctrine of correlation of forces steadily making its way. In the Bakerian Lecture for 1863 Mr. Sorby shows, not perhaps a direct correlation of mechanical and chemical forces, but that when, either by solution or by chemical action, a change in volume of the resulting substance as compared with that of its separate constituents is effected, the action of pressure retards or promotes the change, according as the substance formed would occupy a larger or a smaller space than that occupied by its separate constituents; the application of these experiments to geological inquiries as to subterranean changes which may have taken place under great pressure, is obvious, and we may expect to form compounds under artificial compression which cannot be found under normal pressure.

In a practical point of view the power of converting one mode of force into another is of the highest importance, and with reference to a subject which at present, somewhat prematurely perhaps, occupies men's minds, viz., the prospective exhaustion of our coal-fields, there is every encouragement derivable from the knowledge that we can at will produce heat by the expenditure of other forces; but, more than that, we may probably be enabled to absorb or store up as it were diffused energy—for instance, Berthelot has found that the potential energy of formate of potash is much greater than that of its proximate constituents, caustic potash and carbonic oxide. This change may take place spontaneously and at ordinary temperatures, and by such change carbonic oxide becomes, so to speak, reinvested with the amount of potential energy which its carbon possessed before uniting with oxygen, or, in other words, the carbonic oxide is raised as a force-possessor to the place of carbon by the direct absorption or conversion of heat from surrounding matter.

Here we have as to force-absorption, an analogous result to that of the formation of coal from carbonic acid and water; and though this is a mere illustration, and may never become economical on a large scale, still it and similar examples may calm apprehension as to future means of supplying heat, should our present fuel become exhausted. As the sun's force, spent in times long past, is now returned to us from the coal which was formed by that light and heat, so the sun's rays, which are daily wasted, as far as we are concerned, on the sandy deserts of Africa, may hereafter, by chemical or mechanical means, be made to light and warm the habitations of the denizens of colder regions. The tidal wave is, again, a large reservoir of force hitherto almost unused.

The valuable researches of Professor Tyndall on radiant heat afford many instances of the power of localising, if the term be permitted, heat which would otherwise be dissipated.

The discoveries of Graham, by which atmospheric air, drawn through films of caoutchouc, leaves behind half its nitrogen, or, in other words, becomes richer by half in oxygen, and hence has a much increased potential energy, not only show a most remarkable instance of physical molecular action, merging into chemical, but affords us indications of means of storing up force, much of the force used in working the aspirator being capable at any period, however remote, of being evolved by burning the oxygen with a combustible.

What changes may take place in our modes of applying force before the coal-fields are exhausted it is impossible to predict. Even guesses at the probable period of their exhaustion are uncertain. There is a tendency to substitute for smelting in metallurgic processes, liquid chemical action, which of course has the effect of saving fuel; and the waste of fuel in ordinary operations is enormous, and can be much economised by already known processes. It is true that we are, at present, far from seeing a practical mode of replacing that granary of force the coal-fields; but we may with confidence rely on invention being in this case, as in others, born of necessity, when the necessity arises.

Two very remarkable applications of the convertibility of force have been recently attained by the experiments of Mr. Wilde and Mr. Holz; the former finds that, by conveying electricity from the coils of a magneto-electric machine to an electro-magnet, a considerable increase of electrical power may be attained, and by applying this as a magneto-electric machine to a second, and in turn to a third electro-magnetic apparatus, the force is largely augmented. Of course, to produce this increase, more mechanical force must be used at each step to work the magneto-electric machines; but provided this be supplied there hardly seems a limit to the extent to which mechanical may be converted into electrical force.

Mr. Holz has contrived a Franklinic electrical machine, in which a similar principle is manifested. A varnished glass plate is made to revolve in close proximity to another plate having two or more pieces of card attached, which are electrified by a bit of rubbed glass or ebonite; the moment this is effected a resistance is felt by the operator who turns the handle of the machine, and the slight temporary electrisation of the card converts into a continuous flood of intense electricity the force supplied by the arm of the operator.

These results offer great promise of extended application; they show that, by a mere formal disposition of matter, one force can be converted into another, and that not to the limited extent hitherto attained, but to an extent co-ordinate, or nearly so, with the increased initial force, so that, by a mere change in the arrangement of apparatus, a means of absorbing and again eliminating in a new form a given force may be obtained to an indefinite extent. As we may, in a not very distant future, need, for the daily uses of mankind, heat, light, and mechanical force, and find our present resources exhausted, the more we can invent new modes of conversion of forces, the more prospect we have of practically supplying such want. It is but a month from this time that the greatest triumph of force-conversion has been attained. The chemical action generated by a little salt water on a few pieces of zinc will now enable us to converse with inhabitants of the opposite hemisphere of this planet, and

"Put a girdle round about the earth in forty minutes."

The Atlantic Telegraph is an accomplished fact.

In physiology very considerable strides are being made by studying the relation of organised bodies to external forces; and this branch of inquiry has been promoted by the labours of Carpenter, Bence Jones, Playfair, E. Smith, Frankland, and others. Vegetables acted on by light and heat, decompose water, ammonia, and carbonic acid, and transform them into, among other substances, oxalate of lime, lactic acid, starch, sugar, stearine, urea, and ultimately albumen; while the animal reverses the process, as does vegetable decay, and produces from albumen, urea, stearine, sugar, starch, lactic acid, oxalate of lime, and ultimately ammonia, water, and carbonic acid.

As, moreover, heat and light are absorbed, or converted in forming the synthetic processes going on in the vegetable, so conversely heat and sometimes light is given off by the living animal; but it must not be forgotten that the line of demarcation between a vegetable and an animal is difficult to draw, that there are no single attributes which are peculiar to either, and that it is only by a number of characteristics that either can be defined.

The series of processes above given may be simulated by the chemist in his laboratory; and the amount of labour which a man has undergone in the course of twenty-four hours may be approximately arrived at by an examination of the chemical changes which have taken place in his body; changed forms in matter indicating the anterior exercise of dynamical force. That muscular action is produced or supported by chemical change would probably now be a generally accepted doctrine; but while many have thought that muscular power is derived from the oxidation of albuminous or nitrogenised substances, several recent researches seem to show that the latter is rather an accompaniment than a cause of the former, and that it is by the oxidation of carbon and hydrogen compounds that muscular force is supplied. Traube has been prominent in advancing this view, and experiments detailed in a paper published this year by two Swiss professors, Drs. Fich and Wislicenus, which were made by and upon themselves in an ascent of the Faulhorn, have gone far to confirm it. Having fed themselves before and during the ascent upon starch, fat, and sugar, avoiding all nitrogenised compounds, they found that the consumption of such food was amply sufficient to supply the force necessary for their expedition, and that they felt no exhaustion. By appropriate chemical examination they ascertained that there was no notable increase in the oxidation of the nitrogenised constituents of the body. After calculating the mechanical equivalents of the combustion effected, they then state, as their first conclusion, that "the burning of protein substances cannot be the only source of muscular power, for we have here two cases in which men performed more measurable work than the equivalent of the amount of heat, which, taken at a most absurdly high figure, could be calculated to result from the burning of the albumen."

They further go on to state that, so far from the oxidation of albuminous substances not being the only source of muscular power, "the substances by the burning of which force is generated in the muscles, are not the albuminous constituents of those tissues, but non-nitrogenous substances, either fats or hydrates of carbon," and that the burning of albumen is not in any way concerned in the production of muscular power.

We must not confuse the question of the food which gives permanent capability of muscular force with that which supplies its requisites for temporary activity; no doubt the carnivora are the most powerfully constituted animals, but the chamois, gazelle, &c., have great temporary capacity for muscular exertion, though their food is vegetable; for concentrated and sustained energy, however, they do not equal the carnivora; and with the domestic graminivora we certainly find that they are capable of performing more work when supplied with those vegetables which contain the greatest quantity of nitrogen.

These and many similar classes of research show that in chemical inquiries, as in other branches of science, we are gradually relieving ourselves of hypothetical existences, which certainly had the advantage that they might be varied to suit the requirements of the theorist.

Phlogiston, as Lavoisier said with a sneer, was sometimes heavy, sometimes light; sometimes fire in a free state, sometimes combined; sometimes passing through glass vessels, sometimes retained by them; which by its protean changes explained causticity and non-causticity, transparency and opacity, colours and their absence. As phlogiston and similar creations of the mind have passed away, so with hypothetic fluids, imponderable matters, specific ethers, and other inventions of entities made to vary according to the requirements of the theorist, I believe the day is approaching when these will be dispensed with, and when the two fundamental conceptions of matter and motion will be found sufficient to explain physical phenomena.

ACADEMY OF SCIENCES.

August 13.

M. Pasteur announced to the Academy that he is about to publish a work "*On the Diseases of Wines and the Means of preventing them.*"

M. Chevreul read an extract from the second volume of his history of chemical knowledge. He called it "*An Historic Note on the Age of Stone,*" and it contained an extract from the life of Confucius by Father Amyott which proved to the author that 1122 years before Christ there was among the Chinese a tradition that stone arrow-heads had been in use in the country. Extracts from a Chinese dictionary and other works confirmed M. Chevreul in his opinion, since they showed that stone implements had been found in various provinces of China, and, indeed, spoke of them as being in actual use. What this has to do with chemistry is not very clear.

M. J. Jannsen communicated an interesting memoir "*On the Spectrum of Aqueous Vapour.*" The author's observations were made with an iron tube thirty-seven metres long filled with steam under a pressure of seven atmospheres. The light was furnished by sixteen gas jets. The spectrum showed five dark bands, of which two well marked answered to D and A (Fraunhofer), and reminded the observer of the solar spectrum seen in the same instrument towards sunset. According to the first comparisons made between the spectrum of steam and that of solar light it appeared that the group A of Fraunhofer, B (in great part at least), the group C, two groups between C and D are due to the aqueous vapour in the atmosphere. The experiment gave another interesting result. The spectrum was very dark at the violet end, and brilliant in the red and yellow, showing that aqueous vapour is very transparent to the latter rays, and suggesting that it will appear orange-red by transmission, and redder according to the thickness of the layer. This result, the author states, requires to be verified with care, but if established, he says, it will explain the redness always observed at sunrise and sunset. M. Jannsen hopes soon to be in a position to pronounce upon the existence or non-existence of aqueous vapour in the atmospheres of the planets and other stars. At present he is only able to say that it is not present in the atmosphere of the sun.

Readers interested in the subject will find in the *Compte Rendu* of the above date "*An Account of the actual State of the Waterworks of Paris.*"

M. J. Kolb presented a paper "*On the Densities of Nitric Acid.*" The author found reason to doubt the accuracy of all the tables he had met with, and made a series of determinations with all precautions for himself. His results are given in a long table, for which we will, if possible, find space.

NOTICES OF BOOKS.

Journal de Pharmacie et de Chimie. August, 1866.

The present number of this journal opens with the preface to the new edition of the French *Codex Medicamentarius*, just ready to be issued. It is an eloquently written account by M. Dumas of the uses of a Pharmacopœia, and the objects to be kept in view in the composition of such a work. The whole well deserves perusal, but we have only room for an extract relating to the part that chemistry is called upon to play in the preparation and application of medicines.

"Chemistry continues to improve the modes of preparation, of purification, of concentration of known medicaments. It isolates everyday active principles; it creates and multiplies to infinity substances that rival them in activity. It is no longer contented to prepare with accuracy the remedies that practice demands, but it pursues their course through the animal economy; it ascertains the modifications they undergo during their stay in the organs of the body, as well as the forms under which they are eliminated. It teaches the practitioner to foresee under what circumstances an inoffensive remedy may become a mortal poison, and, in its turn, how a poison may become inert. It furnishes us with facts and views which allow us in a great number of cases to point out beforehand on what organs or what system of organs a medicament will exert its influence, by what general processes its elimination will take place, and consequently what will be the limits and probable duration of its action." Again: "Chemistry will show then how we purify and how we concentrate active principles; experimental physiology will teach to what precise organs the medicament addresses itself, and what variations its effects undergo, according to the formulæ adopted for its preparation or its employment. With regard to energetic substances, the art of healing will be informed by the studies of the chemist of the means to obtain them pure, to avoid associations which change them, to choose those which favour their preservation or assure their efficacy; the studies of the physiologist will teach the exact part they play, what field their action embraces, and what limits their power acknowledges. Thus, medicines with a simple effect, of physiological origin, will increase in number and importance, while complex medicaments transmitted by tradition will lose their authority. We shall no longer seek to weaken and dilute opium by distributing it through a mass of theriacum; but, on the contrary, shall endeavour to remove from the crude product the inert matter, distinguishing each active principle in it, and defining still better the specific action of morphia, codeia, narcotine, narceine, &c."

We shall only make one more quotation, which applies to pharmaceutists, and makes special reference to England and present disputes in France. "The object is to administer medicines brought to their maximum of energy and consequently of danger under the best conditions to guarantee the safety of their employment, and the certainty of their action on an organ, or even on a well-defined element of the organism, and some would do away with well-instructed pharmaceutists! The physician prescribes hydrocyanic acid or pepsine, for example, and it matters little that the seller of these articles knows enough to assure himself whether his hydrocyanic acid is the most violent of poisons or the most harmless of matters—whether the pepsine he vends is the true ferment of the gastric juice or a powder without virtue! With increased responsibility an increase of knowledge is necessary. To what dangers are not families exposed if the pharmaceutist is ignorant that the name chloride of mercury may designate either a violent poison or an innocent purgative, and that there is nothing in common between chloride and cyanide of potassium so easily confounded by common people. The pharmaceutist, let us say, requires a more extended and deeper instruction in proportion as the progress in therapeutics places in his hands medicines more numerous, more powerful, more changeable, more easy to adulterate, with regard to which the least error threatens the life of the patient, and the slightest modification mars the hope of the physician. When this conviction takes root in England herself, enlightened by the mistakes which multiply under her eyes, and the evils they involve, it is not the moment that France should choose to abandon it."

We do not hold the same views as M. Dumas respecting the "liberty of pharmacy;" but this is not the time to argue with him. His remarks will meet with the approval of many in England, and we quote them for the advantage of those who agree with the author. The next article is by M. Guibourt "*On the Productions of Mexico,*" a paper communicated to the Pharmaceutical Society of Paris.

The next paper is an extract from a thesis by Dr. A. Commaille, entitled "*Researches on the Chemical Constitution of Albumenoid Substances.*" The author has isolated the various constituents of compound albumenoid substances. Thus in gluten he finds five nitrogenised principles. 1. *Inésine* (the fibrin of gluten). 2. *Sitésine* (the casein of gluten). 3. *Glutine.* 4. *Mucine.* 5 *Sitosine* (the albumen of gluten). He describes the properties of these, and gives analyses of their chloroplatinic compounds. In like manner he describes the albuminous matters of eggs, of sweet almonds, of leguminous seeds, of milk, of muscular flesh, of the blood, and of the urine. With regard to white of egg, the author points out that raw albumen differs chemically as well as physically from coagulated. It has a different solubility in dilute acids, and it is certain that heat causes the elimination of a small quantity of a peculiar substance, which is only imprisoned in the coagulated mass. This fact was pointed out by Bostock in 1808. A culinary experiment shows that cooking effects a dissociation of the principles of white of egg, or some peculiar change in the albumen. Silver is not affected in a raw egg, but everybody knows it is blackened in a boiled one. The author put a recently struck coin in white of egg, and then heated it to coagulation in a water bath. The coin came out not only blackened, but corroded in places. Nothing like this was observed with the raw egg, or with the yolk raw or cooked. M. Wurtz has pointed out that sulphuretted hydrogen is evolved during the coagulation of albumen, but the author is not certain that this gas alone gives the peculiar odour to hard eggs. He rather believes that there is a volatile substance which contains all the sulphur hitherto supposed to be a constituent of the albumen itself.

The albumenoid matter found in urine, he states, presents a close similarity to that found in the juice surrounding muscular fibre, and to which he has given the name "*Oposine.*"

In a short note "*On Thallium Amalgam,*" M. Nicklès states that this metal, like all those which are, so to speak, *moistened* by mercury, is permeable to the latter metal.

Some papers from the *Comptes Rendus* and the *Proceedings of the Paris Pharmaceutical Society*—the latter of no interest—together with some medical papers, fill up the rest of the number.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

1633. W. B. Brown, Manchester, "An improved anti-acid oil."—Petition recorded June 16, 1866.

1838. J. Law, Queen's Road, Bayswater, London, "Decolorising the products obtained in the distillation of shale, coal, and wood, including tar, for the purposes of dipping, pouring, and smearing sheep, and thus preserving the purity of colour and the healthy condition of the wool."

1846. A. Prince, Trafalgar Square, Middlesex, "Improvements in the means of preserving timber from decay." A communication from G. P. Ball, New York, U.S.A.—July 13, 1866.

1917. G. Davies, Serle Street, Lincoln's Inn, Middlesex, "Improvements in the manufacture of sulphate of soda and sulphate of potash." A communication from P. Rémond, Paris.—July 24, 1866.

1969. F. C. Hills, Deptford, Kent, "Improvements in the manufacture of oxalic acid."—July 31, 1866.

NOTICES TO PROCEED.

933. W. B. Collis and E. J. Collis, Stourbridge, Worcestershire, "Improvements in coke ovens."—Petition recorded April 2, 1866.

983. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the production of white or semitransparent glass" A communication from Dr. H. Kunheim, Berlin.—April 5, 1866.

992. J. Young, Limefield, N.B., "Improvements in distilling."—April 6, 1866.

MISCELLANEOUS.

Method for Assaying the Purity of Arrowroot from the Maranta.—M. Albers (*Archiv der Pharm.* and *Dingler's Polytech. Jour.*) gives the following method for discovering the presence of wheat or potato starch in the arrowroot of the Maranta. The following is the process:—Take one part of fecula and mix it with three parts of a proof liquor, consisting of two parts of chlorhydric acid, sp. gr. 1·120, and one part of water at the ordinary temperature. In three or four minutes pure arrowroot will not be affected by the acid liquor, but wheat or potato starch, on the contrary, will be changed to a transparent gelatinous mass, which becomes fluid by the further action of the acid, transforming the starch jelly to dextrine. When potato starch is the adulterant, it evolves a peculiar odour, well known to those who have made dextrine from it. When a mixture thus exists, the true arrowroot granules will subside as the gelatinised adulterant is converted to dextrine, and may be separated by a strainer, washed, dried and weighed, and the relative amount of adulteration may be judged of approximately by the consistence of the jelly at first developed.—*Jour. de Pharm.*, 218, *Fevrier* 1866.

Yield of Essential Oils.—Zeise has distilled on a large scale, and gives the following as the yield calculated for 100 kilogrammes of the original material:—

Pimento, from 2½ to 3 kilos.
Bitter almonds, from 360 to 420 grammes.
Aniseed, 2 kilos.
Star anise, 4·15 to 4·44 kilos.
Cardamoms, 2·9 kilos.
Camomiles (Anthem. nob.), 275 grammes.
,, (Matricar. cam.), from 60 to 270 grs.
Cinnamon, from 420 grammes to 1·69 kilo.
Copaiba, 58 to 67 kilos.
Cubebs, 390 to 730 grammes.
Peppermint (dry), 680 grammes.
Juniper, 550 grammes.
Savine, 2·75 kilos.
Sassafras, ¾ kilo.

The distillation of cinnamon, the author says, used to be profitable, but now the yield of oil is small, owing to the practice of extracting the oil by steam in Ceylon, before the bark is sent to Europe.—*Journ. de Ph. et de Chim. Neues Rept. für Pharm.*, t. xv. p. 126.

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.

The Answers to Correspondents are unavoidably deferred until next week.

Received.—"Aluminium;" T. C. E.

Books Received.—Ganot's Elementary Treatise on Physics, Experimental and Applied. Translated by E. Atkinson, F.C.S. Part II.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On a Process of Organic Elementary Analysis, by Combustion in a Stream of Oxygen Gas, by C. M. Warren.

(*Concluded from page* 87.)

4. As an additional control over the supply of oxygen, and serving also as a temporary safeguard against the escape of incompletely oxidised substance, in case of too rapid distillation, with an insufficient flow of oxygen, I have two or three inches in length of the tube filled with coarse, strongly ignited oxide of copper, placed in front of the asbestos, and this followed by a plug of the latter substance to keep it in place, and prevent the formation of a channel along the upper surface of the oxide of copper. The tube itself being laid in an iron trough, as previously described, with the upper half of the tube exposed, the oxide of copper is heated in such a manner that any reduction would be readily observed at the end in contact with the asbestos. In this manner it serves as a valuable indicator by which to determine at a glance whether the flow of oxygen is sufficient. It will rarely happen that any reduction of the oxide of copper will take place. I have, however, in some of my earlier experiments, with too short a column of asbestos, and ill-adapted bulbs, had so much of the oxide of copper reduced that combustible gases passed through the absorbing apparatus; and in one instance, when the unabsorbed gases were collected, the quantity of combustible gas was so considerable as to form with the oxygen collected with it—which of course came forward at an earlier or later stage of the process—an explosive mixture. Having seen no indications that any other than gaseous bodies escaped the combustion tube in such a case, it occurred to me that such an analysis might be saved by collecting the gas over mercury, and, at the close of the combustion, before detaching the absorbing apparatus, conducting it a second time through the combustion tube.* As a matter of economy, also, in the saving of the excess of oxygen, when a considerable number of analyses are to be made, this idea seemed to recommend itself; as the oxygen would, at the same time, become purified from any traces of combustible matter which might be present, and could then safely be collected as pure oxygen, and finally transferred to the oxygen gasometer.

I therefore constructed for this purpose the apparatus which is represented in the background of the figure (see Chem. News, p. 86) as attached to the anterior end of the absorption apparatus. At the close of the combustion, when only pure oxygen appears to enter the potash bulbs, the flow of oxygen is interrupted; the communication with that portion of the drying apparatus which is back of the short U tube, A, is closed at b; and the tube B—which is movable in the cork—turned up.† The joint at c is then disconnected; the end leading to the receiver C tightly closed with a piece of glass rod: and a communication established between the absorption apparatus and another receiver containing water—not shown in the figure—for collecting the pure oxygen. On opening the spring-clip d (the more modern form, which is provided with a fine screw, is excellently well adapted for this purpose), the mercury will flow from the reservoir D into the receiver C, and force the gas through the capillary tube $e\ e$; thence through the short U tube A, containing chloride of calcium, to the combustion tube and absorption apparatus; and the gas is finally collected over water in the receiver provided for that purpose.

The introduction of a longer column of oxide of copper would probably accomplish the same purpose with less expense; but neither expedient can be regarded as essential to the process. As the saving of an analysis by the use of a longer column of oxide of copper would only be occasional, the additional heat required, and consequent discomfort occasioned by its continual use, would hardly be compensated for. So that while I would not, therefore, recommend the use of an additional quantity of oxide of copper, I would also discard the other expedient of collecting the gas over mercury, or water, &c., unless the saving of the surplus oxygen, together with the additional security afforded, should be considered of sufficient importance to recommend it. As the passing through of the gas the second time requires no attention after it is once started, and occupies but a short time, during which the operator may attend to anything else, I much prefer, for myself, to retain in use that part of the process.

5. Some other less important peculiarities in the construction and use of the apparatus will now be noticed in connexion with some remarks on the performance of the analysis.

The posterior end of the combustion tube, as seen in the figure, is bent obliquely upward, as in the common form, except that instead of being drawn out to a point it is left of the full size of the tube. The object of this form is to prevent, in a great measure, the escape of oxygen during the time occupied in introducing the substance for analysis; and also for greater convenience and security from loss in the performance of this operation, especially in the case of volatile liquids. In the latter case the neck of the bulb—which has previously been provided with one or more scratches on its side near the end—is introduced into the end of the combustion tube, and broken off by pressure against the side of the tube; the bulb itself is then allowed to drop in, and the end of the tube immediately closed with a perforated cork containing a glass tube, f, connecting it with the drying apparatus. This connecting tube is constructed of hard Bohemian glass; the anterior end of which is drawn out to a short, blunt point, and the opening nearly closed in the blowpipe flame, to the size of a small needle; the object of which is, to increase the rapidity of the flow of oxygen at that point, and thereby diminish the liability to loss from diffusion of gases or vapour backward into the drying apparatus, which is always too liable to occur when the posterior end of the combustion tube is not sealed.

As an additional precaution against loss from this source, this connecting tube is packed with asbestos in the same manner as the combustion tube, and during the combustion is heated with one of Bunsen's burners. In case vapour of the substance should reach this tube, notwithstanding the above precaution against it, it could not reach the drying apparatus as such; but would be immediately decomposed, and the carbonic acid formed would at least stand a good chance of being carried for-

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* As the time consumed in an experiment is so short, and the quantity of combustible gas present, if any, so very small, and that mixed with a very large quantity of oxygen, it is not improbable that the gas might as well be collected over water; as the quantity which could be absorbed by the water in so short a space of time would probably be inappreciable.

† That this tube may not operate as a siphon, the outer limb is formed by attaching near the bend a flexible tube, of larger bore than that of the glass tube. This flexible tube is preferable to glass on account of the readiness with which it adapts itself to any change of position of the glass tube, by which it may always project into the receiver underneath, and prevent waste of mercury.

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ward, and prevent a loss in the determination of the carbon. The heating of this connecting tube may be superfluous for the object above described (a point which I have not yet taken the time to determine); but it certainly has the good effect of heating the oxygen, and thus preventing the condensation of liquid at the cork in the end of the combustion tube.

In the performance of an analysis, the first step should be to expel the moisture from the combustion tube, while hot, by passing through it, for some time, a stream of dry air from the gasometer.‡ The tube should then be filled with oxygen, before the substance, if volatile, is added; as otherwise particles of unburnt substance might escape during the displacement of the air, and occasion loss. The absorbing apparatus, having been previously weighed, is then attached, and, if the excess of oxygen employed is to be saved, the oxygen again admitted to expel the air from the absorbing apparatus. The connexion is then made with the receiver *C*, if used, and the tightness of the joints tested by turning down the tube *B*, so as to partially exhaust the apparatus. If found tight, as indicated by the liquid in the potash bulbs, the tube *B* is again turned up, and the substance then introduced in the manner above described. A very slow stream of oxygen is now admitted; the tube *B* again turned down till the level of mercury in this tube shall be half an inch to an inch below the level of mercury in the receiver *C*; and from time to time during the combustion the position of this tube is adjusted so as to preserve about this difference between the levels of the mercury, or at least so as to prevent the mercury in the tube from ever rising above that in the receiver.

In this manner the mercury, instead of offering resistance to the passage of gas from the combustion apparatus, and thus increasing the internal pressure upon the joints, which would be objectionable, actually operates advantageously by producing partial exhaustion, and thus diminishing the internal pressure upon the joints, and consequently the liability to leakage. The distillation of the substance is now commenced, and conducted as previously detailed above. So soon as condensation of moisture appears in the neck of the chloride of calcium tube, indicating that combustion has commenced, the flow of oxygen may be gradually accelerated to keep pace with the progress of the combustion, as indicated by the bubbles in the potash bulbs. When the burning of the subtance seems to have been completed, heat is gradually applied, for a short time, along the whole length of the column of asbestos, to obviate the possibility of any loss from unburnt substance.

The absorbing apparatus may be weighed filled with either oxygen or air; for myself I prefer the latter, as, on the whole, more convenient and less liable to lead to error. At the close of the analysis, therefore, I expel the oxygen from the apparatus by admitting air from the air-gasometer,§ saving for further use the oxygen which is expelled during the first five or six minutes. Thus far I have applied this process only in the analysis of volatile hydrocarbons of the formula C_nH_{n-6}; $C\ H_{n+2}$, &c.|| As a mixture of the vapours of these bodies with oxygen is highly explosive, a more severe test of the safety of the process could not be applied.

In every experiment which I have made, the combustion has proceeded as quietly as if burning in the open air. The results obtained are extremely accurate and uniform.

Although the bodies which I have analysed represent but a single class of organic substances, I can see no reason to doubt that the process will apply equally well in the generality of cases.

If this view be corroborated by actual experiment, the process can hardly fail to supplant the common methods, if for no other reasons than its greater convenience, economy of time, avoidance of excessive heat, neatness, &c.; while, as regards accuracy of results, it will, at least, not be found inferior to the other methods; but, on the contrary, I think preferable, as affording greater security against failures and errors from accidental causes.

Having obtained such satisfactory results in the cases referred to, and being prevented by other important work, to which the study of this process is only incidental, from pursuing the subject further at present (except so far as I shall have occasion to use the process in my other investigations), I have thought it advisable to present the process to the Academy as it now stands. I hope, however, before long to be able to resume the work, with the view to determine, by experiment, the extent of its applicability as a general method, and will report the results to the Academy.

TECHNICAL CHEMISTRY.

On the Assay of Coal, &c., for Crude Paraffin Oil, and of Crude Oil and Petroleum for Spirit, Photogen, Lubricating Oil, and Paraffin, by JOHN ATTFIELD, *Ph.D., F.C.S., Director of the Laboratory of the Pharmaceutical Society of Great Britain.**

THE enormous increase, during recent years, in the use of oils of mineral origin for lighting, lubricating, and other purposes, has so stimulated the demand for these liquids, that analytical chemists are often required to determine the value of a specimen of coal, shale, lignite, &c., as a source of crude paraffin oil, or the value of a specimen of the oil itself, or of the allied substance of natural origin termed petroleum. Hitherto there has not been published any detailed method of conducting these examinations. The author, therefore, having from

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‡ The necessity for this may be entirely obviated, after the first analysis, and much time saved and uncertainty avoided, by connecting the anterior end of the combustion tube, at the close of a day's operations, with a set of stationary drying tubes of ample capacity, which may stand back of the furnace out of the way, communication with which is established by means of a flexible tube. Or, better, a movable tube may be attached by means of a screw to the opening in the top of the gasometer, extending to the top of the upper reservoir, so that water cannot enter, and then, by simply turning the cock underneath, communication would be opened between the surrounding air and the combustion tube, through the intervening drying apparatus. At the close of work the anterior end of the combustion tube should then be tightly corked, the fire extinguished, and the tube allowed to cool in dry air. It would thus be always ready for immediate use.

§ The oxygen-gasometer and the air-gasometer each having a separate drying apparatus, the time consumed in changing from one to the other is very much shortened, as the necessity for displacement of the oxygen or air—as the case may be—which is contained in the drying apparatus is avoided. Each drying apparatus consists—1st, of Liebig's bulbs, containing sulphuric acid; 2nd, of a U tube, fifteen inches high (nearly three feet of tube), filled with soda-lime for carbonic acid; and 3rd of two such U tubes (five to six feet of tube), filled with chloride of calcium. The object in using drying tubes of such large dimensions is to avoid the necessity of too frequent renewal. The gasometers stand in a pan of copper, which is provided with an outlet to the sink, so that they may be filled without disconnecting from the drying apparatus; thus giving a degree of permanence to the apparatus, and saving some labour.

|| In an analysis of amyl-alcohol, made in my laboratory by my friend Mr. Storer, for the sake of familiarising himself with the process,—it being his first analysis by this apparatus,—the following result was obtained :—

	Experiment.	Theory.
Carbon . . .	68·53	68·18
Hydrogen . . .	13·63	13·64

* Read before the Chemical Section of the British Association, Nottingham meeting.

time to time had occasion to make a large number of such assays, ventures to supply the deficiency.

First, with regard to the assay of coal and other carbonaceous matters for crude oil. The method of manufacturing crude oil on the large scale consists, as is well known, in simply heating the coaly matter in large retorts; oil, water, and gas then distil off, and are collected in suitable receivers, while coke remains in the retort. Now, the object of the analyst in experimenting on small quantities of oil-yielding materials of unknown value must be to accurately imitate this process, while, at the same time, he provides for the collection of products of all possible variety of character. It has been stated that a good indication of the value of such materials may be obtained by placing ten or twenty grammes in a porcelain crucible, embedding the latter in charcoal contained in a much larger common crucible, and heating the whole in an ordinary furnace for an hour or two. Volatile matters then pass off, and coke, prevented from burning by the surrounding charcoal, remains in the inner crucible. When cold the coke is weighed, and the difference between this and the original weight of coal used gives the proportion of volatile matters. The facility with which such an experiment may be made has led to its frequent performance; the result is that one may see in books, &c., devoted to this subject, long columns of figures showing the proportion of volatile to non-volatile matter in a large number of oil-yielding substances. Probably, however, but little confidence can be placed in such results. A very small percentage of volatile matter would of course at once indicate that the substance operated on was of no value as a source of oil. Under all other circumstances the experiment is of little or no value, for I have found that the relative proportions of oil, water, and gas in volatile matter vary so greatly, that of much volatile matter but little may prove to be oil, and of a small percentage of volatile matter nearly all may be oil; and, again, the difficulty of applying a low and regular heat to such an arrangement of crucibles is so considerable, that I have met with differences of 10 to 15 per cent. of coke from the same sample of broken and previously well-mixed coal. In one experiment four porcelain crucibles were placed in one large common crucible, the first porcelain crucible being placed near the bottom, and the three others in the upper part, and all charged with the same prepared specimen of coal. After ignition, the lower crucible yielded 9 per cent. more coke than the others; owing mainly, doubtless, to its receiving more heat than they—a high temperature, as is well known, causing decomposition of some of the hydrocarbons, of which oil and gas are formed, with separation of solid carbon.

Rejecting, then, the experiment of subjecting the coal, &c., to a preliminary coking operation, the material is at once subjected to distillation. This I usually perform in a piece of common iron gas-piping, a metre and a quarter long, and five to eight centimetres internal diameter. Two or three kilogrammes of the coal, properly sampled, is then broken down to the size of peas or hazel nuts, avoiding the formation of dust. The fragments are well mixed together, and from one-half to one kilogramme weighed out for distillation. This quantity is poured into one end of the iron tube, a diaphragm of wire gauze, suspended by a long wire at about thirty centimetres from the other end of the tube, preventing the coal from falling through. The coal so placed occupies half a metre or more of the tube, leaving a free space of thirty or forty centimetres at either end of the tube. The region of the tube occupied by coal is now heated by a series of gas-jets until the lowermost part of the iron is just visibly red in a darkened room, the gas-jets being turned off during the moment of observation of the temperature. To heat the tube equally and not too highly by charcoal is difficult. A Hofmann's gas furnace, two-thirds of a metre long and having three rows of burners is perhaps the most convenient for the purpose; it should be just fairly alight along its whole surface. These arrangements are, in my opinion, those most convenient for quantitative experiments; if the object be merely the production of oil, a wider tube and a furnace of five rows of burners may be used. For experimental purposes, the iron tube and furnace should, I think, in nearly all cases be inclined downwards from the horizontal position at an angle of ten or fifteen degrees. Indeed, one office filled by the wire-gauze diaphragm already alluded to is to prevent the falling of the coal out of the region of the furnace when the iron tube is inclined as just stated. The advantage of inclining the tube is, that while nothing is lost which could possibly be formed in or obtained from a retort of the usual form, some of the paraffin and heavier vapours, which might under other circumstances remain about the source of heat, and become decomposed mainly into gas, at once flow off downwards from the region of danger. The condensation of the vapours produced in the distillation is effected in a common bottle of one or two litres' capacity, partially immersed in a vessel of cold water, a wet cloth covering the upper surface of the bottle and dipping into the water. This arrangement is usually sufficient even for the condensation of oils from coals containing a considerable amount of moisture. The iron retort tube is connected with the bottle by a hollow tin cone about a third of a metre long, the larger orifice fitting loosely over the end of the iron tube, the smaller passing through a cork into the condensing bottle. The neck of a broken retort, commonly used as an adaptor in laboratory distillations, may be used in place of the tin cone, but is more than usually liable to fracture. The tin is luted to the iron by plaster of Paris, or, still better, linseed meal, which, being some distance from the source of heat, is more effective than might be supposed. The opposite end of the iron tube is closed by a cork, which also, being from twenty-five to thirty centimetres from the furnace, is scarcely charred in several operations. The cork of the condensing bottle should be perforated by a second hole for the insertion of a glass tube for carrying off gas, or for connexion with a second condensing bottle. The second bottle may, in the distillation of coal yielding much very volatile matter, be connected with a Liebig's condenser. But if the operation be conducted slowly, extending over about two hours, the whole of the product will, in nearly every case, be found in the first bottle. The gas produced in the process may be conducted into a chimney, burned at a jet, or collected in a gas-holder for measurement and experiment.

I have had constructed other forms of retort than the long iron tube just described, but have not found them to possess any particular advantage. In one, the furnace being placed horizontally, the tube at the point where it emerged from the source of heat on the condensing side was bent upwards for about ten centimetres, and then downwards, so as to resemble the neck and beak of an ordinary glass retort. In some comparative experiments this form of retort yielded oil somewhat better in quality, but slightly smaller in quantity, than that given by the inclined straight tube. This result was probably simply due to the exclusion of the heaviest hydrocarbons, an effect said to be sometimes desired by the manufacturer, but to be generally avoided by the experimentalist, who should be careful to obtain from a coal, etc., everything volatile that it can in any way be made to yield. Another retort, similar in form to the last mentioned, was provided with a tube for the admission of steam, under the conjecture that the escape of oil-vapour as fast as produced might be thereby facilitated, as in the corresponding operation for the extraction of the ready-formed volatile oil of seeds, fruits, etc. But an experiment with the same coal as used in the other cases showed that the use of steam did not cause a better yield of oil, and was attended by some inconvenience, owing to the necessity of adopting adequate condensing arrangements. The use of superheated steam has been proposed, and is used to some extent, I am told, in the distillation of oil from coal on the large scale, no external heat being applied to the retorts. What direct or indirect advantage is thereby gained I am unable to state, not having performed any experiments in this direction. It may assist in the escape of the heavier vapours, but for this purpose the analyst will find carbonic acid gas preferable, as will be presently seen. Should the use of steam at a temperature approaching redness ever be demonstrated to cause such an increase in the yield of oil as to counterbalance the increased cost of condensation, it would be easy for the analyst to imitate the method on the small scale, by passing steam generated in an ordinary flask through a heated coil of metal pipe before entering the retort containing the coal.

The distillation of the coal completed, the source of heat is removed, and the weight of the condensing bottle and its contents noted; from this weight that of the bottle previously ascertained is deducted, and the weight of the crude oil and water yielded by the coal thus determined. The separation of the oily from the aqueous portion of the distillate is generally easy of accomplishment. The bottle is placed in a vessel of cold water, which is then heated to from 30° to 60° C., for an hour or two, and allowed to cool slowly. If complete separation of oil and water has apparently occurred, the latter may now be siphoned off, or, if the oil is semi-solid, the water may be simply poured off, and the weight of the two be respectively determined. If desired, the water can then be examined for ammonia, &c. Sometimes the separation of oil and water is not so decided as is necessary for analytical puoposes. Under these circumstances, a portion only is removed for examination, and a strong aqueous solution of common salt poured into the bottle; the whole is then well shaken, and again heated as before described. The superior specific gravity of the brine now enables the oil to rise to the surface. After standing a few hours, the brine is carefully removed by a siphon. The weight of the oil deducted from the weight of the original distillate gives the weight of the water. The retort having cooled, the coke is removed and weighed, and a portion burnt for ash or otherwise examined. And now the difference between the combined weights of oil, water, and coke, and the quantity of coal originally taken gives the weight of the gases evolved in the operation. From these weights the percentage or any other proportions are easily calculated. In English commerce, conventionality requires that the oil value of a coal be stated by giving the number of gallons of oil yielded by one ton of the coal. This is readily accomplished by calculating from the centesimal proportions the number of pounds of oil per ton of coal; the specific gravity of the oil is then ascertained in the usual way; and now the number of pounds, divided by the figures representing the specific gravity, indicate the number of gallons afforded per ton.†

The value of the crude oil is next determined. A specimen of natural mineral oil or petroleum requires similar treatment. This is a matter of fractionation with or without previous distillation, with or without previous purification. As a general rule it is best to at once distil about fifty cubic centimetres of the rough oil in a small glass retort, a thermometer being inserted in the liquid and the distillate allowed to flow into a cubic centimetre measure. By watching the thermometer, and roughly noting the amount of products yielded at different temperatures as the thermometer rises to 250° C., and, after removing the thermometer, at temperatures above 250° C., a fair indication of the character of the oil is obtained. A specimen of "once-run" oil is also thus secured, the appearance and specific gravity of which should be observed. The residue in the retort should have been so heated as to be but a carbonaceous, friable mass; when cold it may be removed and weighed. If the residue form only 2 or 3 per cent. of the crude oil, and the latter was not of very dark colour, then the crude oil may probably be submitted to the process of purification without previous distillation, but if the loss is 10 or 12 per cent. it is an indication that the crude oil should be "once run" before purifying. Sometimes the contents of the retort towards the close of this first experimental distillation assume the appearance of melted pitch; in that case a portion should be removed by a glass rod, and if, when cold, it is hard, black, and lustrous, the distillation should be stopped, and the amount of the pitch (asphalte) ascertained by weighing the retort and contents and subtracting therefrom the weight of the retort previously noted; or, if the retort has not been already tared, as much of the contents as possible may be poured out, the retort then cleaned with naphtha, and, when dry, weighed. If the first specimen of pitch removed from the retort does not become hard, the distillation should be continued some time longer. The vapours which are evolved above 250° C. are very heavy, and only distil with difficulty from such a retort as just described, even though the glass be in direct contact with an air-gas flame. After removing the thermometer, therefore, I usually insert in its place a glass tube, through which a current of carbonic acid gas is passed; in such an atmosphere the heavy paraffin and other vapours rise and flow off better than in a current of steam. A fifth of a litre of the once-run oil, or of the crude oil or petroleum, if not of very bad odour or colour, is now mixed with about ten cubic centimetres of strong sulphuric acid, and agitated frequently during a period of from two to three hours. The mixture is set aside for the oil and acid to separate, the oil poured off from the thick treacle-like deposit ("foots"), washed two or three times with water, and then shaken with about the same quantity of a strong solution of caustic acid (sp. gr. 1·3 or 1·4) for an equal period. The soda solution having subsided, the oil is poured off and washed by agitation with water. If the oil is still of bad colour, it is again treated with acid and soda as before, at a moderately warm temperature (30° to 35° C.); and sometimes a third treatment is necessary. Sometimes,

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† The heavier the oil, the smaller amount of photogen it will yield, for the specific gravity of the latter should range as low as from 0·790 to 0·825; crude oils above 0·900, or "once-run" oils above 0·880, are not yet viewed with much favour in the market, unless, by their solidity, obviously containing much paraffin. Their value as lubricating oil will, however, probably rise to that of burning oil, when the use of the latter becomes more extended.—J. A.

also, the oil is best treated by soda first and acid afterwards. It is now redistilled in the manner already described, three chief fractions being collected separately, the volume of each noted, and its specific gravity taken. The fraction of lowest boiling-point, the "spirit," may in this first fractionation have a specific gravity of 0·750; the next, the burning-oil or "photogen," of 0·850; the "lubricating oil" will be the fraction coming over at the highest temperatures. Each of these fractions may now be once redistilled; the spirit will yield some photogen, which may be mixed with the photogen first obtained; the photogen will then, at the commencement of the distillation, yield a little spirit, and, towards the end, some lubricating oil, which may be mixed with the lubricating oil first obtained; the lubricating oil will then yield a little more photogen. The spirit should finally have a specific gravity only a few degrees above or below 0·730, and the photogen be within 10° or 15° of 0·805 and not give off inflammable vapour when at a temperature of about 40° C.[‡] The specific gravity of the *lubricating oil* will vary. A fifth of a litre of crude oil having been used, the number of cubic centimetres of the three fractions divided by 2 will of course give the percentage volumes (in England gallons) of each product, the difference between these and 100 being the loss that has occurred during purification or "refining." In some cases this loss may be decreased by boiling together the two residues or "foots" of the acid and alkaline treatment and well washing the resulting "coarse grease" with water. The lubricating oil may also, if semi-solid at temperatures between 15° and 20° C., be further separated into oil proper and *paraffin*. To this end 100 grammes are distilled so long as the distillate, tried in quantities of 2 or 3 c.c. at a time, gives no crystals of paraffin on being cooled to 5° C. When this point is reached, the residue in the retort is poured out into a cup and cooled. The resulting solid fat ("lubricating grease") is then removed, wrapped in a sheet of unsized paper, and placed in a small press having hollow metal face-plates. Ice-water is now passed through the press-plates, and when sufficient time has elapsed for the fat to become cooled gentle pressure is put on the plates, and the force increased slightly from time to time during a period of twelve or twenty-four hours. The paraffin will now be in a solid cake, the weight of which in grammes will be the percentage proportion yielded by the lubricating oil from which it was obtained. The proportion of lubricating oil to crude oil being known, the amount of paraffin in the crude oil is readily calculated. The paraffin ("paraffin scale") thus obtained is not quite pure, retaining some colouring and odorous matters. By subsequent treatment with sulphuric acid and soda, or recrystallisation from petroleum spirit, it may be obtained colourless and inodorous, but this operation is generally unnecessary of performance by the analyst, as but little by weight is lost in the purification. Its melting-point should, however, always be determined, as the higher this is the more valuable the paraffin. For this purpose a small quantity of the melted paraffin is drawn up into a capillary tube ten or twenty centimetres long and about half a millimetre in diameter, the tube immersed in cold water, and the vessel containing the water heated until the minute cylinder of paraffin changes from the condition of an opaque solid to a transparent liquid. By means of a delicate thermometer placed in the water, the point of change can be determined to the tenth of a Centigrade degree: it varies from 40° to 60° C.

In conclusion I would recommend that in reporting on the oil-value of a coal, etc., the chief products be described respectively only by the terms "spirit," "photogen," "lubricating oil," "paraffin," and "coke," and that the specific gravity, at 15·5° C., and boiling point of each of the liquids, and the melting point of the paraffin be always given. The term "spirit" is already common for this the liquid of lowest boiling point, and is sufficiently indicative of its use as a substitute for spirit of turpentine. "Photogen" is definite as a distinctive name for the burning-oil or "light-producer," and already more restricted in its application than its synonyms "paraffin oil," "lamp oil," "illuminating oil," "heavy naphtha," "solar petroleum," "solar oil," &c. In the International Exhibition of 1862 (see Juries Report, Class II., Section A.) solar oil was in one place described as the coal product, having a specific gravity of 0·833 or 0·835, in another as the product containing no oils of less specific gravity than 0·870 or more than 0·920. Such discrepancies are most confusing, and should be avoided. If the results of the examination of coal, lignite, shale, &c., and petroleum be reported in the manner above indicated, the amount of acid and alkali used and the loss in distillation and in purification being also given, there will not be much difficulty in determining the money value of the raw material, as the cost of erecting and maintaining oil works can now be readily ascertained, and the prices of all materials and products are almost daily published.

17, Bloomsbury Square, London.

PROCEEDINGS OF SOCIETIES.

BRITISH ASSOCIATION, NOTTINGHAM.

Address to the Chemical Section, by H. Bence Jones, *A.M., M.D., F.R.S., President.*

From the foundation of the British Association, in 1831, I believe no practising physician has been President of the Chemical Section; and I cannot take this chair when I know there are so many around me much better qualified than I am to lead and to direct the discussions that will take place on various papers that will be read, without asking your extreme indulgence for my shortcomings when subjects are before you which will be far above the direction of my inquiries.

When, however, I consider that my presence here may be regarded as a slight evidence of the relationship that exists between chemistry and medicine, I am encouraged in my undertaking by the thought, that whatever sets forth the union of chemistry and medicine tends to promote not only the good of science, but also the welfare of mankind.

For centuries this union has been at one time admitted and at another disallowed; but in the last half-century the discovery of Dr. Bright has proved that chemistry is absolutely requisite for the detection of a large class of diseases, and that without chemistry the nature of these diseases cannot be understood.

Moreover, since this great discovery the action of different chemical substances on the different forces in the different living textures, as, for example, in the muscles

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[‡] Photogen, as usually met with in commerce, does not begin to boil till heated to 170° or 180° C. Some liquids yielded by coals, treated as above described, have a much lower boiling-point and much higher specific gravity. In four recent experiments with common household coals (Silkstone, &c.), which had been carefully distilled at a temperature just below a low red-heat, I obtained products boiling at 115° to 120° C., and having specific gravities of 0·880 to 0·920. They closely resembled the "coal naphtha" of the coal-tar obtained in distilling coal at the high temperatures of gas manufacture. Shales found in the neighbourhood of such coals also often yield naphtha instead of photogen.

and nerves, has been so far investigated by chemists that it is daily becoming more and more certain that not only must every medical man become a chemist if he wishes to have any clear idea of the action of air, food, and medicine, but that the chemist who has most knowledge of the different forces that act in the body will require to learn the forms of matter in which those forces reside, and then with tentative skill he will quickly be able to regulate the qualitative and quantitative errors which constitute disease. In other words, when the union of chemistry and medicine is perfect, then science will show us how to keep or to regain the greatest of blessings, health.

The past year has not for chemistry been a year of great progress, though the harvest of new truths has been quite equal to the average.

That grand field for discovery, the synthesis of organic substances, furnishes as usual the most important fruit; and, as in duty bound, let me first mention the results that have been obtained by Professor Frankland at the Royal Institution.

His synthetical researches on ethers have partly been published in the *Philosophical Transactions*. He has succeeded in replacing all three atoms of hydrogen in the methyl of acetic acid by alcohol radicals; and thus he has obtained a third kind of butyric acid, namely, di-meth-acetic acid,

$$\left\{\begin{matrix}\mathrm{CMe_2H}\\ \mathrm{COHo},\end{matrix}\right.$$

and a new valerianic acid, namely, tri-meth-acetic acid,

$$\left\{\begin{matrix}\mathrm{CMe_3}\\ \mathrm{COHo};\end{matrix}\right.$$

also, iso-lauric acid,

$$\left\{\begin{matrix}\mathrm{CAy_2H}\\ \mathrm{COHo}.\end{matrix}\right.$$

The same reaction has also been extended to the replacement of the hydrogen of acetic acid by isopropyl, and an entirely new series of compounds containing this radical has thus been obtained. One of these forms a second new valerianic acid, namely, isopropyl-acetic acid,

$$\left\{\begin{matrix}\mathrm{CPr\beta H_2}\\ \mathrm{COHo}.\end{matrix}\right.$$

The numerous compounds of this beautiful series have not yet all been examined and submitted to analyses, and hence these results are still unpublished.

Taken together, the data furnished by this investigation establish beyond doubt the internal architecture of the fatty acids, placing the constitution of these bodies on as certain a basis as that of the compound ammonias synthetically investigated by Hofmann.

Professor Frankland has also continued his researches with Mr. Duppa on the synthesis of acids of the lactic series.

M. Persoz and Professor Maxwell Simpson have added still further to our knowledge on the synthesis of organic acids; and Professor Hofmann, notwithstanding his engagements in superintending the building of two grand laboratories for the promotion of chemical research, has found time to send us the synthesis of guanidine.

Before leaving this subject of synthetical chemistry, I must mention Professor Roscoe's paper on the "Chemical Intensities of Sunlight," for this is the direction in which the chemist looks for the glorious climax of all his synthetical investigations—the discovery of the chemical architecture of substances in the vegetable world.

The next grand field of investigation, analysis, seems comparatively deserted now. A most remarkable discovery has been made by the Master of the Mint on the absorption and dialytic separation of gases by colloid septa: for example, he finds that mixed gases pass through india-rubber at different rates proportioned to their power of liquefaction. The oxygen of atmospheric air passes through rapidly, whilst the nitrogen is comparatively stopped. The importance of this discovery in metallurgy, and its application to the physiology of respiration and of the passage of oxygen from the blood into the textures must be apparent to all. Mr. Vernon Harcourt has begun to estimate quantitatively the effect of time in influencing the amount of chemical change; or more generally, the laws of connexion between the conditions of a chemical change and its amount. Then we have new researches on gun-cotton, and a new series of hydro-carbons has been extracted from coal-tar. Some further spectrum analyses have been made by Mr. Huggins: among these are the analyses of comets and of the new star in Corona Borealis, of which the author will give you his own account; and, lastly, in physiological chemistry we have an important paper on animal heat, by M. Berthelot, being the third memoir of his researches on thermo-chemistry; and a most valuable work on colouring matters and extractive matters of the urine, by Dr. Schunk; and a paper on the detection of an alkaloid fluorescent substance like quinine in the different structures of the body, by Dr. Dupré and me.

Pardon my egotism if for a moment I dwell on my own subject, when you may consider other subjects are far more deserving of further remarks.

It seems but a few years ago when we were taught that the animal and vegetable kingdoms were composed of entirely different kinds of substances. Nitrogenous compounds were said to belong to the animal kingdom, and the vegetable kingdom was said to be formed of carbonaceous matters only. The ammoniacal products of the gas-works were considered curious; and only from the time of Professor Liebig's investigations do we date our knowledge of the all-pervading presence of albuminous substances in vegetables. We can now see plainly that this was the death-blow to all chemical distinction in the composition of vegetables and animals.

But no wrong knowledge is easily set right. First starch, then woody fibre, then colouring matters like indigo, then alkaloids like quinine were one after the other thought to distinguish the vegetable from the animal creation, and each of these substances or their representatives have at last been found in animals. Even protagon, which was thought to belong only to the nerves of animals, has been found by Hoppe in maize and other cereals to the amount of 0·149 per cent. So that really at the present time no chemical distinction whatever between vegetables and animals can be made; and except in the mode in which these different substances are produced in the two kingdoms of nature, no chemical difference exists.

This is seen in the following two columns of substances, and to each column must now be added protagon:—

Formed synthetically	and	Formed analytically
Oxalic acid		Albumen
Formic "		Casein
Lactic "		Animal quinoidine
Acetic "		Indican
Valerianic "		Glycocol
Glycerine		Taurin
Sugar		Leucin
Starch		Urea
Cellulose		Caprylic acid
Cholesterin		Caproic "
Butyrin		Capric "
Palmatin		Olein
Stearin		Stearin
Olein		Palmatin
Capric acid		Butyrin
Caproic "		Cholesterin
Caprylic "		Cellulose
Urea		Starch
Leucin		Sugar
Taurin		Glycerine
Glycocol		Valerianic acid
Indican		Acetic "
Quinine		Lactic "
Casein		Formic "
Albumen		Oxalic "

Let me for an instant point out to you what a vast field for analytical discovery lies open here to the chemistry of the future:

Various processes of oxidation, hydration, dis-hydration, and splitting, taking place at a temperature below 100° F., produce in animals a multitude of compounds which lie between albumen and carbonate of ammonia. The analytical chemistry of the future will some day be able to form from albumen all these descending compounds, as surely as we are now progressing by synthetical discovery to the formation of all the compounds that are put together by the synthetical chemistry of vegetables; and as the synthetical chemist is already surpassing nature by forming combinations which vegetable life has never yet produced, so the analytical chemist of the future will probably from albumen educe innumerable compounds, which in the tissues and secretions of animals have never been known to occur.

It is the special function of the British Association to popularise science, and to interest the public generally in the discovery of scientific truth. This Association is in fact a means of education. It was intended to promote the diffusion of natural knowledge among the people, because it was considered that that knowledge surpassed all other knowledge in its usefulness and benefit to mankind.

From its relationship to the public, the British Association is more interested than any other society that exists in hastening the time when education in natural knowledge will be at least as general as the education in classical knowledge now is.

My predecessor, Professor Miller, last year told you that "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. 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."

Although we may say with Mr. Gladstone that time is on our side; and although we are beginning to ask how our present formula for education has arisen, and why it remains almost unchanged whilst all natural knowledge is advancing; and although an entire change in everything except the highest education has taken place; yet public opinion is affected so slowly, and the prejudices of our earliest years fix themselves so firmly in our minds, and the belief we inherit is so strong, that an education far inferior to that which a Greek or a Roman youth, say twenty centuries ago, would have received, is the only education fit to make an English gentleman, that I consider it is of no use, notwithstanding the power which this Association can bring to bear on the public, to occupy your time with the whole of this vast question.

But there is an outlying portion of this subject which personally touches each one of us here present, and this with much diffidence I venture to bring before this section of the British Association.

I allude to the present state of education in natural knowledge of that portion of the community who may at any moment be asked to tell any of us here present what mechanical means should be used to lessen or increase the mechanical actions of the body, and what chemical substances should be taken to lessen or increase the different chemical actions within us when they rise or fall to such a degree as to constitute disease.

I know well that no expression of opinion can be given collectively by this chemical section on the necessity for a preliminary education in chemistry and physics of those who undertake, first to understand, and then to give advice on the errors of oxidation, digestion, secretion, and nutrition of our bodies; but I may, perhaps, lead you individually to consider this subject, and to bring your influence to bear upon this question as being at the root of a great change, which may bring a direct benefit to us and to our children in helping us to procure and to preserve our health; whilst it will lead to an increase in the number of those who are looked on with great favour by the British Association—I mean the individual cultivators of natural knowledge.

In order that you may see clearly what is wanted, I will contrast the present state of medical education with that reasonable knowledge which I am quite sure every one in this chemical section will say ought to be possessed by those who attempt to understand and to regulate an apparatus that works only whilst oxygen is going into it and carbonic acid is coming out of it.

I will, as shortly as possible, put before you the present education of those who practise medicine.

The present higher education for the medical profession consists, shortly, in learning reading, writing, and arithmetic in the first ten years of life. In the second ten years, Latin, Greek, some mathematics or divinity, and perhaps some modern language. In the third ten years, physics, chemistry, botany, anatomy, physiology, and medicine, and perhaps surgery.

Looking at the final result that is wanted—namely, the attainment of the power of employing the mechanical, chemical, electrical, and other forces in all things around us for increasing or diminishing the mechanical, chemical, and other actions taking place in the different textures of which our bodies are composed, it is quite clear that the second decennial period is passed without our advancing one step towards the object required; and that in the third decennial period the amount to be learned is very far beyond what is possible to be attained in the time allowed.

If we turn to the lower education. In the first eighteen years of life, reading, writing, and arithmetic, and enough Latin to read and write a prescription, constitutes the minimum to be acquired. During the next three years, physics, chemistry, botany, anatomy, physiology, and the practice of medicine, surgery, and midwifery have all to be learned, and from this crowding it follows that the study of physiology is begun at the same time as the study of physics and chemistry. In other words, the structure and the foundations are commenced at the same time. The top of the house may be almost finished when part of the foundations has not been begun.

What chance is there of any one understanding the actions of the chemical, mechanical, and electrical and other forces in the body, until a fundamental knowledge of chemistry, mechanics, and electricity has been first obtained? What chance has a medical man of regulating the forces in the body by giving or withholding motion, food, or medicine with any reasonable prospect of success when a preliminary education in these sciences is thought to be of no importance?

It seems to me that the only possible way to make the present preliminary education for medical men less suited to the present state of our knowledge would be to require them to know Hebrew or Arabic instead of Latin, in order that the origin of some of our words might be better understood, or that prescriptions might be written in one or other of these languages.

Let me now, for contrast sake, draw you a picture of a medical education based upon the smallest amount of classical knowledge and the greatest amount of natural knowledge which can be obtained.

In the first ten or twelve years of life a first-rate education in the most widely used modern language in the world, English, with writing and arithmetic, might be acquired, and in the next five or ten years a sound basis of knowledge of physics, chemistry, and botany, with German or French, might be obtained; and in the following five years anatomy, physiology, and medicine, surgery, and midwifery.

If every medical man were thoroughly well educated in the English language, and could explain the nature of the disease and the course to be followed in the most idiomatic and unmistakeable English, and if he could use all the forces in nature for the cure or relief of his patient, and if he could, from his knowledge of chemistry and physics and their application to disease and medicine, become the best authority within reach on every question connected with the health and welfare of his neighbours; and if he possessed the power of supervising and directing the druggist in all the analyses and investigations which could be required as to the nature and actions of food, drink, and medicines, and as to the products of disease, surely the position and power and agreement of medical men would be very different from that which they now obtain by learning some Latin and less Greek.

In reference to this subject allow me to read an extract from a letter received from Dr. Acland, Regius Professor of Medicine in the University of Oxford, and therefore no mean authority on the study of classical languages:—

"It was proposed by me that physics should be optional with Greek. The proposal was rejected, and the Council has passed the recommendation that no one shall be allowed to register as a medical student for any department of practice who has not passed in Greek What kind of Greek examination is it to be? Dr. Liddell, Goldwin Smith, Dr. Temple, in vain raised their voices, through me (who was authorised to quote them), as to the mischief of this resolution, if passed. It tends to encourage inaccuracy, to lower classical study, to foster cram, and to deteriorate examinations. It tends to exclude many youths who have a great and special aptitude for physical pursuits and observation from medical study. It is difficult to assign any good reason beyond this, that Greek is part of a gentleman's education, and must therefore be put on the list of study for a liberal profession. It cannot be urged that it is the best preparation for a youth intended for a general practitioner in a country place to prepare a cram, minimum Greek examination. If he were forming thereby accurate habits of thought and of observation, it were otherwise. It cannot be so with all. I look on the decision as a grave one, both for the Council and for the students. If any licensing body or university refuses to adopt the recommendation, I cannot think the Privy Council would disfranchise it."

At present, so far from physicians possessing more knowledge of food and of medicine than any other class of persons in the community, the analytical and pharmaceutical chemists are rapidly increasing in knowledge, which will enable them not only to understand fully the nature and uses of food and medicines, but even to detect the first appearances of a multitude of chemical diseases. Their habits of investigation and their knowledge of the nature of the forces acting in the body will gradually lead them to become advisers in all questions regarding the health of the community, and from this they will, like M. Bouchardat, in Paris, become almost, if not altogether, practitioners of medicine.

No doubt chemists are very far from being medical practitioners at present, but remember that there is no limit to natural knowledge, and that each moment the chemical knowledge of things around us is progressing, and that chemists are becoming able better to answer every question that can arise regarding the air, water, food, drink, and medicine which, by means of the forces that exist in them, act upon the forces within us, and give rise to the phenomena of health and of disease; whilst, as if to lessen the time that might be devoted to acquiring natural knowledge, the authorities who regulate medical education only this last spring have determined that, in addition to Latin, every medical man shall possess a competent knowledge of Greek, in order that the derivation of hard words may be obtained from the brain instead of a dictionary.

In confirmation of my opinion of the direction in which the treatment of disease is progressing, I may just refer to the cattle plague, which in 1745 was treated by Dr. Mortimer, at that time secretary of the Royal Society, and therefore one of the most scientific physicians in the country, with antimony and bleeding. In 1866 two chemists, Dr. Angus Smith, Ph.D., F.R.S., and Mr. Crookes, F.R.S., gave the only useful suggestion for combating the disease, namely, by the arrest or the destruction of the poison by chemical agents.

There is yet another point of view in which chemists will see the harm that results from our present medical education.

The use of Latin in our prescriptions requires that the pharmaceutists should learn at least sufficient Latin to read what we have written. Many errors have arisen, and will arise, from the dispenser being unable to give the directions rightly. To avoid such mistakes a portion of the time that ought to be given to the attainment of the highest possible amount of chemical acquirement, and a perfect knowledge of the English language, or some foreign language, wherein he might learn the discoveries in chemistry, and the improvements in pharmacy of other countries, must be devoted to the learning of Latin in which the physician writes his directions.

All our druggists in England ought to be what they are in Germany and in France, chemists capable of any analysis that might be required of them, and able to satisfy themselves and the medical men that the substances they sell are what they profess to be—pure, unadulterated chemical compounds.

No one of my hearers in this section will consider five years a long time for the acquirement of such knowledge; and until the pharmaceutists all obtain this education, medicine will be subject to a great cause of uncertainty in the variations in the quality and quantity of the different substances which, under the same name, are obtained from different druggists.

Before I conclude, I must apologise to some in this section who may think that this subject is of no interest to them by reminding them that none but chemists can judge what the worth of chemical education really is, and I am sure that no body of scientific men exist who are so fitted to judge of the necessity of an education in natural knowledge for those who employ the forces around us to regulate the forces within us as the chemical section of the British Association.

Last year Professor Miller said, "It behoves all who are themselves engaged in the pursuit of science to consider in what way they can themselves aid in forwarding the cultivation of natural knowledge."

I ask you, for the good of science and for your own good, to exert your influence in the first place, and more especially to effect a change in the preliminary education of all those who intend to practise medicine, so that, leaving Greek and Latin to be the ornaments and exceptions in their education, they may have time to obtain the best possible knowledge of the chemical and physical forces with which they have to deal. I urge this because of my conviction that whenever the most perfect knowledge of chemistry and physics becomes the basis of rational medicine, then, and not till then, medicine will obtain the highest place among all the arts that minister to the welfare and happiness of man.

Ozonogene.—Under this name M. Duplessis has produced an instrument like that in use for the continuous disengagement of hydrogen, but in which nitric oxide is generated by the action of nitric acid on copper turnings. A little of the gas being allowed to escape produces nitrous acid, which acts as a powerful disinfectant. A small instrument for domestic use might be made on the same plan as a Dobereiner's lamp.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, *by* Dr. Percy, F.R.S.

Lecture No. VIII.

(Continued from page 81.)

Now let us look at the composition of peat, and let us compare it with the composition of wood, as shown by the analysis I gave you a little while ago. I have taken a series of analyses of peats from various parts of the world, and will give you one or two as samples. Watch the change of composition from woody tissue. I will not give you the result simply of the analysis, because the quantity of ash is variable from the introduction of foreign substances—sand, for instance—into a peat bog. Hence we cannot judge from raw analyses. I will therefore eliminate these accidental constituents, and compute the proportions between the quantities of carbon, hydrogen, and oxygen, and then we shall get the means of exactly comparing these bodies with reference to their composition.

We will take a specimen of Irish peat:—

Carbon	62·18
Hydrogen	6·99
Oxygen and nitrogen . . .	31·03

You see here is a marked difference already between this peat and woody tissue, especially in the relative increase in the carbon and hydrogen. I will show you by and by how you can explain all the transformations completely by the separation of the gas called marsh gas, carbonic acid and water, during the process of natural decay and the formation of peat. We have a specimen of that gas on the table. It is the gas which produces the terrible accidents in coal mines. Carbonic acid is the gas of soda-water—"fixed air." By certain formulæ, with which I will not trouble you in detail, it may be shown that every transformation—every variety of coal fuel we meet with—may be explained easily by the separation of these various gases from woody tissue; and we know that in boggy ground these two gases are evolved—marsh gas and carbonic acid. The gases so evolved may be collected, and after separating the carbonic acid by lime water you get the marsh gas, which is the clear colourless gas contained in this vessel on the table.

Now let us take a careful analysis of the peat of Cashmere:—

Carbon . . .	55·66
Hydrogen . . .	61·12
Oxygen . . .	38·22

I am sorry to trouble you with these numerical details, but really it is impossible to avoid them if we wish to arrive at accurate results. It contains various kinds of organic matter, which have been perfectly investigated, but the results are not of sufficient importance to us for me to occupy your time with them.

I may say, *en passant*, that peat might of course, in the absence of coal, be regarded as a very valuable fuel. Peat differs from coal as containing more hydrogen and carbon, but carbon is the great point. It may be shown that, weight for weight, peat is very greatly inferior in heat-giving power to any of the commonest varieties of coal. While coal is abundant and cheap in this country, it is quite hopeless to bring peat in competition with it. Various attempts, I know, have been made and repeated at intervals to smelt iron by peat in Ireland, but all the attempts that have been made in that direction have hitherto failed, and I believe they will fail, of necessity, until our coal becomes considerably increased in price, or, what is equivalent, much rarer. The price of coal is rising, and rising pretty rapidly, but until it is very much greater than at present, the competition of peat with coal is quite hopeless. Peat is used in some parts of the Continent—in Sweden, for instance—in some processes connected with iron smelting. It succeeds there because labour is very cheap there, and coal does not exist. The labour involved in this employment of peat consists in collecting the peat, submitting it to a grinding operation—like that to which clay is submitted in the making of bricks—forming the peat so prepared into a muddy mass, and then compressing it into bricks. All this is very expensive in point of labour. It may do in Sweden, but it will not do here. In Bavaria, peat is used in locomotive engines.

The next division of our subject is coal, properly so called. Under this term "coal" are included a great variety of bodies, which, both in their external characters and internal constitution, differ immensely from each other. We have, for example, at one extreme, the brown coal. Here is a specimen of it, presenting a distinctly woodlike structure. It is very much like a piece of wood, but yet it is very far removed from wood in composition. It is farther removed from wood than peat is, notwithstanding its appearance. Then, at the other extreme, we get the mineral called anthracite, which occurs in South Wales. It is a shining, lustrous body, which may practically be regarded as carbon. It contains a little oxygen and hydrogen, but it is essentially carbon. I have collected specimens of coal from almost every part of the world, and I shall direct your attention especially to several of these coals, as they present features of particular interest; and much of the information I shall give has not been laid before the public.

You will naturally ask me for a definition of coal. Well, I confess that is one of the most puzzling things I have ever attempted to grapple with We all know, or fancy we know, what we mean by the term coal—the black, hard stuff which we buy here in London and use for fuel—but what is there essential about coal? How may coal be represented so as to distinguish it from every other body? The construction of an exact definition is the difficulty; I cannot give you one. Many have attempted to define coal, and I believe all have hitherto failed. That is owing to the fact of the different kinds of matter to which the name coal is applied varying so widely, not only in external appearance, but also in chemical composition. You can easily understand, then, the difficulty of constructing a definition to embrace, and embrace only, all these various matters, and to exclude the matters which occur in association with coal—resin, and so forth. Perhaps you have all heard of that famous trial which came off in Edinburgh on that subject, and which was published in a quarto volume containing 250 pages. The suit was to try the definition of coal. Gillespie, the plaintiff, granted a lease of a colliery to Russell, in which it was agreed that the lessee should pay to the lessor sixpence a ton royalty on all the stuff he raised from the pit as coal. In the course of the working a stuff was turned up which was sold at a much higher price than ordinary coal—the Boghead coal or Torbane mineral. One party objected to apply the name "coal" to it because if it could be proved to be coal then it came under the terms of the lease and was subject to the royalty; but inasmuch as a much higher price was obtained for it than for ordinary coal, it occurred to the lessee to dispute the nature of it, and the matter resulted in a trial at law. A very extensive trial it was. Witnesses from all parts of the world were examined—chemists, botanists, geologists, and all sorts of men, and perhaps there were as many on one side as on the other, one scientific man saying it was coal and another saying it was not, as is usual in cases of this kind. Well, the poor jury were utterly bewildered, and they were directed by the Lord Justice to ignore altogether the scientific evidence, and to come to their verdict on a plain consideration of the practical facts of the case. They gave their verdict in favour of the lessor as against the lessee. Well, it is a very curious thing that shortly after the Scotch jury in this particular case had affirmed this stuff to be coal in the ordinary meaning of the term coal, the Prussian authorities had to discuss the very same question with regard to the duty on the import of this mineral in question, and they determined that it was not coal. There has been another trial, Gillespie *v.* Russell, and the lessor got the victory with heavy damages. I do not know anything more interesting than the study of this wonderful trial, which has been published; and it is not only very instructive, but also very amusing. You find these scientific gentlemen coming forward and giving their evidence most confidently, six on one side and half a dozen on the other, all the way through.

Now, what element shall we take in attempting to construct a definition of the term coal? I am sure we cannot take its chemical constitution purely; shall we take its geological character? Well, possibly there is more hope in that direction, but here is one point in the consideration which you will see will puzzle us directly. As peat may contain a large amount of foreign matter—sandy matter—washed in, so may coal. It may contain a large amount of shale, for instance, which is a variety of clay. You know how some coal contains a large amount of ash, and housekeepers complain of the dusty quality of such coal. Now, the substance called shale is nothing more than clayey matter containing a certain amount of coal universally diffused throughout the mass. On the other hand, that which we acknowledge to be coal contains a certain amount of shaley matter. In one case we may have a shaley mass containing 95 per cent. of clay and 5 per cent. of coal; in the other case, we may have a coal containing 5 per cent. of clay, the rest being carbonaceous matter. Now, between these two extremes we may find every gradation. The one thing we call coal, and the other we call shale, and the one gradually passes into the other. Now, where is the line of demarcation? There is no exact line of demarcation, and hence from this cause alone there is no precise definition possible. The shale is a comparatively useless body. It could not be used as fuel. It was proposed to define as coal only such as could be used as fuel. Then, with regard to the geological aspect, I do not think I can present you with evidence sufficiently conclusive on which to base a definition. In fact, we cannot construct a definition of coal from geological considerations merely. We know perfectly that in coal measures there are fossils associated therewith; but then coal is not confined to those measures. We find coal in the lias; we find coal in the tertiary, and so on; and some of these coals are so identical in every respect with the true coal of the coal measures that it is impossible to distinguish one from the other. I have tried a definition of coal, but it is not as satisfactory as I could wish. It is this: "Coal is a solid mineral substance, more or less easily combustible; varying in colour from brown to black; opaque, except in very thin slices; brittle; not fusible without decomposition not sensibly soluble in such solvents as dissolve resins, as ether, benzol, chloroform, and turpentine; and not containing sufficient earthy matter to prevent its being applied as a source of heat." You see how vague our terms must be with regard to the combustibility of coal. In its brittleness, too, there is great variety. So far as I know, coal is not fusible without decomposition. This is a very important element in the definition. If we take certain coals and expose them to heat in close vessels, the coal softens, and if we continue the heat, the coal will come out as coke. The particles adhere, and we get that form, but in the softening there has been decomposition to some extent. There is no fusion of coal like that of a piece of beeswax: it is a totally different thing. I have mentioned that coal is insoluble in four solvents which dissolve resinous bodies. It is true that a small quantity of coal may be extracted from coal by these solvents, but still the coal itself is insoluble. I am careful to mention this, because sometimes we find associated with coal in large quantity, as in the New Zealand coal, resinous matters which do dissolve in these menstruums. We might, I think, probably, speak of stratification, sedimentary origin, and so on, in connexion with coal. Dr. Playfair suggests that, but I am not quite certain about that point, because we find some coal which is conceived to be formed by the sublimation of certain bodies which have percolated through shale and schist and converted them into coaly matter.

In order more exactly to compare the constitution of wood and the various matters derived from it under the names of peat and coal, I have drawn up a short table in which I have uniformly calculated the carbon at 100. This is in order to enable you to see the relative change in the composition of coal as we proceed from woody tissue towards anthracite. These quantities are the mean of many analyses.

	Carbon.	Hydrogen.	Oxygen.
Wood	100	12·18	83·07
Peat	100	9·85	55·67
Brown coal or lignite .	100	8·37	42·42
Non-caking coal . .	100	6·12	21·23
Steam coal from the Tyne	100	5·91	18·32
Semi-anthracitic coal from South Wales	100	4·75	5·28
Pennsylvanian anthracite	100	2·84	1·74

You see what a large quantity of oxygen, relatively, has passed off from the woody tissue, even in its transformation into peat. The brown coal, as the Germans call it, or lignite, is the coal nearest approaching wood in composition. There is a relative increase in the proportion of carbon all the way through the table. The points to keep in view are the relative increase in the proportion of carbon and the relative decrease in the proportion of oxygen. The non-caking coal is represented by the coals of South Staffordshire, Derbyshire, Yorkshire, and Scotland. These are not coals we use to burn in London. You know when we put the sea coal on a fire—Newcastle coal, for instance—the pieces form a lump, and we have to break them up. The semi-anthracitic coal, as it is termed, is well adapted for steam navigation. The Pennsylvanian coal I have given is a very fine specimen I obtained from Sir Charles Lyell, and analysed many years ago.

Now, beginning with wood, and just eliminating gradually as we go on, and as Nature has done in her process of decay, those three compounds, carbonic acid, marsh gas, and water, we are enabled to explain in the simplest and most rational way the formation of every variety of peat and coaly matter from wood.

Before I conclude I will draw your attention to a specimen of this marsh gas, which I have placed before you. This fiery stuff is produced by a chemical process known in the laboratory. This is the gas which, mixed with air, has proved so terribly disastrous in coal mines. When mixed with oxygen it is highly explosive. This gas is contained in coal pretty much in the same way—at least in some cases—as air is contained in charcoal. I have many times heard the gas issuing from the coal when a new piece of coal is opened in a pit. It diffuses itself, and when you draw up your safety lamp into the gas, the gas enters the lamp, and the flame elongates. It is interesting to watch this effect. This gas causes loss of life to about one thousand persons annually, besides maiming many others.

In our next lecture we will conclude the subject of coal.

ACADEMY OF SCIENCES.

August 20.

M. Stanislas Meunier gave an account of "*A Compound of Oxide of Cadmium and Potash.*" In a former communication the author had mentioned that oxide of cadmium dissolves freely in potash and soda in a state of fusion, and had expressed an opinion that a definite cadmiate of potash was formed under the circumstances. He now describes a method of separating what he believes to be such a compound. Fused potash is saturated with oxide of cadmium, and while the mixture is kept in a state of fusion a cold solution of potash is carefully added. After each addition of the solution a white precipitate forms which redissolves, but after a time this precipitate becomes permanent. When this happens the author stops the process and allows the mixture to cool slowly. It thus becomes a crystalline mass, but at the bottom some of the white precipitate is found. The crystals do not entirely dissolve in water. The liquid is seen to be full of pearly shining scales, which, when collected, are found to be quite insoluble in water and to be rich in oxide of cadmium. They are, in fact, according to the author, hydrated cadmiate of potash, but he has not yet obtained them in sufficient quantity to analyse. The compound is hydrated, he says, for a prolonged boiling with a solution of potash decomposes it and causes a deposition of oxide of cadmium; it contains cadmic oxide combined with potash, for acids cause the disappearance of the scales and produce amorphous hydrate of oxide of cadmium soluble in an excess of the acid.

M. Monthier presented a note "*On three new Hydro-electric Piles.*" In the first the author uses sulphuric acid and iron. In a cylindrical vessel of iron he places a prism of carbon, and then pours in diluted sulphuric acid. The carbon and iron form the two poles. Two of such batteries are sufficient to cause the ordinary bell to ring. The batteries are said to be cheap, inasmuch as the sulphate of iron produced may be used in another system, composed as follows:—In a cylindrical vessel containing a concentrated solution of protosulphate of iron the author places a cylinder of zinc and a prism of carbon, forming the two electrodes of the pile. The zinc dissolves, hydrogen is disengaged, and hydrated sesquioxide of iron precipitated. Two elements of this kind served for an electric bell for several months. Thirdly, we have described a battery which we believe to be entirely novel, cheap, and nasty. In a pile composed as the last mentioned, the author employs putrid human urine in the place of the ferrous solution. According to M. Monthier, this last battery is rather stronger than the former.

M. C. Davaine presented another note "*On the Rotting of Fruits and other parts of Living Vegetables,*" in which he showed that the fungi mentioned in the previous paper would set up changes in the roots, leaves, and branches of some plants, similar to those fruits undergo. The paper will have some interest for vegetable physiologists.

M. A. Bertin presented a note "*On the Constitution of Glacier Ice.*" The author has examined glacier ice by polarised light. He has found that the superficial part of the higher glaciers is composed of agglomerated snow; but lower down, where the water has sunk into the fissures and become frozen, traces of crystallisation and true ice are found.

NOTICES OF BOOKS.

Journal für praktische Chemie. Nos. 10 and 11. 1866.

The first of these numbers contains two papers by Schönbein. In the first, entitled "*A Contribution to a closer Knowledge of Peroxide of Hydrogen,*" the author states that a solution of the peroxide may be concentrated by boiling, and almost completely dehydrated by evaporation over sulphuric acid and under an air-pump at the ordinary temperature. He tells us also that white filter paper drenched with a solution containing only one-half per cent. HO_2, and dried at the ordinary temperature, will give the reactions of the peroxide. Thus, a strip of such paper touched with acetate of lead is soon coloured brownish yellow; touched with a mixed solution of ferridcyanide of potassium and a persalt of iron, it is quickly coloured blue; touched with dilute mixture of ferrous sulphate and iodide of potassium with starch, it is instantaneously coloured the deepest blue; it is also coloured blue by a dilute chromic acid solution containing SO_3; indigo tincture is first blued, and then, when touched with ferrous sulphate solution, is quickly decolorised. Paper dipped in the solution of the peroxide may be kept in a closed bottle, but if left exposed to the air loses the HO_2. The author has also remarked that a strip of such paper enclosed in a bottle containing strongly ozonised air for a few hours ceased to give the reactions of HO_2, while the end left out of the bottle continued to give them, showing that the peroxide of hydrogen is destroyed—that is, converted into water by the ozone. Although water is so much more easily volatilised than the peroxide, the author shows that the latter is volatile. A strip of paper previously dried over sulphuric acid, and then suspended in a bottle, the bottom of which is covered with water containing only $\frac{1}{200}$ HO_2, will, after an hour, give the reactions of the peroxide with ferrous sulphate, iodide of potassium, and starch. An easy method here given of producing a small amount of peroxide of hydrogen, sufficient, however, for these experiments, we have already published, but may mention again. It is only necessary to shake a few amalgamated zinc turnings with a little in a bottle containing oxygen or even atmospheric air. After shaking for a minute the water will show the presence of the peroxide. Of the next paper, "*On the Action of Platinum, Rathenium, Rhodium, and Iridium on Chlorine Water, an Aqueous Solution of a Hypochlorite, Peroxide of Hydrogen, and Ozonised Oxygen,*" we have already given an abstract. Dr. Hoffman's paper "*On the Synthesis of Guanidine,*" follows, and then we have the description of "*An Improved Process for the Preparation of Diazoamidobenzol,*" by Dr. Martius. The author takes dry and perfectly neutral crystallised hydrochlorate of aniline, and adds to it very gradually, with continual stirring, a cold and faintly alkaline solution of nitrite of soda. The solution should have the specific gravity 1·5, and ought not to contain more than one-half per cent. free alkali and no carbonate. It must also be cooled to + 5° C. A lively reaction soon ensues; the crystals of hydrochlorate of aniline become coloured with a yellow layer of diazoamidobenzol; and soon the whole becomes a thick, homogeneous, lemon-yellow-coloured paste. When this point is reached, a little more of the nitrite solution is added to make the paste more fluid, and it is then transferred to a cloth, washed with cold water, and lastly the diazoamidobenzol is freed from the remaining mother liquor by pressure. If this operation is carefully performed with pure materials, the whole of the aniline, it is said, will be converted.

We give the titles of the more important remaining papers and abstracts. "*On the Relations of Isopropyl-alcohol to Propylglycol and Glycerine,*" an abstract of a paper by Linneman; "*On Bromide of Benzylidene, and two Hydrocarbons derived therefrom,*" by Michaelson and Lippmann; "*On some Amides of the Toluyl Series;*" "*On Sulphur holding Derivatives of Toluol;*" "*On Orcin;*" "*On Bromangelica Acid;*" "*On Quinine and Quinidine.*" The last-mentioned is an abstract of a paper by O. Hesse, describing several salts of these bases.

No. 11 is almost entirely occupied with papers already noticed in our columns. The only original article is by Dr. Werner Schmid "*On the Action of Peroxide of Manganese on Solutions of Cuprous Salts.*" The author finds that an excess of freshly precipitated peroxide of manganese left in contact with a solution of sulphate of copper displaces the latter metal, causing a precipitate of CuO_2, and giving a solution of sulphate of manganese. Repeated quantitative determinations showed that exactly an equivalent of CuO and one equivalent of MnO_2 took part in the reaction. The result confirms Schönbein's opinion that peroxide of manganese is an antozonide. Whether peroxide of copper is an ozonide or not is not yet known.

The titles of other papers are as follows:—"*On Franklinite and Thomsonite,*" by F. v. Kobell; "*On the Solubility of Isomorphous Salts and Mixtures of them,*" by Carl Ritter v. Hauer; "*On the Dimorphism of Antimonious and Arsenious Acids,*" by H. Debray; "*On the Chlorides of Wolfram,*" by the same author; "*On some Resins, and the Products formed from them by Fusion with Alkalies,*" by Hlasiwetz and Barth; "*On Dichlorglycid and its Transformation into Allylen;*" "*On Hydantoinic Acid and Allantrin;*" and "*On the Cyanides of Aromatic Aldehydes.*" The papers the titles of which we have omitted have appeared in our pages either at length or in full abstract.

NOTICES OF PATENTS.

3345. *Improvements in Treating Hydrocarbon Oils.* James Young, Jun., Limefield. December 27, 1865.

This looks like a very valuable invention. The patentee submits the heavier hydrocarbon oils to distillation under pressure, and finds that thereby the heavy oils originally operated upon are converted into oils of lower specific gravity, possessing a higher commercial value. The process may be carried on in ordinary steam boilers (not tubular), which should be proved to 100 lbs.; but it is not found necessary to operate much beyond a pressure of 20 lbs. to the inch. The means of regulating the escape of, and condensing, the vapour can be easily imagined. The operation may be carried on with the crude products of the original distillation, or the lighter oils may first be separated by an ordinary rectification, and only the heavy oils submitted to this treatment.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

1892. R. Hooper, Bradford, near Manchester, "Certain improvements in furnaces."—July 21, 1866.

MISCELLANEOUS.

Excise Prosecutions against Druggists.—On Monday, at the Guildhall, York, before the Lord Mayor Mr. G. Wilson, and Mr. W. D. Husband, informations were preferred by the Board of Inland Revenue against Mr. Knowles, Mr. T. Cooper, Mr. Johnson, Mrs. Spurr, Mr. G. Brown, and Mr. Jacob Wood, all druggists residing in the city, and the charge was that they had sold methylated spirit without a licence. The magistrates convicted Knowles, Cooper, Johnson, Spurr, and Wood, but, in consideration of what they thought was their intention, they remitted the penalty to one-fourth, besides recommending the whole of the cases to the consideration of the Board in London. They were not unanimous in convicting Mr. Brown, and they thought the case against him should have been withdrawn. In this case they should strongly recommend that the whole of the penalty should be remitted.

The City Pumps.—Dr. Letheby has made a special report to the Commissioners of Sewers on the City pumps and their possible influence on the health of the inhabitants. It seems that the water from most of them is derived from shallow wells which receive the soakage from adjoining drains and sewers. In some cases the saline constituents of the water indicate at once the source and nature of the pollution. Thus the water from the well in Leadenhall market, where large quantities of hides are salted on the public way, contains 40 grains of common salt per gallon. The wells in churchyards are strongly tainted with nitrates of potash and ammonia. In all a large amount of organic matter is present. Dr. Letheby, therefore, recommends that the water furnished by the pumps should not be used for domestic purposes.

The Sodium Process in Nova Scotia.—The following extract of a letter from a correspondent in Nova Scotia will interest some of our readers:—"The experiments which I carried out with Dr. K. at the Lake Major Gold Mines proved so satisfactory that Dr. K. was induced to operate upon a quantity of pyrites, which has hitherto been accumulating as waste matter in enormous quantities about the works, as you are aware. This morning he informed me that he has, by the sodium process, and in a very simple and inexpensive way, obtained gold from the pyrites in the proportion of *five ounces per ton.* This result far exceeded his most sanguine expectations. He is desirous of making arrangements for having large quantities of amalgam, and would like to know what it would cost in quantities of a ton."

British Association. — Section B. — Chemical Science.—The following are the titles of all the papers read in the Chemical Section. Most of them will be given in this and future numbers of the Chemical News:—

"*Preliminary Report on the Chemical Nature of Cast Iron*"—A. Matthiesen.

"*On a Phosphatic Deposit in the Lower Green Sand of Bedfordshire*"—J. F. Walker.

"*On a Proposed Use of Fluorine in the Manufacture of Soda*"—Walter Weldon.

"*On the Assay of Coal, &c., for Crude Paraffin Oil*"—John Attfield.

"*On the Poisonous Nature of Crude Paraffin Oil, and the Products of its Rectification upon Fish*"—Stevenson Macadam.

"*On Ozone*"—Dr. Daubeny.

"*On an extraordinary Iron-stone*"—T. L. Phipson.

"*On a New Process in the Manufacture of Whitelead*"—Peter Spence.

"*On Disinfectants*"—W. Crookes.

"*On the Oxidising Action of Carbon*"—Dr. Crace Calvert.

"*On the Magnesium Lamp*"—H. Larkin.

"*On the Olefines in Relation to the Isomerism of Vinic Alcohols*"—E. T. Chapman and W. Thorp.

"*On the Refraction and Dispersion Equivalents of Chlorine, Bromine, and Iodine*"—Dr. Gladstone.

"*On the Chemical Action of Medicines*"—Dr. Bence Jones.

"*On the Sources of the Fat of the Animal Body*"—J. B. Lawes and J. H. Gilbert.

"*On the Accumulation of the Nitrogen of Manure in the Soil*"—J. B. Lawes and J. H. Gilbert.

"*Report on Isomeric Alcohols*"—J. A. Wanklyn.

"*Report on the Synthesis of certain Organic Acids*"—A. R. Catton.

"*The Action of Chlorine on Amylene*"—Dr. Bauer.

"*On some Phenomena connected with the Melting and Solidifying of Wax*"—C. Tomlinson.

"*Sur le Spectre de l'Atmosphère Terrestre et celui de la Vapeur d'Eau*"—Dr. Janssen.

"*Sur une Spectroscope à Vision Directe*"—Dr. Janssen.

"*To draw attention to the Present Condition of our Knowledge on the Origin of Muscular Force in Animals*"—Dr. Lyon Playfair.

"*The Nature and Properties of Ozone and Antozone demonstrated experimentally*"—J. M. McGauley.

"*On the Purification of Terrestrial Drinking Waters by Neutral Sulphate of Alumina*"—A. Bird.

ANSWERS TO CORRESPONDENTS.

Aluminium.—Vol. I., part 4, of Richardson and Watt's "Technology" (1865) gives a good account of aluminium and some of its alloys.

X.—1. The formula of aniline black has not yet been made out. 2. Not known. 3. We do not think you will find the bodies in commerce. Try Hopkins and Williams, 5, New Cavendish Street.

A. B.—There is no special work on the manufacture of manures.

G. H.—We have never seen the substance, and have strong doubts of its existence.

G. T.—There are many patents on the subject. We quite agree with our correspondent that a classified selection of chemical patents should be published. The funds of the Patent Office, if applied to their legitimate purpose, are more than sufficient to allow of it.

THE CHOLERA POISON.

In a letter from Dr. Frankland to the Registrar-General on the state of the water supplied by the East London Company, occur the following passages:—

"I have conclusive evidence that even boiling, which is generally regarded as the most efficacious means, will not prevent water which is so contaminated—*i.e.*, with organic matter alleged to constitute choleraic poison—from producing violent cramp and diarrhœa.

"This fact is not incompatible with the theory that choleraic and similar poisons are the germs of organisms, for it is well known that organic germs can develope into life after being boiled in water for a short time."

Dr. Frankland accordingly urges the employment of permanganate of potash or of animal charcoal as the only practicable means in which he would have much confidence for the removal of such noxious matters from water.

In reference to this proposed remedy, we think that there are no sufficient grounds for assuming that the addition of a permanganate to water will destroy the cholera virus. The oxidising powers of this agent, although very energetic on many kinds of dead organic matter, are successfully resisted by living organisms. Animalcules will live for some time without apparent inconvenience in water coloured with permanganate of potash; and assuming, with Dr. Frankland, that the cholera virus possesses organic vitality, we have not only no guarantee that the agent in question will effect its destruction, but strong grounds for believing that it will be inoperative.

For this reason we should be inclined to unite the suggestions both of Dr. Letheby and of Dr. Frankland, and boil the water after adding permanganate. It is scarcely within the bounds of probability that the cholera germs could resist the destructive action of boiling permanganate of potash.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Sources of the Fat of the Animal Body, by J. B. Lawes, *F.R.S., F.C.S., and Dr.* J. H. Gilbert, *F.R.S., F.C.S.**

In 1842 Baron Liebig had concluded that the fat of Herbivora must be derived in great part from the carbohydrates of their food, but might also be produced from nitrogenous compounds. Dumas and Boussingault at first opposed this view; but subsequently the experiments of Dumas and Milne-Edwards with bees, of Persoz with geese, of Boussingault with pigs and ducks, and of the authors with pigs, had been held to be quite confirmatory of Liebig's view—at any rate, as far as the carbohydrates were concerned. But at the Bath meeting of the British Association in 1864, Dr. Hayden expressed doubt on the point, and at the Congress of Agricultural Chemists held at Munich last year Professor Voit, from the results of experiments with dogs fed on flesh, maintained that fat must have been produced from the nitrogenous constituents of the food, and that these were probably the chief, if not the only, source of the fat even of Herbivora. Baron Liebig disputed this conclusion, and his son, Hermann v. Liebig, had since sought to show its fallacy by reference to experiments with cows.

The authors agreed with the conclusions of these latter authorities, but pointed out the inadequacy of the data relied upon by Hermann v. Liebig. They showed that, owing to the much less proportion of alimentary organs and contents, the higher character of the food, the much larger amount of fat produced both in relation to a given weight of animal within a given time and to the amount of food consumed, the much less proportion of the solid matter of the food that passed off in the solid and liquid excretions, and finally the larger proportion of fat in the increase, results obtained with pigs must be much more conclusive than those with either cows, oxen, or sheep.

Numerous tables were exhibited showing the results which had been obtained by the authors in experiments with pigs, from which the following conclusions were drawn:—1. That certainly a large proportion of the fat of the Herbivora fattened for human food must be derived from other substances than fat in the food; 2. That when fed on the most appropriate fattening food, much of the stored-up fat must be produced from the carbohydrates; 3. That the nitrogenous constituents may also serve as a source of fat, more especially in defect of a liberal supply of the non-nitrogenous ones.

TECHNICAL CHEMISTRY.

The Preparation of Sulphocyanide of Potassium, by James F. Babcock, *Boston.*

The usual process for the preparation of this salt, as given by Fresenius, is as follows:—

"Mix together 46 parts anhydrous ferrocyanide of potassium, 17 parts of carbonate of potassa, and 32 parts of sulphur; introduce the mixture into an iron pan provided with a lid, and fuse over a gentle fire. Maintain the same temperature until the swelling of the mass which ensues at first has completely subsided, and given place to a state of tranquil and clear fusion; increase the temperature now towards the end of the operation, to faint redness, in order to decompose the hyposulphite of potassa which has been formed in the process. Remove the half-refrigerated and still soft mass from the pan, crush it, and boil repeatedly with alcohol of from 80 to 90 per cent.

"Upon cooling, part of the sulphocyanide of potassium will separate in colourless crystals; to obtain the remainder, distil the alcohol from the mother liquor."—*Fresenius' Qual. Analysis, 6th ed., p. 57.*

Those who have attempted this process may have been disappointed in not obtaining so large an amount of sulphocyanide as they were led to expect. The process is, when best conducted, far from economical.

The management of the heat is difficult, as well as the exclusion of the air; and the subsequent boiling "repeatedly with alcohol of from 80 to 90 per cent." is of course expensive.

Moreover, the slimy mass left after the solution has been made retards, and in some cases almost totally prevents, the filtration of the liquid, while it has been the writer's experience to find it extremely difficult by this process to get rid entirely of the sulphide of potassium formed, the presence of which unfits the sulphocyanide for the ordinary uses to which it is applied. Repeated failures by this and other methods in use, as the "bisulphide of carbon and ammonia process" (London *Pharm. Journ.*, vol. vii., No. 4), which is certainly disagreeable, and not entirely free from the objections mentioned above, and the want of a process really economical, led to experiments, the result of which is the following method, which has been found uniformly

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* British Association, Nottingham—Section B. August 27, 1866.

to give good results, a large yield, and to require far less alcohol than any other process known to the writer.

The saving in alcohol, where the quantity prepared is large, is of course of considerable importance.

The process is as follows:—

Take of cyanide of potassium, in small pieces of about the size of a pea, two parts by weight; sulphur one part.

Mix thoroughly, and fuse gently in an iron pan over a Bunsen's burner, until the cyanide is entirely fused and mixed with the melted sulphur, and the blue flame of sulphur, and the scintillation caused by the burning of minute particles of iron, have ceased; and allow the whole to cool, until a drop let fall into water no longer produces a hissing sound.

Then pour the still soft mass into three parts of water, n which it immediately dissolves; filter, to separate impurities, particles of sulphuret of iron, &c. The filtrate contains a large amount of sulphocyanide of potassium, mixed with sulphide, hyposulphite, cyanate, &c.; the next step is for the removal of these.

This is simply and perfectly attained by the addition, with constant stirring, of dilute sulphuric acid (1 to 4), until the reaction is slightly acid. This operation should be performed under a hood, or in some place where the gases evolved may be removed.

Sulphocyanide of potassium is neutral to test-paper, and not affected by dilute suphuric acid in the cold, while all the other substances mentioned above are at once decomposed, evolving sulphuretted hydrogen and cyanogen compounds, and depositing a considerable amount of sulphur.

The liquid is filtered to separate this, and then contains only sulphocyanide of potassium and sulphate of potassa; the quantity of the latter depends upon the purity of the cyanide of potassium employed, since any carbonate present forms direct sulphur compounds, which are afterwards decomposed by the sulphuric acid added. Where the amount of sulphate formed is large, it may partially separate with the sulphur, as a dirty white crystalline powder.

The filtered liquid is evaporated to one-third its bulk, and allowed to cool, to deposit a quantity of sulphate of potassa. It is then mixed with its own volume of alcohol of about 90 per cent., which causes the precipitation of almost the whole of the sulphate of potassa (*Anthon, J. Pr. Ch.*, vol. xiv., p. 25).

The solution after filtration may be evaporated to dryness, and yields a product containing only a trace of sulphate of potassa, and of sufficient purity, without further crystallisation, for any of the purposes for which it is required—whether as a reagent (iron test), the precipitation of sulphocyanide of mercury for "Pharaoh's Serpents," or the preparation of the ammonium salt for photography. Subsequent crystallisation from alcohol yields the salt perfectly pure.

The commercial cyanide of potassium, being very impure from carbonate and cyanate of potassa, is not so well adapted for use in this process as that known as "granular cyanide;" the increased price of the latter being more than compensated by the larger yield and improved quality of the product. Good commercial cyanide gives, however, very good results.

The heat required is not great, and the vessel should be removed from the fire as soon as possible after the formation of the sulphocyanide, as it rapidly decomposes at a temperature of fusion in contact with the air. This process gives equally satisfactory results, whether small or large quantities are operated upon, and has been perfectly successful in the hands of the writer in the preparation of quantities varying from two ounces to twenty-five pounds. The amount of sulphocyanide obtained is, with good cyanide of potassium, about equal to the weight of the latter employed.—*American Journal of Pharmacy.*

PHARMACY, TOXICOLOGY, &c.

On the Poisonous Nature of Crude Paraffin Oil and the Products of its Rectification upon Fish, by Dr. STEVENSON MACADAM, *F.R.S.E.**

THE great extension of paraffin oil works, both crude and refined, during the last few years, has led to attention being directed to the nature of the discharges which emanate from such, more especially to those matters which find their way into rivers which form the natural drainage of the district. The deleterious nature of these discharges has manifested itself already in the total destruction of all fish in more than one of our Scottish streams, and in the impregnation of the water with paraffin oil and the products of its rectification to such an extent as to impart the characteristic taste and odour of paraffin to the water, and render it unsuitable for domestic purposes. I have had occasion to make a large number of experiments on such discharges, taken alone and diluted with much water, with the view of testing the destructive nature of these liquids and mixtures upon the life of fish, and the general results of the inquiry I propose to lay before the Section. The discharges from the paraffin oil works are of the following nature:—1. Crude petroleum and shale oil escaping from the crude oil casks, either when full or when empty, when the drainings leak away into the surrounding soil, and thence to the drains. 2. The condensing water from the worms of the crude and refining stills, which often passes away impregnated with paraffin oil. 3. The spent acid liquor which has been used in acting upon the crude petroleum or shale oil. 4. The spent alkaline liquid or soda which has been employed in acting upon the oil which has been previously treated with acid. Besides these there is the accidental overflow of the retorts both during the first redistillation of the crude oil, and subsequently in the distillation of the refined oil, and which can hardly be altogether provided against. The drainings from the oil casks, when the latter have been emptied and are exposed to the sun, are considerable when a number of casks are stored together, and the oil which percolates through the soil is liable not only to ooze through the ground, but when rain falls, the oil floats thereupon, and is thus carried into the ordinary drains. Any material damage to rivers, however, from this cause may be lessened by providing proper surface drains, which carry all the oily water to traps where it settles, and the oil may be removed from the surface whilst the water is run off underneath. The condensing water from the stills is liable to be impregnated with paraffin oil from the leakage of the pipes, which is greater when the pipes are of cast iron than when they are constructed of malleable iron. Of course, any excessive leakage is quickly arrested, but there is generally that taint communicated to the water which, independent of the lesser proportion of oxygen dissolved in the water, as compared with ordinary river water, renders the water more or less deleterious to the health of fish. The spent acid liquor and the spent soda liquor, however, are the most serious discharges which

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* Read at the Meeting of the British Association.

either regularly or occasionally escape from paraffin oil works, and their influence upon the health and life of fish is much more decided than the paraffin oil itself. The spent acid liquor consists of the sulphuric acid which has been added to the crude oil, accompanied by tar products, including picoline and other basic oils, and to which the acid liquor no doubt owes part of its poisonous properties. Whilst now the material in question is to some extent utilised by separating the tar, and either mixing it with spent oak bark or sawdust, and using it as a fuel, or by distilling it into pitch, yet occasionally this acid liquor is discharged into a neighbouring stream. It is a black tarry liquid, of the consistence of molasses, with a somewhat sulphurous odour, and a very small quantity added to water confers upon the latter poisonous properties. In one instance, I found this spent acid liquor which was collected, somewhat diluted with water, to possess the following powerful effects upon fish :—1. When the liquor was taken by itself, and fish immersed therein, they were dead in five minutes. 2. When the liquor was diluted with three times its volume of good stream water, and fish introduced into the mixture, they were killed in ten minutes. 3. With one of the liquid and twenty of water the fish died in fifteen minutes. 4. One of the liquor and 100 of water killed the fish in fifteen to twenty minutes. 5. One of the liquid and 1000 of water was poisonous to the fish in two hours; whilst in one of the liquor to 10,000 of water, the fish were not killed by their immersion in the mixed liquid for twenty-four hours, but were apparently sick and prostrate. The spent soda liquor which has been employed in treating the oil which had been previously acted upon by acid, is necessarily decidedly alkaline and caustic in its nature. It has extracted from the oil, and retains in solution, more or less carbolic acid and its homologues, and the poisonous nature of the spent soda liquor is doubtless materially augmented by the presence of these acids. One sample of this soda liquor which was flowing from a paraffin oil work, and which contained extra water, proved destructive to fish in ten minutes; diluted with three parts of water, it killed fish in twenty minutes; with twenty of water, the fish were dead in twenty-five minutes; with 100 of water, the fish were killed in thirty minutes; diluted with 1000 times its volume of water, the soda liquor was destructive to fish in twenty hours; whilst in 10,000 parts of water the fish were not killed, but were apparently slightly sick. Experiments were also made with crude shale oil and the refined oils obtained therefrom, and with Pennsylvanian petroleum and the refined oils extracted from it :—The crude shale oil was destructive to fish when taken in the proportion of one of the oil to 1000 of water; the crude oil being more energetic in its action than any of the others, then in succession the lubricating oil, the burning oil, and the lighter spirit.

The Pennsylvanian petroleum was not so powerful in its poisonous properties as the shale oil employed in the experiments. The crude shale oil, in the proportion of one to 1000 of water, was poisonous to fish in twelve hours, whilst the crude Pennsylvanian oil, in the same proportion, did not kill the fish for twenty-four hours. The refined oils acted in a corresponding manner on fish; thus the refined shale oil, in the proportion of one to 1000 of water, killed the fish in twenty-four hours, whilst the refined Pennsylvanian oil did not prove destructive till two days. The importance of this subject will probably soon be greater than what it is at present, as the manuacture of crude paraffin oil, in conjunction with gas, has already been introduced into one of our gas works in Scotland. The coal used is the Newbattle gas or cannel coal, which yields, when distilled in ordinary gas retorts, at a bright cherry-red heat, about 11,000 cubic feet of gas, with an illuminating or photogenic power of thirty-four standard sperm candles for every five cubic feet of oil gas burned during every hour. When distilled, however, at a low or black red heat, in larger retorts, as carried on in ordinary paraffin oil works, the coal yields only 3000 to 3500 cubic feet of illuminating gas, with the photogenic power of thirty candles for every five cubic feet burned during the hour, so that two-thirds of the total quantity of gas capable of being yielded by the coal is sacrificed; but in place thereof there are obtained about sixty gallons of crude paraffin oil, with a specific gravity of ·900 to ·905. The gas works in question are virtually crude paraffin oil works, in which the gas is utilised, and as the change in the mode of working the coal appears to be profitable, there is every reason to consider it likely that other gas works will follow the example, and become virtually crude paraffin oil works, with refineries attached thereto.

*Chlorate of Quinine,**

by CHARLES R. C. TICHBORNE, *F.C.S.*, *&c.*†

WE have determined upon bringing before the British Pharmaceutical Conference a *résumé* of our experiments upon what promises to be one of the most useful of the quinine salts.

The chlorates and perchlorates of the organic bases have not been so far much investigated, although some of them seem stable compounds, easily crystallised, and are, many of them, of great beauty.

Composition.—This point was determined (as regards the neutral salt) by the estimation of each component—each serving as a check upon the other.

The results may be formulated as follows :—

$$4(C_{20}H_{24}N_2O_2,HClO_3)7H_2O.$$

The centesimal composition being—

		Theory.	Practice.
Quinine	. . .	73·65	73·9
$HClO_3$	H. . .	·23	
	Cl. . .	8·07	8·04
	O. . .	10·90	10·53
HO	. . . .	7·15	7·18
		100·00	

The above analysis was made of the salt after drying twenty-four hours over sulphuric acid or well-dried in the air. On continuing the drying over sulphuric acid, it gradually lost nearly the whole of the water. The loss of water at 100° C. was constant.

The quinine was estimated by Professor Jelletts, with the aid of his saccharometer. We may remark that the accurate estimation of quinine can only be accomplished in the above manner, or by the combustion of the carbon—it having been lately pointed out that even the determination of the nitrogen cannot be relied on.

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* Chlorate of quinine was made at the request of Dr. Lyons for some experiments, performed at the Whitworth Hospital, Dublin, in connexion with two or three cases of "Black Death." It has since been employed by that gentleman with great success as a new febrifuge. *Vide* Dr. Lyons' Clinique, *Medical Press and Circular*, vol. i., p. 653. In its therapeutical effects, it must be borne in mind that the particular advantage that it possesses over the other salts of quinine is supposed to arise from the fact that over 10 per cent. of the salt assimilated is available oxygen, and that, from the fact of its being a chlorate of an organic base, it will be a more probable yielder of oxygen to the system than such a salt as chlorate of potassium.

† Read at the meeting of the Pharmaceutical Conference

Chemical and Physical Properties.—Chlorate of quinine presents many of the characteristics of the alkaline chlorates, only in a less marked degree. When pure, it crystallises from a watery solution, in small mushroom-shaped masses, which, on examination, are found to consist of filiform snowy-white crystals. Some chemical salts and many well-known minerals are found to take this character. They present the appearance of an amorphous mamillated exterior, perfectly devoid of crystalline structure, yet, when broken through, are found to consist of exquisite geometrical forms, which are produced by needles or prisms radiating from some axis or point towards the amorphous circumference. The beautiful and well-known mineral wavellite may be cited as a specimen of this characteristic crystallisation. Many of the quinine salts present the same peculiarity, and none more so than the chlorate. When a boiling solution of pure chlorate of quinine is allowed to cool, the solution becomes quite milky, not, as might at first be supposed, from a deposition of minute crystals, but, as the microscope shows, by the deposition of the salt in the form of oily globules, which, on cooling, become vitreous balls, then in a short time change to fine filiform masses of crystals. In this form the salt is again deposited upon the outside periphery of the mass, in an amorphous condition; but at the same time becoming crystalline in the interior as the process continues. A slide from which micro-photographs were procured, by Mr. J. Woodworth, was produced by allowing the solution of chlorate of quinine to cool slowly upon the glass, and when the globules were sufficiently collected to dry rapidly under the recoiver of an air pump; by this means the chlorate was retained in its vitreous condition, otherwise it became crystallised. The globules seemed to arrange themselves in a symmetrical form, so much so as to produce a rather pretty microscopic object, each large globule being surrounded by a series of small beads. The vitreous quinine does not polarise, whilst the crystalline does. When the amorphous salt is once dried, it retains that character permanently, but on submerging it in a cold saturated solution of the salt, it very slowly and imperfectly regains its crystalline form.

When the mushroom-shaped masses are broken up, they resemble the ordinary salts of quinine in appearance.

The chlorate cystallises readily from spirit, in which it is very soluble; the solution gives a salt retaining the same number of atoms of water of hydration. Heated gently upon a spatula, it gradually melts, and, after a little time, goes off with a vivid combustion, which sometimes amounts to explosive violence. The combustion is generally attended with a cloud of carbon, a carbonaceous residue being also left upon the spatula. Treated with hydrochloric acid and gently warmed, it evolves chlorine. On adding ammonia in excess to this mixture, a green colour is developed. It is very soluble in boiling water, and soluble in 78·5 parts of cold (15·5° C.). It is also very soluble in water acidulated with the stronger acids, including perchloric.‡

It crystallises much more readily from its solution if it is impure—viz., if it contains a trace of sulphate or hydrochlorate, the crystals in each case retaining the character of the impurity.

Tests.—Chlorate of quinine, when dissolved in water and acidulated with nitric acid, should give no precipitate with chloride of barium, and none, or only a faint opalescence with nitrate of silver. It should give no precipitate with diluted sulphuric acid, the ordinary tests for quinine being applicable to the base. It is always necessary to ignite a portion, which should leave no appreciable residue. A sample of the so-called chloride of quinine submitted to us consisted of chlorate of potassium and sulphate of quinine.

Process for making Chlorate of Quinine.—The following process and precautions have been adopted by the writer in the manufacture of this preparation:—310 grains of chlorate of barium are dissolved in a small quantity of boiling water, 2 ounces of Howard's sulphate of quinine are mixed with about 12 ounces of hot water, at a temperature of about 90° C., in a porcelain dish. Double decomposition takes place immediately on mixing the two solutions.

$$2(2C_{20}H_{24}N_2O_2,H_2SO_4)15H_2O + 2(2BaClO_3,H_2O) - 10H_2O = 4C_{20}H_{24}N_2O_2,HClO_3)7H_2O + 2Ba_2SO_4.$$

It is intended that so far there should be a slight excess of sulphate of quinine to insure the precipitation of all the barium. This excess is evidenced by a slight scum, consisting of crystals of the undecomposed sulphate, floating upon the surface of the liquor. The dish is then transferred to the lamp and precipitated carbonate of barium added whilst stirring, and in small proportions, until the last trace of sulphate is decomposed and the crystals are replaced by a fine oily pellicle. This simple index serves to point out a state of absolute purity as regards the liquor, providing that the salts used are pure—*i.e.*, it will be found to contain neither sulphuric acid nor barium. The mother-liquor, evaporated over a water-bath, yields a further crop of crystals. The crystals should be air-dried or dried at a gentle heat. There is none, or, under certain circumstances, only a partial decomposition between sulphate of quinine and chlorate of potassium. Indeed, a solution of sulphate of potassium is capable of decomposing chlorate of quinine.

On Liquid and Dried Pepsine, by M. Besson.*

M. Besson first endeavoured to find out whether pepsine could be preserved and used in a liquid state, or whether it could be dried without losing its properties, and the result of his experiments is that pepsine preserved and used in the liquid state possesses all the properties attributed to it by chemists and physiologists, but that it loses them entirely by the simple fact of drying. The following are the experiments on which M. Besson founds his opinion:—

Take from the stomach of a dog 200 grammes of gastric juice, which divide into two equal parts; into one put ten grammes of some meat cut up fine; put the whole into a stove heated to 35°, and in less than five hours the digestion will be completed—that is to say, the meat will be perfectly disintegrated to a solution or homogeneous pulp, with the characteristic odour.

Then dry, with all the necessary precautions, the remaining portion of gastric juice, triturate with starch, and steep it in 100 grammes of distilled water, place it in contact with ten grammes of meat, and treat it in the same way as the first portion. At the end of the five hours no digestion will have taken place, and putrefaction ensues if the experiment be prolonged.

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‡ For the internal administration of this salt, it is soluble enough in water (probably the most efficacious method of exhibiting it). It is incompatible with the mineral acids, as they form the ordinary salts of quinine; it is for this reason that Dr. Lyons has hitherto prescribed it in conjunction with perchloric acid, itself a valuable oxidiser.

* *Journal de Pharmacie et de Chimie, iv. 53.*

Convinced by these experiments that pepsine should be preserved and used in the liquid state, M. Besson has endeavoured to discover the average quantity of pepsine contained in the rennet bag of the calf, in order to avoid the trouble and difficulty of making a fresh estimation each time. He found that the quantity varies in each rennet bag, which may be accounted for by the degree of development of the organ, the age of the animal, and the state of its health. But of fifty or a hundred rennets the average is 0·45 gr. of pepsine each—that is to say, the equivalent of eight grammes of Corvisart's amylaceous pepsine.

New Facts relating to Fixed Oils, by M. J. NICKLÉS.

There exists in the commerce of southern France an oil called oil of apricots, which resembles the oil of sweet almonds in appearance and many of its properties, but is cheaper, and is used for adulterating the latter oil. The author was called upon to assay a sample of oil of sweet almonds suspected of this adulteration. He found that oil of apricots was susceptible to the action of hydrated lime in powder, forming with it an emulsion, which slowly takes an unctuous consistence; on the contrary, oil of almonds is not emulsified in this case. By repose the calcareous powder separates little by little and leaves the oil clear.

But when a certain quantity of oil of apricots is present it emulsifies on agitation, and on standing the unctuous compound of oil of apricots and lime is deposited, and may be separated by filtration. This unctuous matter, which is neither an oil nor a soap, melts in the water bath, and becomes a limpid liquid, which concretes on cooling; but less dense than water, it floats on boiling water unchanged, except in consistence. It is soluble in hot oil, but on cooling it separates as a white cloudiness, more or less dense, which can be removed by filtration. This unctuous compound may be freed from any excess of lime by filtering hot, and is soluble in bisulphuret of carbon. The following is the author's process for applying the test.

Take 185 grains of the suspected oil of almonds, and agitate it with about 23 grains of hydrate of lime, then heat it at a temperature below 212° F., filter hot in a heated funnel. By cooling the filtrate by ice-water, the oil loses its transparence if oil of apricots is present. The author finds olive oil and oil of colza behave like oil of almonds; whilst the oils of hemp seed, poppy seed, groundnuts, walnuts, and linseed produce more or less of this unctuous matter in the presence of hydrate of lime; cotton-seed oil gives but very little; castor oil forms a thick coagulum almost like resin.

The author believes this process may be utilised in regard to the three non-coagulable oils above stated.—*Journ. de Pharm.*, May, 1866.

On the Adulteration of Resin of Jalap with Aloes.—M. Daenen (*Bull. Soc. Pharm.*, Brux.) calls attention to a specimen of resin of jalap, which he was led to suspect, by its bitterness, not to be pure. It was friable, and gave a yellowish-gray powder, nearly insoluble in ether, sulphuret of carbon, or chloroform; entirely soluble in alcohol of 28° Baumé, and partially soluble (30 per cent.) in distilled water, liquid ammonia, and an aqueous solution of carbonate of soda, when pure resin of jalap is insoluble in these three last menstrua. It also afforded carbazotic acid by the action of nitric acid, and was not affected by chlorinated soda solution in a manner to indicate guaiacum.

PROCEEDINGS OF SOCIETIES.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, by Dr. Percy, F.R.S.

Lecture No. IX.

We will proceed this morning with the subject of coal. I was calling your attention on the last occasion to the gradual alteration in composition of coal, and we were tracing that alteration successively from wood at the one extreme to anthracite at the other. I pointed out particularly the relative increase of carbon. Now, here is another relation which it is well to point out—one of considerable importance in a practical point of view. You remember I said the hydrogen is always in excess of that required to form water with the oxygen present. We shall find now, on examining the same series of bodies — wood, peat, lignite, certain varieties of coal, and anthracite—that there is a gradual increase in the proportion of hydrogen above that required to form water with the oxygen present. This table shows the increase of the hydrogen over the oxygen.

1	1·80
2	2·89
3	3·07
4	3·47
5	3·62
6	4·09
7	2·63

No. 1 represents the increase in wood; No. 2, in peat; No. 3, in lignite; and the numbers below represent the increase in the various kinds of coal to which I called your attention. You see there appears to be an exception in the case of anthracite, the last in the series; but possibly this may not prove to be exceptional. In all the other cases you will notice a marked gradual increase in the proportion of hydrogen as compared with that of the oxygen.

I said that the production of coal from woody tissue may be explained by the elimination in greater or less degree of three things—namely, marsh gas or fire damp, of which I showed you a specimen on the last occasion, CH_2 (using the old notation); carbonic acid CO_2; and water HO. It would be possible to present to you a series of formulæ which would make this perfectly evident. To those who are curious in this inquiry, I may mention that the work of Bischoff on "Chemical Geology" will furnish very ample information. There you will see a great number of formulæ illustrating this point most excellently. You have all noticed, I have no doubt, that on stirring up a muddy pool where there is a large quantity of vegetable matter undergoing decomposition, bubbles of gas escape. Well, that gas is fire damp or marsh gas, with a certain proportion of carbonic acid. This is the sort of gas we find escaping in coal mines now-a-days.

Nitrogen is always present in coal, and generally in about the same proportion per cent.—say from 1 to 2 per cent. It is one of the most fixed constituents of coal. We find it even in anthracite. I have never yet seen a specimen of coal free from nitrogen. Of the products of the destructive distillation of coal—those which are produced when coal is heated in a gas retort—some are condensable and some are gaseous. Well, the condensable will always be found to have an alkaline reaction, due to the presence of ammonia, and that ammonia is to be explained by the fact of the coal containing nitrogen.

Sulphur exists always in coal. I think I may say "always." I do not know a single exception. I believe there is none. There are some points of interest concerning the presence of sulphur in coal. It is found in three distinct states of combination. First of all we have the sulphurous pyrites—common pyrites. You have all seen that shining stuff in coal—bisulphide of iron, or iron pyrites. It occurs sometimes so finely diffused throughout the coal, that the naked eye fails to detect its presence; at other times in exceedingly delicate films, almost imperceptible, if I may use the expression. Sometimes it occurs in small masses, and then again in lumps, and sometimes in actual veins. It is this pyrites which, on exposure of the coal to the conjoint action of air and moisture, undergoes decomposition, being oxidised and converted into sulphate of peroxide of iron. The first product of the action is the sulphate of the protoxide of iron. The sulphur is oxidised and the iron is oxidised, and we get green copperas—that which gives an inky taste to water coming from coal mines. Well, by the further action of the air, that salt undergoes oxidation and becomes converted into this sulphate of peroxide of iron, which makes its appearance in the coal of old gate-roads in pits, or those roads by which the coal is gotten. In these cases you may see yellow patches consisting of this substance. It is owing to the presence of the pyrites that the weathering of coal takes place sometimes very rapidly, and the coal becomes wholly disintegrated—reduced almost to powder. We have specimens illustrating this in some of these jars. Here is one from the Forest of Dean, which I have preserved on purpose to show this fact. It contains pyrites diffused through the mass, and on exposure to the air the coal falls to powder. That is a serious drawback on all coal intended for storing for steam navigation. You will find also, as another product, that peculiar white, silky, delicate, crystalline body, which is a kind of iron alum—not a true iron alum. It consists of a combination of sulphate of alumina and sulphate of protoxide of iron with a small quantity of water. The alumina is derived from the shale which is present in coal, and the alumina is acted upon by the sulphuric acid generated by the oxidation of the pyrites. Here is a specimen received a short time ago which will well illustrate this action. This coal when exposed to the air for a certain time becomes disintegrated, and that fact is due entirely to the interposition of pyrites. There is one which we have plunged into water and then exposed to the air. The action is very rapid, and in the course of a day or two this yellowish-brown colour was produced. It is the substance I before referred to as misy. During the oxidation of this pyrites much heat is developed, and if there be a large quantity of pyrites present, that heat may be sufficient to ignite the surrounding coal. Of the different hypotheses set up to explain the spontaneous ignition of coal pits—a very serious accident which not unfrequently occurs—that of the oxidation of pyrites is, perhaps, the most generally accepted. There is no doubt that if the pyrites be present in large quantity it is amply sufficient to explain the fact; but I am strongly impressed with the belief, from what I have seen, that there may be another cause—namely, the rapid oxidation of the coal when reduced to a state of very fine powder. There is no doubt that oxygen is absorbed, with the production of carbonic acid, and that may go on until actual ignition takes place. I have observed the phenomenon myself in coal pits. The first coal has a peculiar odour, which in Staffordshire is known by the name of "fire stink"—to use the good old Saxon expression—and it suggests to me precisely the odour produced by the distillation of coal at the lowest possible temperature. The pyrites occurs in some coals to such an extent as to be an object worthy of extraction, that pyrites being now much in demand for the purpose of making sulphuric acid.

But sulphur exists in coal, as I have said, in three states. The second state is in combination—for example, in sulphate of lime. It is certain that sulphuric acid is present in certain coals in combination with a base. We have ascertained that beyond possibility of question. The third state to which I refer is one of so-called organic combination. We find on the analysis of coals that there is frequently much more sulphur present than can be explained by the sulphuric acid existing in the coal, or by the iron pyrites present in the coal. We therefore infer, and reasonably too, that that sulphur is in a state of organic combination, just in the same way as it exists in hair and nail and other organic matter. Recently a mineral has been analysed by Mr. Church, which he has called tasmanite, of which we have a specimen in the Museum. It consists of carbon, hydrogen, and sulphur in combination as an organic body. The composition is—carbon 79 per cent., hydrogen 10 per cent., sulphur 5 per cent., and oxygen 5 per cent., the sulphur being in organic combination. Possibly, on further examination, it may turn out that we have some compound of this kind actually existing in coal. Whether that discovery be made or not, it is perfectly certain that coal does contain sulphur frequently in organic combination.

All coal contains water to a greater or less extent, and this water may be expelled at a comparatively low temperature. Ordinary bituminous coal contains 4 or 5 per cent.; but there is a variety of coal to which I shall direct your attention specially directly—lignite—which always contains, I believe in all circumstances, a very large quantity of water, and I believe, indeed, that this water, when accurately determined, will enable us to decide whether the coal is a lignite or not; at all events, it will in many cases.

All coal contains, as you would naturally expect, a sensible amount of inorganic matter. The ash left on the combustion of coal is this matter. That ash is derived partly from the inorganic constituents existing in the woody matter from which the coal has been produced, and partly from those other matters which have been accidentally washed into the coal bogs, or whatever you may choose to call them, during the production of coal. Whatever theory we adopt with regard to the formation of coal—whether it be formed *in situ* or from drift wood—it is certain that sand and other inorganic matter has been washed in in the process of the conversion. The common shale, for example, which we find in alternate beds with coal, demonstrates this. Sometimes we find a single lump of coal showing shale interlaminated throughout. That shale is one of the best examples we can give of coal containing inorganic matter not derived from wood. The shale is not derived from the inorganic matter existing in plants, because it contains silicate of alumina, which is not a constituent of the mineral matter in plants. I will give you a well-known analysis of the shale of coal—an analysis by Mr. Taylor, of the North of England:—

Silica	62·44
Alumina	31·22
Sesquioxide of iron	2·26
Lime	0·75
Magnesia	0·85
Potash	2·48

Now, it must not be supposed that the sesquioxide of iron actually existed as such in the shale. It may have been, and no doubt was, the result of the process of incineration adopted in the analysis. The iron most likely occurred in the coal as protoxide, and was converted into peroxide. In another analysis of shale before me, there is 31·4 per cent. of silicate of alumina. The quantity of shale existing in coal varies very considerably, as every one knows, and, as I remarked on the last occasion with respect to the amount of shaly matter in coal, it is impossible to say where coal ceases and where shale begins. There is no point of demarcation between the two.

One interesting constituent of coal is potash or soda, which indicates or suggests the precise condition under which coal may have been produced—proximity to sea-water.

Having made these general remarks concerning coal, we will pass on to consider certain classes of coal with more detail. The first in order is that class to which I have referred several times already—namely, the lignites, or wood-like coals, as they are sometimes very properly called. We have them sometimes closely resembling wood in structure. Now, if you look at that specimen of lignite from Bovey Tracey, in Devonshire, you would not hesitate to say that that was woody tissue; but then, on the other hand, some are so much like ordinary coals in appearance, that you cannot tell the one from the other. To the woody varieties of lignite the Germans have applied the term "bituminous wood." Between the two extremes we have every degree, some being more or less earthy, schistose, or slaty. These lignites occur especially in geological strata of comparatively modern date. We have, for example, numerous tertiary lignites. The point which is, perhaps, of most importance to remember in connexion with the composition of lignites is the large amount of hygroscopic water they contain. We have made many determinations of the proportion of water in lignites from many parts of the world. I have looked over the recorded analyses of lignites published in various journals and elsewhere, and I infer from these data that lignites generally contain a very large proportion of hygroscopic water—water, you will remember, which may be displaced by the action of gentle heat, without effecting the slightest decomposition in the coal itself. In this respect lignites approached very much to wood. Lignites contain sometimes 15 or 18 per cent. of water, and even more than that; and you may displace this water completely by a gentle heat, but on leaving the dry lignite again exposed to the air it will reabsorb the same amount of water as you displace. I think this point is one of the most characteristic of all with respect to lignites. We find these lignites—or, as they are sometimes called, brown coals—wood-like in structure, earthy, sometimes almost like black soil, so little coherent are they; then, again, we find them compact, like a piece of ordinary coal. Their fracture is either wood-like, conchoidal—breaking like a piece of glass almost—or uneven. Their colour varies very considerably, as you will observe here—from light brown to coal or jet black. They are all non-caking. This is another very important property to remember in connexion with the subject.

What do I mean by the term "non-caking?" Now, if we take the powder of certain coals—those which we are accustomed to burn here in London, from Newcastle-on-Tyne or its vicinity—and heat that powder in a close vessel, without access of air, gradually to a red heat, it becomes, after much smoke, a solid mass. The particles agglomerate and form a solid lump, which will not crush between the finger and thumb. Then again, if we take the powder of some other coals—those from Scotland and elsewhere—and heat it, it remains powder; the particles will not adhere. I know there is one method in which you may obtain a coke from these particles, tolerably coherent, by the action of heat alone, but then that involves a very special condition.

Well, these lignites are non-caking—all the true lignites, without exception, as far as I know. They approximate to wood not only in point of hygroscopic water, but in point of chemical composition. I need not trouble you now with an analysis of these lignites. In a table which I have before me I find one which contains, deducting the ash, 74 per cent. of carbon, 5·88 per cent. of hydrogen, and 20 of oxygen. What I want you to note is the large proportion of oxygen. We shall find, as I pointed out before, that as we pass from lignite to bituminous coal that proportion is continually diminishing. These lignites are found almost over all the world. We have them in this country abundantly at Bovey Tracey, in Devonshire, but there a large quantity of iron pyrites is present, which produces a disagreeable smell when the coal is burned. There is a very valuable work just published, or in process of publication in Germany, on the brown coals or lignites, giving a very exhaustive history of the whole subject, with an account of the plants, figures, and so forth. The term "coal" is generally applied to lignites, but those persons who are connected with coal mines, or who may invest in them, should bear in mind the distinction between lignites and bituminous coals. There are very good lignites, but they are all inferior in heating power to bituminous coals, because of their containing more oxygen, which, you know, is worse than useless. Hence, when you hear of coal being found here and there, be careful to ascertain what coal it is before you invest your money; if it is a lignite, estimate it at its real value.

I will now give you an analysis of different lignites occurring in different parts of the world. I will give you the proportions with the ash deducted, so that you may be able to compare the composition of one lignite with the other. The ash being a variable accidental body, it is clear that unless we deduct it we cannot properly compare two lignites with reference to their essential constituent parts.

	Carbon.	Hydrogen.	Oxygen & Nitrogen.
Lignite from Hesse Cassel	72·48	5·15	22·37
" Philippine Islands	73·85	5·59	20·56
" Desolation Island	70·38	5·68	23·94

You see how wonderfully near the composition of these lignites is. The analysis of the lignite from the Philippine Islands has not before been published. The lignite from Desolation Island, a very out-of-the-way place, is a very remarkable specimen, and was received last year from the Admiralty. There is in connexion with it one point of considerable mineralogical, if not geological, interest, and I do not know any other example of the kind on record. If you inspect it carefully, you will find it seamed with delicate laminæ, white and more or less crystalline. We have endeavoured to collect sufficient for analysis, but unfortunately have not succeeded in doing so, so as to get a satisfactory result. Still, we have got enough to determine the nature of this body. It is a hydrated silicate of lime and alumina. In fact, it is a zeolite. Here, then, you have a coal containing innumerable beads or laminæ of a true zeolite. I do not know any other case on record of the occurrence of such a body in coal. Here we have it collected very carefully and put aside in a little bottle. In Trinidad we have some very fine lignites. They have been examined very carefully by Mr. Wall, a former student of this Academy, and he has published a monograph upon them.

With regard to the action of chemical reagents upon coal, this part of our subject has been particularly investigated by Frémy, and he has suggested, in fact, that we may be able to determine the geological age of a coal by the action of these reagents. Well, of all the varieties of coal we have to deal with, lignite is most easily acted upon. Here is a specimen of lignite put in nitric acid. You see it has become deep brown and nearly wholly dissolved. There is a specimen of bituminous coal acted on at the same time and under precisely the same conditions. The coal is very slightly acted upon. There, again, is a specimen of anthracite, exposed to the same conditions, but it has not been acted upon at all. So with regard to hyposulphite of soda: lignite is considerably changed by the action of this salt, bituminous coal is slightly affected, and anthracite is not at all acted upon. Here are specimens showing the action of sulphurous acid. This has been going on for a couple of years. The lignite is very speedily acted upon by this acid. Here is the result of the action of potash on these three varieties of coal. The potash forms a deep brown solution of the lignite, and the odour evolved from this solution is remarkable. I do not know what it is at all. The whole of that lignite is dissolved; the bituminous coal to a considerable extent, but still not wholly; the anthracite not at all. The products here are very well worth the attention of chemists. Perhaps they are not very interesting now, but I have no doubt that inquiries like this, continued for a long time, would yield information of great value.

With regard to the ashes of lignites I need not say much. They are exactly the same as the ashes of ordinary coal. In some lignites we find bodies of interest—for instance, arsenic has been detected by Daubree in a tertiary lignite from the lower Rhine, and we have also found arsenic in a bituminous coal of this country.

I will call your attention next to the great class of bituminous coal. Now, what do we mean by bituminous coal? Well, it is a very indefinite term. It is used by different authors, unhappily, in different senses. First, we have it applied to those coals which burn with a smoky and bitumen-like flame. Then we have it put down to represent the volatile matter which escapes when coal is heated in an open vessel. Then again it is employed to represent the oxygen, nitrogen, and hydrogen existing in coal. These are three different senses. It is supposed by some that these bituminous coals which we are accustomed to deal with in London contain the mineral bitumen; but it is no such thing. We cannot extract any by means of solvents.

Bituminous coals vary in physical qualities as well as in chemical composition. They are all solid, more or less brittle, and opaque. Their lustre differs considerably from dull to shining. Their colour varies from brown to black. The colour of the powder is always brown, or more or less brown. Then, some of them soil the fingers, and some do not. Like cannel coal or jet, which is only a variety of cannel coal, they break remarkably—sometimes in geometric forms, more or less cubical or rhombic; but do not be misled by this: it has nothing to do with crystallisation. People sometimes talk of the crystallisation of coal: there is no such thing. It is not crystallisation which coal assumes upon cleavage. Then, again, these coals sometimes present a conchoidal fracture. They all burn with a more or less smoky flame, and all yield, when heated in a close vessel, the product called coke, which contains all the fixed inorganic matter of coal.

There are two or three—we will say three—distinct classes of these coals. First of all, when speaking of these coals, we should be careful to inquire whether they belong to the caking or non-caking class, because much depends upon that. The caking coal can be applied for certain purposes, but not for others; so with a non-caking coal. That is a great distinction among these coals. Then, again, as to composition, I gave you three varieties in the last lecture: they were three typical general expressions of three kinds of coal, and represented the three kinds to which I am about to advert. This classification of these bituminous coals is founded on a large number of analyses, and I find it every day confirmed. First, we have bituminous non-caking coals, rich in oxygen; and in so far they approximate to wood or lignite. They are the next step to lignite properly so called. Then we have the caking coals; and lastly, we have the non-caking coals, rich in carbon. The non-caking, rich in oxygen, are represented by our South Staffordshire coals, Scotch coals, and coals from various other parts of the world. They burn with a long copious flame. Then we have the caking coal, which every one knows; and there is the non-caking coal rich in carbon, which approximates nearly to anthracite. You will be good enough to remember these three typical formulæ: they refer to these three varieties of coal—non-caking rich in oxygen, caking coal, and non-caking rich in carbon. It is the last variety which forms such a valuable steam coal. It burns with a bright, hot, short flame, and contains a comparatively small amount of oxygen. One variety contains only 7.36 parts of oxygen to 100 of carbon, whereas the non-caking coal rich in oxygen contains about 21 parts of oxygen to 100 of carbon. In the analyses of lignite I gave you just now, I stated the percentage composition. The proportion of carbon was about 72 per cent., and that of the oxygen 20 per cent. or upwards. There is no marked difference between these varieties of lignite and coal. They pass by insensible gradations into one another. You cannot say where one begins and the other ends. If coal be vegetable matter which, during a long period—I mean long in a geological sense—has been undergoing a natural process of decay, or conversion from wood into a substance more or less resembling carbon, then it is evident that there must be—I was going to say an infinite series of perfectly gradual changes—changes from one into the other, so that we might, if we could get a sufficient number, place before you such a series of coal as would represent that transition by successive stages. It is a matter of time, so to speak. It is perfectly true that there are other influences at work. You will very naturally say to me, "If you assert that the coal is nothing more than the product of a natural decay, or natural change of woody tissue, how is it that we find all these varieties in coal—varieties in point of physical character and varieties in point of composition?" Well, the question of composition is, I think, easily answered: it is a matter of time and other conditions—temperature, for instance, and, it may be, pressure, and so forth. Now, to give you an illustration of this, certain coals are not fiery; they do not contain fire-damp at all. Well, it is perfectly evident that during the formation of that coal the gas has been able to get away; but in some coal pits the gas has not been able to get away; it has been retained, and sometimes it bursts out under great pressure and fills the coal pit in two or three minutes. Then, again, the presence of hot water and the proximity of igneous rocks, and so forth, are all conditions which have to be taken into account. Variety of composition in different coals does not at all invalidate the general proposition, that all coal is nothing more than the result of the conversion of woody matter, or the decay of woody matter, or its gradual conversion into a substance resembling carbon as nearly as may be. There are many other points of great interest bearing on this question, but I find the time admonishes me to pass them by.

With regard to the caking quality of coal, I may mention to you a very curious point—that some of these coals cake when freshly taken out of the pit, and cease to cake or form coke after exposure to the air for even a short time. I say there is no doubt whatever of the existence of fire-damp in coal pretty much as air occurs in charcoal. You may hear it escaping from coal in the pit, and you may get it from the coal after it is taken from the pit. Only this morning the paper tells us of an explosion having taken place in some coal which was stored in a ship. That explosion was due to the gradual elimination or escape from the coal of the gas I have spoken of after the coal was taken from the pit and stored in the vessel. The gas became mixed with common air, and consequently an explosion was the result upon the mixture becoming ignited. Nothing can be plainer than that.

It is very important, when speaking of coal, to pay attention to its remarkable varieties—varieties of physical character, varieties with respect to the mode of burning, varieties also with respect to composition.

There is one variety of coal we must mention here particularly—namely, the well-known cannel coal, which sometimes occurs in immediate proximity—nay, in alternation, with ordinary coal. Here is a piece of cannel coal from Wigan, and a very fine illustration it is, because it shows how one may occur in combination with the other in the same pit. Cannel coal varies very much in point of properties. Here is a specimen in which it is smooth; here it is rough and dark; here it is of a deep brown colour, and does not stain the fingers. It contains a large amount of hydrogen in excess of that which is required to form water with the oxygen present. The name is corrupted from the word *candle*, for a small piece of this coal may be ignited even at a candle flame, and will then burn away. We have fine specimens in different parts of England. Some of the finest occur at Wigan. It is found also in North Wales. I have examined some from the Leeswood colliery, and I think this is one of the finest I have ever seen. There is also the famous Boghead cannel in Scotland. Curly cannel is the best, and is admirably adapted for gas-making. It fetches a guinea or thirty shillings a ton. It is especially adapted for making paraffin oil.

The last coal to which I must direct your attention is anthracite. Now, anthracite is apparently the last stage of conversion, or nearly the last. It may, practically, be regarded as carbon. It contains, it is true, a little hydrogen, and a little oxygen, and a little nitrogen. These anthracites are black, shining, sometimes almost metallic in lustre, breaking with an irregular fracture, exceedingly difficult of ignition. There is no gas to burn. It is true we can in a particular way generate a gaseous flame, because if we ignite this anthracite in a mass—say in a furnace, for example—when the oxygen comes in contact with the incandescent coal, we get first of all carbonic acid produced, and that carbonic acid, on rising through the incandescent mass above it, takes up another portion of carbon, and becomes converted into carbonic oxide. That carbonic oxide is a combustible gas, and on leaving the furnace it will burn with a flame; so, although I say that the anthracite does not contain hydrogen, you see how we can get flame from it. The flame, however, is obtained indirectly, as I have explained, and not by the direct burning of hydrogen. In other coal the flame is due to hydrogen, but in this anthracite it is due to the formation of carbonic oxide. There is a serious defect in the burning of anthracite, especially that of this country. It decrepitates, or becomes reduced to small particles, on the application of heat. I have seen specimens reduced to absolute powder in that way. That is a fatal objection to its application for the purpose of smelting iron. This anthracite I hold in my hand comes from China. There is a magnificent coal-field in China, near Pekin, about 300 miles in extent. We obtain steam coal thence, which is brought over in her Majesty's ships. The Chinese are rather jealous of European interference. Specimens of the coal have been tried, and found to coincide with other anthracites.

There is a fine coal in Borneo. It is a fine coal apparently, as far as we can judge from composition—a true coal of the carbonaceous period. Exclusively of ash, it contains 78·02 parts of carbon, 6·02 of hydrogen, and 15·96 of oxygen and nitrogen. Then in the island of Sardinia there is a coal which was supposed to be a lignite; it contains a large amount of ash, but chemically I should say it was a true coal. Then we have had coals from Brazil, which appear to be true coals of the carbonaceous period, but unfortunately they are very much deteriorated in consequence of the presence of a large amount of iron pyrites. When the pyrites is deducted, they have essentially the composition of true carbonaceous coals.

In some coals we find associated matters of great interest. There are some fine resinous matters met with in some coal. Here is a Tasmanian coal, in which occur large masses of resinous matter. These matters have probably been derived from the trees of which the coals are formed. Amber is contained in a coal from India. These resinous bodies are most unchangeable in their character. They have not been properly investigated in reference to their presence in coal. I have spoken of arsenic in coal. We have found it in coal of this country—a Nottingham coal. Galena has also been found in coal. There is a fact with regard to anthracite of which I have not spoken—namely, the presence of copper. We have examined it from time to time, and found it associated with that metal. I might go on enlarging on this subject, for it is difficult to know where to stop; but as I have so many things to do, I must draw to a close with regard to coal. Before doing so, however, there are one or two points with respect to coal to which I wish to call attention.

A great deal has been said of late about the duration of our coal, and evil prophecies have been put forth. The extent of our coal-fields is pretty well known, but probably coal will be found over a much larger area than at present known. Our rate of consumption is very large—say between 80,000,000 and 90,000,000 tons per annum, including the coal exported to other countries. It is not for me to condemn the exportation of coal. It is a subject open to grave differences of opinion, but in parting with our coal we are parting with our natural power. We are selling a power which can never be replenished—a power derived entirely from the operation of the sun, and stored up for us during millions and millions of ages. Whether it be proper to sell that power it is not for me to decide. It is derived from the sun's force. All coal is the product of the decomposition of woody matter of one kind or other by a natural process of decay. Now, no plant can exist without the agency of solar light. That light is essential to enable the plant to decompose the carbonic acid of the air upon which it mainly lives, and to separate the carbon from the oxygen. That separation, then, is effected by the operation of solar force, and the carbon thus set free is the carbon which comes down to us in the form of coal. The carbon of coal being the carbon which was separated in former geological periods by the action of the sun, we are, therefore, right in asserting that our coal is so much accumulation of sun force. There is an excellent book published this year on the coal question by Mr. Jevons, which I have read with much interest.

But I have digressed somewhat. To recur to the question of the exhaustion of coal. We are now going on at an enormous rate—about 90,000,000 tons a year, as I have said. But these 90,000,000 tons do not represent the actual exhaustion, because in the getting of coal, especially in some cases, there is a large amount of coal wasted. Perhaps in past times the waste has amounted to about one-half. The waste occurs in the form of small coal or slag which is buried in our pits never to be gotten again—at all events, not for some centuries to come, or while coal is at its present price. This slag contains as much heat-giving power as the solid coal. Hitherto the price has been so low that manufacturers have not cared to burn this small coal and get the heat out of it; but owing to the rising price they have been driven to make use of fuel which they would formerly have despised. There is no doubt that there is a large amount of coal in this country, which is very deep, and which will be inaccessible for a long time to come. It is impossible to say how far down we may go, but the increase of temperature at great depths is an obstacle. However, bold is the man who will set a limit to what human power can do. It may be too expensive to get at these deep coals until we have exhausted the coal-fields of our neighbours on the Continent and in America, for still they come into competition with us. There are numerous coal-fields in various parts of the world, especially in America. Of all coal-fields known, I suppose that in North America is by far the largest. It is only scratched upon the surface yet. The time may possibly come when our own coal-fields will be exhausted. I do not know whether in future ages England will be a sort of watering-place for other countries, but certainly our own coals will have disappeared long before there is any serious inroad made upon the American coal-field. Coal occurs in France and Prussia—in France under the chalk, the intervening measures being absent. Then there are the Belgian and Austrian coal-fields; and we have colonial coal-fields of very great value in Nova Scotia, Australia, and elsewhere.

With regard to the time our coal-fields will continue to yield—whether one hundred years or two hundred years—

no man can pronounce satisfactorily upon that point; for the moment foreign coal comes into competition with ours the working of our own coal-fields will stop. They will last our time, and no doubt some generations after us; but certain it is that the process of exhaustion is going on at a great rate, and must go on until the supply ceases. We shall be rendered then absolutely powerless, and shall have to depend upon peat or wood for fuel. At all events I think the lesson to be learned is that we ought to economise this power more than we do; for the waste of coal is enormous, not only in the getting of it, but in the consumption of it. Take the case of a common British fire-place—why, I suppose that nine-tenths of the heat generated there is entirely wasted. There is some talk about the possibility of finding a substitute for coal, but I think that success in that direction is very improbable. Can you conceive of anything less expensive as a fuel than coal—the product of sun-force during past ages? We get our power by just setting a spark to it. There is the oxygen in the air outside it, and there is the carbon in it, and as soon as these come in contact under suitable conditions, we get any amount of force. We can no more create force than we can create matter. Sometimes people not very well informed say, "Oh, when this coal is gone we shall get some other source of heat." I see no source of heat-giving power except that which may be derived from tidal action, but it will be an expensive matter to get heat from tidal action. We can get heat out of force now, but it is a very costly thing to do. There has been a notion put forth of drawing heat from the sun's force in the great desert of Africa, by means of thermo-electric batteries. Well, force might there be got and transformed into heat. It is one of those theoretical and interesting possibilities which I am afraid will not be realised.

I might have spoken of coal-like matters under the head of petroleum or coal oil, but the subject would take one or two lectures, and I must omit it on this occasion. Here are some samples of these matters—Canadian, Grecian, and Wallachian—for which I am indebted to Dr. Ward.

I will now proceed to make a few remarks upon the diamond, for these illustrations of which I am very much indebted to Mr. Tennant. The diamond is nothing more than a form of carbon. It is crystallised carbon. Carbon crystallises, as we know, in two distinct systems. One is the rhombohedral, in which state it is graphite or plumbago, which is opaque and difficultly combustible. Then we have carbon crystallised in the cubical system. It is then the diamond, one of the most beautiful and the most glorious of all gems, but one of the most mortifying to the chemist, for what would appear simpler than the idea of crystallising carbon? Numerous attempts have been made to convert carbon into a crystalline form, but hitherto entirely in vain. The diamond occurs of various and very beautiful colours. You will see some splendid illustrations of these colours in the case before you—green, yellow, various shades of topaz, brown, pink. The diamond is sometimes opaque, here is such a specimen; and there is a variety of diamond we meet with which is black and coke-like. There is one in the form of the octahedron, belonging to the cubical system. Then we have the more complex form, which is used for cutting glass.

ACADEMY OF SCIENCES.

August 27.

An important paper was communicated by M. P. A. Favre. It was entitled "*A Study of Chemical Reactions by the aid of the Heat borrowed from the Pile.*" The description of the author's mode of experimenting is too long to be quoted; we give only his conclusions. When a body is decomposed by the battery the constituent elements in separating borrow or absorb a larger amount of heat than they disengage again in combining under ordinary circumstances. Thus, in the *nascent state* bodies possess an excess of heat, which they give up on becoming modified to the ordinary state. We may suppose, then, that in chemical reactions, whether of combination or decomposition, the molecules set in motion undergo modifications that precede the combination or follow the decomposition, these modifications being shown by an absorption or disengagement of heat, quite independent of the calorific phenomena which accompany the chemical combination or segregation. The author's experiments revealed another fact—that secondary actions take place in the battery, accompanied by a disengagement of heat which is not turned to account in the current, and therefore he says that electro-magnetic machines cannot dispose of all the heat set in action in the battery.

M. Isidore Pierre presented a memoir "*On Silica and the Laying of Corn.*" Some people have supposed that corn becomes laid because of the weakness of the stalk from the absence of silica; but chemical analysis has not supported this idea. M. Pierre has observed that the corn on poor land rarely gets laid, and he believes the stalks in general give way in consequence of an over-development of leaf, which is at once a load for the stalk to carry, a surface to catch the wind, and a hindrance to the free access of air. The remedy suggested is evidently a different style of sowing.

M. Ch. Mène presented a memoir "*On an Iron Mordant used in Dyeing Silk Black.*" It is practically a solution of persulphate of iron. The author goes on to give directions for the manufacture of this, with which we need not trouble the readers of the Chemical News. He subsequently describes the method pursued at Lyons for dyeing silk black, which we shall quote on another occasion.

M. Blondlot presented a note "*On the Crystallisation of Phosphorus.*" The author, with proper precautions, sublimed phosphorus in an atmosphere of nitrogen, and obtained beautiful crystals apparently belonging to the cubical system. While these were preserved from the light they remained bright and colourless; but even in diffused light they soon became red, without, however, altering in form. Red phosphorus, therefore, is not, strictly speaking, amorphous.

NOTICES OF BOOKS.

On the Future Water-Supply of London. By G. W. Hemans, C.E., and R. Hassard, C.E. London: Stanford. 1866.

The future water-supply of London is a subject which imperatively demands serious consideration. Although it must be admitted that the present supply is amply sufficient in quantity for to-day, it must also be admitted that the quality is not all that could be desired. There is good reason to believe, too, that we have reached the maximum quantity that can be obtained from our present sources, and still London continues to grow "as rapidly as a log-built village on a water privilege in Michigan." As larger and larger quantities are taken from the Thames, it is found that the volume of water in the river is becoming seriously diminished, a matter which excites considerable alarm in many minds. Our other sources, and particularly the River Lea, are just now in discredit, and altogether the public mind is ready to entertain any scheme for supplying London with an unlimited quantity of wholesome water.

Several schemes are before the public. Mr. Bateman proposes to bring Bala Lake to London at a cost of eight millions. The scheme is opposed mainly, we believe, on the ground that it would cost another million or more to compensate people whose supply might be interfered with by diverting the water from its present outlet. The authors of the pamphlet we now notice propose to go to even a greater distance for their supply. Those well-known mountain ranges, they say, of the counties of Westmoreland and Cumberland draining into the rivers Lowther, Eamont, and Greta, and adjoining the lakes of Haweswater, Ullswater, and Thirlmere, possess all the attributes of a locality from which an enormous amount of the purest possible water may be obtained; and the existing lakes can easily and at small expense be adapted to form immense reservoirs for its conservancy and storage, at convenient altitudes for the water to be drawn off and conveyed by gravitation to London. The entire district is bare hill pasture and rock of the primitive formations, and excepting a small area in the vicinity of Ullswater, which can easily be excluded from the scheme, is free from mineral workings or other sources of contamination, and the waters are of remarkable purity and softness, as the following analyses by and letter from Professor Way will show:—

Grains per Imperial Gallon.

	River Lowther.	Haweswater Lake.	Ullswater Lake.	Thirlmere Lake.
Lime	1·54	0·50	0.81	0·42
Magnesia	0·50	0·18	0.20	0·14
Soda	0·80	0·71	0·51	0·46
Chlorides of sodium and potassium .	0·48	0·40	0·69	0·77
Oxide of iron, silica, &c. . . .	0·50	0·25	0·20	0.05
Sulphuric acid	0·51	0·51	0·37	0·44
Carbonic acid	2·05	0·82	1·03	0·56
Organic matter	0·62	0·62	0·35	0·77
Total impurity	7·00	3·99	4·16	3·61
Hardness before boiling . . .	5·2°	2·0°	2·1°	1·5°
Hardness after boiling . . .	4·4°	1·8°	2·1°	1·5°

These results, the authors are careful to add, although so favourable, exhibit the waters in their worst aspect and condition, the samples for analysis having been taken in January last, immediately after long-continued and heavy rains, and include the drainage from the small mineral district, which is intended to be excluded from the scheme.

From the above sources it is proposed to bring 150 millions of gallons for daily consumption in London, and 50 millions to populations along the line of conduit. Of the sufficiency and constancy of the supply there can be no doubt, nor in these days can there be any difficulty in constructing the works. Beyond a tunnel seven miles and a half long under Kirkstone Pass, there would seem to be no extraordinary work required. From the south end of that tunnel the water would be conveyed to London by conduit, funnel, and iron pipes; the aqueduct would pass by Ambleside and Kendal, and down the eastern side of Lancashire, avoiding the Wigan coalfield, to the east of Manchester and the Potteries district, and to the east of the Staffordshire coalfield and of Birmingham, and onwards towards London, following a route nearly parallel with that of the London and North-Western Railway, and would terminate in a large regulating reservoir, to be constructed to the north of Harrow, at a distance of about twelve miles from Cumberland Gate, Hyde Park.

The cost of this project is estimated at about twelve millions sterling; and with this amount of capital and after paying the present dividends to all existing water companies, the projectors see their way clearly to the realisation of large profits. We are not in a position to dispute their figures, which, indeed, look reasonable; and we need only express a hope that the scheme may receive attention. The quality of water, the quantity to be obtained, and the advantages afforded by the altitude of the source, are such, we believe, as cannot be found in any other part of England.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

1752. H. A. Bonneville, Rue du Mont Thabor, Paris, "Improvements in the construction of furnaces and kilns."—A communication from A. Martin and A. Béranger, Rue Louis-le-Grand, Paris.—Petition recorded July 2, 1866.

1912. G. T. Bousfield, Brixton, Surrey, "Improvements in the manufacture of certain alkaloids derived from aniline and its homologues, and in their transformation into colouring matters suitable for dyeing and printing."—A communication from A. Poirrier and C. Chappat, Rue d'Hauteville, Paris.—July 23, 1866.

1934. C. E. Brooman, Fleet Street, "A new or improved process or method of treating armour plates to render them inoxidisable."—A communication from M. Bernabé, Paris.

1938. W. E. Newton, Chancery Lane, "Improvements in treating iron for the purpose of converting it into steel or hard metal, and for plating or coating and hardening and tempering iron and steel."—A communication from E. Savage, West Minden, Conn., U.S.A.—July 25, 1866.

Notices to Proceed.

1023. J. Sparrow and A. Poole, Frood Iron Works, near Wrexham, Denbighshire, "Improvements in collecting the heated gases from blast furnaces, so as to utilise the same."—Petition recorded April 10, 1866.

1971. G. T. Bousfield, Brixton, Surrey, "Improvements in the manufacture of fuel from peat and such-like vegetable."—A communication from L. Elsberg, New York, U.S.A.—July 31, 1866.

CORRESPONDENCE.

Magnesium.

To the Editor of the Chemical News.

Sir,—Can you give me a reason why magnesium is not reduced from its oxide by carbon like other metals? Why should its treatment, as well as aluminium, so far depart from the ordinary rule? Has any one tried to obtain magnesium from magnesia by charcoal at a high temperature?

A Novice.

MISCELLANEOUS.

Death from Swallowing Carbolic Acid.—At Liverpool last Friday the relative of a patient in the hospital who had died of cholera went in a state of half intoxication to see the body in the dead-house. Perceiving a bottle of carbolic acid that had been left in the room, he mistook it for rum, and swallowed a quantity. His death was instantaneous.—*Medical Times and Gazette*, August 18.

Pharmaceutical Conference. — The meeting of the Pharmaceutical Conference was in every respect a success. It received a large accession of members, and the attendance was more numerous than on any previous occasion. Professor Bentley, F.L.S., was President, and delivered an opening address on the study of botany in connexion with pharmacy. At the daily meetings several useful and interesting papers were read, for most of which we hope to find space. The exhibition was considered to be successful beyond the most sanguine expectations of its promoters, and the dinner given by the resident members to the visitors was an extremely agreeable entertainment.

Composition and Quality of the Metropolitan Waters in August, 1866.—The following are the Returns of the Metropolitan Association of Medical Officers of Health:—

Names of Water Companies.	Total solid matter per gallon.	Loss by ignition.*	Oxidisable organic matter.†	Hardness.	
				Before boiling.	After boiling
Thames Water Companies.	Grains.	Grns.	Grains.	Degs.	Degs.
Grand Junction	18·31	0·81	0·60	13·5	4·0
West Middlesex	16·80	0·59	0·48	13·0	3·5
Southwark & Vauxhall	18·67	1·00	0·64	14·0	3·5
Chelsea	18·43	0·65	0·56	13·0	3·5
Lambeth	—	—	—	—	—
Other Companies.					
Kent	27·36	0·70	0·03	17·5	8·5
New River	17·09	0·54	0·22	13·0	3·5
East London	18·19	0·88	0·56	13·0	4·0

* The loss by ignition represents a variety of volatile matters, as well as organic matter, as ammoniacal salts, moisture, and the volatile constituents of nitrates and nitrites.

† The oxidisable organic matter is determined by a standard solution of permanganate of potash, the available oxygen of which is to the organic matter as 1 : 8; and the results are controlled by the examination of the colour of the water when seen through a glass tube two feet in length and two inches in diameter.

H. LETHEBY.

All the samples of the metropolitan waters received during the month have been remarkably bright and free from colour, and the proportion of organic matter has not in any case exceeded 0·7 of a grain per imperial gallon of water, while in the East London water it was very little more than half a grain per gallon, and in the Kent water it was only 0·03 of a grain per gallon. The total amount of saline matter in the water derived from the Thames is a little more than it was last month, but that of the other companies is a little less.

Metropolitan Sewage Irrigation.—As we have persistently advocated the scheme for carrying the metropolitan sewage to the Maplin Sands, we have much pleasure in recording the perfect success of a preliminary experiment. The directors caused upwards of 3000 tons of the sand to be brought to the neighbourhood of the outfall reservoir at Barking-creek, and spread it out two feet deep on an acre of land in March last. It was sown with Italian rye grass on April 14 and irrigated with the sewage. Grass cut on July 17, and of only 27 days' growth, represented 14 tons to the acre. Another portion cut before that date represented even a greater weight. We hope this proved success will lead to a very extensive application of the sewage to the grass lands of Essex.

The Welsh Diggings.—Some three or four years since it was generally believed that the auriferous quartz deposits of Wales could be worked to advantage, and that the quantity of gold that could be extracted would prove sufficient to make handsome profits. The temporary success of the Vigra and Clogau mines gave colour to this opinion, and the promoters of gold-mining companies found but little difficulty in inducing the public to subscribe to their projects without anything like a reliable inspection of the properties offered having been previously made. The new mines were vigorously worked for a time, but it was soon discovered that the quartz did not yield sufficient gold to make its working profitable. The quantity of gold raised in the whole of Wales during the year 1861 reached 2886 oz.; in 1862, 5299 oz.; in 1863, 552 oz.; in 1864, 2333 oz.; and in 1865, 1664 oz. The large decrease here shown indicates that gold mining is on the wane in the Principality, and the mines that continue to be worked give little hope of any increase in the returns. The general opinion prevails that until the inventive genius of the nation has produced a more perfect and economical means of production than is at present in use, Welsh quartz, although containing slight traces of the precious metal, will not be worked with profit.

[We take the above from the *Times* of Tuesday last. We have good grounds for stating that many of the gold mines in Wales which are now unworked, or worked at a loss, would at once pay a profit were the sodium process of amalgamation introduced.—W. C.]

British Association.—The meeting at Nottingham will leave many pleasant recollections in the minds of the members. The attendance was beyond the average, being greater than at Birmingham last year, though considerably below the number of Bath and far below the attendance at Newcastle. Still, numerically, the meeting must be considered a success. The attendance, we have no doubt, would have been larger but for the exorbitant price demanded for accommodation in the town. The lodging question is one to which we would call the attention of all future local committees, as of primary importance. As a rule, we may say without offence, the members of the British Association are not rich; and it would be well if the local committees could prevail upon their fellow-townspeople to agree to a tariff of reasonable charges suited to the accommodation offered. Quitting this disagreeable part of the subject, we may notice with the utmost cordiality the munificent public hospitality displayed on the occasion, which almost effaces all recollection of private greed. The *soirées* were great successes. It would be impossible, in the short space we can devote to the matter, to give anything like an adequate description of these entertainments, or to enumerate a tithe of the objects of interest displayed. They gave unbounded satisfaction to all present, except perhaps to Mr. Ladd's assistant, who so narrowly escaped a dangerous wound at one. The excursions were admirably varied to suit all tastes, and gave the utmost pleasure. Newstead Abbey and Belvoir Castle, Charnwood Forest, the Peak Cavern and Matlock, and the Derby Railway Works in turn delighted romanticists, geologists, and mechanists. If the truth must be told, the scientific results were but small, and it can hardly be said that the scientific interest of the meetings increases. We are somewhat inclined to the opinion of an evening contemporary that the Association needs an editor or editors, if these meetings are not to be allowed to degenerate into opportunities for advertising small inventions and trotting out scientific hobbies. But, due allowance being made for these perhaps unavoidable drawbacks, enough remains in such meetings as this held at Nottingham to attract people really devoted to science, while the educational and stimulating influence of the gatherings is beyond all question. We must most heartily thank the people of Nottingham for their hospitable reception, and wish for the Association a continuance of such successes.

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.

Chemicus.—See Dr. Faraday's paper in the *Philosophical Transactions.*

D. J. O.—The amount varies with every sample of naphtha. The operation must be repeated once or twice.

J. C. B.—Several courses are given in the evening by public and private teachers. See our advertising columns.

J. B.—Sprinkle with dilute aqueous carbolic acid.

FORECASTS OF THE WEATHER.

Attentive readers of the morning papers have missed for some time past the paragraph in the meteorological report which told the probable state of the weather for the next succeeding day. They will doubtless be glad to learn that there is every likelihood of these forecasts soon being resumed. Upon the death of the late Admiral Fitzroy, the forecasts, which had been brought to a condition of tolerable certainty by his unremitting exertions, were discontinued, and a correspondence took place between the Board of Trade and the Royal Society with respect to the Meteorological Department. The result of that correspondence was the appointment of a committee to consider and report upon the following questions:—

1. What are the data, especially as regards meteorological observations at sea, already collected by, and now existing in, the Meteorological Department of the Board of Trade?

2. Whether any, and what, steps should be taken for arranging, tabulating, publishing, or otherwise making use of such data.

3. Whether it is desirable to continue meteorological observations at sea, and if so, to what extent, and in what manner.

4. Assuming that the system of weather telegraphy is to be continued, can the mode of carrying it on and publishing the results be improved?

5. What staff will be necessary for the above purposes?

The Report of the Committee has now been published, and the authors of the Report arrive at the following conclusions in respect to the ocean statistics, weather telegraphy, foretelling weather, and observations affecting weather in the British Isles:—

"The collection of observations from the captains of ships is a function which can probably best be performed through the medium of such agencies as a Government Office can command, and which was in fact well performed by the Meteorological Department before its attention was devoted to the practice of foretelling weather. We assume, therefore, that this function will remain with the Board of Trade.

"The digesting and tabulating results of observations is, on the other hand, a function which requires a large knowledge of what the state of the science for the time being requires, as well as exact scientific method.

"This function is one that has not been satisfactorily performed by the Meteorological Department. And we believe that it would be much better, as well as more economically, performed under the direction of a scientific body—such as a Committee of the Royal Society, or of the British Association, if furnished with the requisite funds by the Government—than it will be if left to a Government Department. The establishment already existing at Kew might probably be easily developed, so as to carry into effect such a purpose. It would in that case become a meteorological centre, to which all observations of value (by British observers), whether made on land or at sea, and whether within the British Isles or not, would be sent for discussion and reduction. We have, therefore, in the following estimates, assumed that all meteorological observations made on land, whether at the stations recommended by the Royal Society, or at the lighthouses or coast-guard stations, as well as all observations at sea, shall be referred to and discussed under the direction of such a scientific body as we have mentioned; and we have also assumed that the aid afforded by Government would be in the shape of an annual vote, so made as to leave the Royal Society, or other scientific body charged with the duty, perfectly free in their method and in their choice of labour, but upon the condition that an account shall be rendered to Parliament of the money spent, and of the results effected in each year."

This Report has been communicated to the members of the Kew Committee of the British Association, and from the Report of the Kew Committee just issued, we find that they cordially acquiesce in the conclusions of its authors. They consider the proposed arrangement to fall within the competence of the Kew Observatory.

In the last Kew Report it was stated that many experiments and observations of a nature to advance science were made by the Committee under the sanction of the Association, the cost of each being defrayed by the promoters.

The Committee consider that the suggested observations contained in the Government Report which has been referred to, would be merely an extension of the usual practice of the Observatory; but in consideration of the magnitude of the work proposed, they suggest that the Council should bring the subject before the General Committee, with the view of the Kew Committee being authorised to discuss and make the necessary arrangements with the Board of Trade, should any proposal be made.

In reference to this subject the President of the British Association made some very appropriate remarks in his inaugural address. To assert, he said, that the great departments of Government should encourage physical science might appear a truism, and yet it is but of late that it has been seriously done; now the habit of consulting men of science on important questions of national interest was becoming a recognised practice, and in a time, which may seem long to individuals, but is short in the history of a nation, a more definite sphere of usefulness for national purposes would, he had no doubt, be provided for those duly qualified men who might be content to give up the more tempting study of abstract science for that of its practical applications. In this respect the Report of the Kew Committee for this year afforded a subject of congratulation to those whom he had the honour to address. The Kew Observatory, the petted child of the British Association, might possibly become an important national establishment; and if so, while it would not, he trusted, lose its character of a home for untrammelled physical research, it would have superadded to it the Meteorological Department of the Board of Trade, with a staff of skilful and experienced observers.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Accumulation of the Nitrogen of Manure in the Soil, by J. B. Lawes, *F.R.S., F.C.S., and Dr.* J. H. Gilbert, *F.R.S., F.C.S.**

The authors had been engaged for many years in experiments, in the course of which they had grown wheat year after year on the same land for more than twenty years; on some portions without any manure, and on others with farmyard manure, or with various descriptions of manure. They had published the results obtained in the field during the first twenty years of these experiments, and they were now engaged in investigating

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* British Association, Nottingham—Section B.

the composition of the produce grown under the different conditions, and also the comparative composition of the soils of the different plots as affected by the various treatment. The point to which they chiefly confined attention on the present occasion was the accumulation, and the loss, of the nitrogen which had been supplied in the manure, and not recovered in the increase of crop. After discussing the difficulties of sampling, preparing for analysis, and analysing soils, in such manner as to yield results applicable to the purposes of their inquiry, and describing the methods they had adopted, they called attention to the results obtained, which were exhibited in several tables hung up in the room. The percentages of nitrogen determinable by burning with soda lime were given for the soil of the first, of the second, and the third nine inches, of eleven differently-manured plots, showing the amounts, therefore, to the depth of twenty-seven inches in all. In some cases the accumulation from the residue of manuring was very considerable; but even with the same amount supplied, it varied, both in total amount and in distribution, according to circumstances; the depth to which the unused supply had penetrated being apparently influenced by the character and amount of the associated manurial constituents. The general result was, that although a considerable amount of the nitrogen of the supplied manure which had not been recovered as increase of crop was shown to remain in the soil, still a larger amount was as yet unaccounted for. Initiative results indicated that some existed as nitric acid in the soil, but it was believed that the amount so existing would prove to be but small. In fact it was concluded that a considerably larger portion would remain entirely unaccounted for in the soil than was there traceable, and the probability was that at any rate much of this had passed off into the drains, or into the lower strata of the soil. Finally, it was shown, by reference to field results, that there was not more than one or two bushels of increase in the wheat crop per acre per annum, due to the large accumulated residue of nitrogen in the soil, notwithstanding its amount was many times greater than that which would yield an increase of twenty bushels or more, if applied afresh to soil otherwise in the same condition. On the other hand, it was shown that the effect of an accumulated residue of certain mineral constituents was not only very considerable in degree, but very lasting.

On the Ammonium Amalgam, by F. S. PFEIL *and* HENRY LEFFMAN.

FOR some years the attention of chemists has been directed to the investigation of the substitution ammoniums. Notwithstanding their close analogy to ammonium itself in many respects, we have not been able to find record of any systematic attempt to form amalgams analogous to the well-known ammonium amalgam. The consideration of this fact induced us to commence a series of experiments to determine the deportment of these bodies with sodium amalgam.

A saturated solution of chloride of trimethyl-ammonium was treated with sodium amalgam, and a series of phenomena followed, exactly identical with those which occur in the preparation of the ammonium amalgam. The swelling rapidly subsided, hydrogen gas being given off, and the liquid was found to contain trimethylamine.

Saturated solutions of the chlorohydrates of aniline, conine, morphine, and quinine, and of the acetate of rosaniline, when treated with sodium amalgam, give rise to copious evolution of hydrogen gas, without turgescence.

These experiments (in addition to those recorded by Dr. C. Wetherill) seem to indicate that the physical phenomena of the ammonium amalgam depend entirely upon the retention of gas bubbles, and also that those ammonias which in the free state are, at ordinary temperatures, either liquid or solid, produce no amalgam.

It may be mentioned that a solution of chloride of ammonium in pure glycerine gives rise to an amalgam, but the turgescence is much interfered with by the viscosity of the solvent; and also that sodium amalgam, when placed upon a crystal of chloride of ammonium, produced no reaction until moistened with a drop of water.—*American Journal of Science*, vol. xlii., No. 124.

PHARMACY, TOXICOLOGY, &c.

*On the Results of the Micro-chemical Examination of Extract of Flesh,** *by* H. DEANE, *F.L.S., and* H. B. BRADY, *F.L.S.*

SINCE the introduction of the so-called "extractum carnis" of Liebig, so sudden and unexpected a demand has sprung up for concentrated preparations of flesh, that they have become, or are likely to become, an important article of export from those portions of the world where the value of cattle is small, and means of transport easily available.

As there are few chemical operations requiring greater nicety of manipulation than those in which the unstable compounds constituting or contained in animal tissues are concerned, and as the manufacture of the extract must necessarily be subject to variation from this cause, it becomes a matter of importance that we should possess some means of estimating, with a certain amount of accuracy, the relative value of samples which may occur to us. In addition to this, the high value of the article presents an obvious inducement to manufacturers to make their product as large as possible and thereby to increase the average profit upon it.

Having in previous years presented to the Conference some notes on a method which we have been in the habit of employing in our researches on other extractives, we propose on the present occasion to offer the results of experiments which we have been engaged upon during the last fifteen months, on the micro-chemical characters of extract of flesh.

We may repeat in general terms that the microscope may be made use of with advantage in the examination of almost any extract, or solution containing extractive matter, in which the active or valuable portion assumes on inspissation a crystalline form. The fewer the active constituents and the more characteristic their crystalline forms, the more readily are they recognised and their relative proportions determined. Not only does the non-crystallisable extractive matter itself afford no drawback to the applicability of the process, but in many cases it really facilitates the separation of the crystalline constituents on evaporation. The number of active bodies which exist in large proportion in vegetable and, we may add, in animal extracts, so soluble as to remain in an uncrystallised state on the evaporation of a large quantity of solution to a nearly solid condition, is exceedingly limited, and even these may be detected, as we shall presently show, by an after process. The one essential in the practical application of this method of determining the relative values of a series of specimens is, that we shall understand clearly what appearances

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* Read before the Pharmaceutical Conference, Nottingham meeting.

the preparation ought to exhibit, and be able to identify the different crystalline bodies in the mixed condition in which they present themselves to our notice. It is not sufficient that we should know merely the forms and crystalline characters of the pure salts and principles, but we must also ascertain in how far the presence of extractive or viscid matters may influence their mode of separation. It is obvious that nothing but the most careful investigation of the appearances of specimens whose value has been otherwise determined will serve as a groundwork whereon to base our conclusions. The plan we have adopted in the investigations about to be detailed has been almost identical with that pursued with reference to preparations of opium, &c.—that is to say, portions of the various extracts have been either mounted for the microscope in the condition in which they are found in commerce, or reduced to a syrupy consistence with hot water placed on the glass while still warm, and allowed to stand until crystals were fully formed. In some instances other menstrua than water were used for the better determination of the crystalline matters. We have also taken advantage of Professor Graham's process of dialysis to determine the relative proportion of crystalline and extractive matters.

The samples of extract of flesh on which observations have been made are as follows:—

1. and 2. Specimens made by ourselves as standards whereby to judge the rest. One of these was made by cold water, the other with water heated to 160° Fahr. Both were prepared from the finest quality of English beef which could be procured, and on a sufficiently large scale to insure a practical value to the result.

3. A specimen prepared in the Royal Pharmacy at Munich, kindly given to one of us by Professor Pettenkofer, on a recent visit to that city. This we look upon as having the seal of official sanction.

4. The South American extract, prepared by Herr Gierbert, and sold with the approval of Baron Liebig.

5. A portion of that at present being imported from Australia.

6. The extract prepared by our friend Mr. Reynolds, from English meat.

7. That supplied by Messrs. Gillon, of Leith.

8. The so-called extract of meat lozenges, introduced by the same firm.

We propose to offer a few remarks on the general characters of these extracts before proceeding to describe in detail their microscopic appearances.

1. Our own cold water extract was prepared by simply macerating carefully selected lean meat, cut very small, in water at 60° Fahr. for twelve hours, and evaporating the liquid obtained, at a temperature considerably below the boiling-point, to the consistence of a soft extract. This was purely an experiment made for the purpose of future reference, and as the amount of extract obtained did not exceed two per cent. on the meat employed, it obviously could never answer in a commercial point of view, the cost being nearly 34s. per pound for the flesh only, without any allowance for fuel and labour. The resulting extract is light-coloured, very fragrant, readily soluble, giving a pale solution of the purest flavour, and highly hygroscopic in damp weather.

2. Our hot-water extract was prepared similarly by maceration, firstly, in cold water for twelve hours, the whole then being transferred to a water-bath heated by steam, the temperature gradually raised to 160° Fahr., the fluid strained off while still hot, and evaporated carefully as before. The product is perceptibly different from the former, being somewhat darker in colour, and containing a small but sensible proportion of gelatinous matter. The flavour and odour were similarly unexceptionable, and the tendency to absorb moisture nearly as great as in the former sample. The weight of the product bore the relation of about three per cent. to the meat employed.

3. Professor Pettenkofer's sample was prepared according to the Bavarian Pharmacopœia process, and when we first obtained it, it was very similar in colour and flavour to our own hot-water extract.

4. The South American preparation was a fair sample of what is at best a somewhat variable article. The colour is darker than our own, the amount of gelatine notably larger, and neither the smell nor taste at all equal to those above enumerated.

5. The only sample imported from Australia which we have at present seen is similar to the South American, but not equal to it in point of flavour and colour, having a muddy appearance, and contains, as we shall presently have to observe, a large proportion of gelatinous matter.

6. That prepared by Messrs. Harvey and Reynolds is in point of flavour and general character very similar to the specimen we have described from Munich, and leaves little to be desired as a commercial article.

7. Messrs. Gillon and Co.'s extract is worthy of note as a fairly satisfactory sample, but we have been somewhat disappointed in its microscopical reactions.

8. The extract of meat lozenges we have little to say about, further than what was stated at the last meeting of Conference by one of us, though we shall adduce afterwards some confirmatory observations.

In making these remarks it is our object not to intrude commercial or personal considerations, nor, further than is necessary with a scientific end, to institute comparisons between the various manufacturers. The names of the two British houses which we have introduced have been selected as producing samples of excellence —a number of other specimens of home manufacture which have come under our notice of varying degrees of goodness or badness being omitted, inasmuch as no good end would be answered by criticism upon them.

We may now proceed to consider the chemical constituents of flesh extract, and these may be classed under two heads, inorganic and organic. The inorganic matter consists of alkaline (or earthy?) phosphates and chlorides, principally phosphate of potash and chloride of potassium. If phosphate of magnesia be present, as stated by some authors, we believe it to exist in extremely small proportions, though it is quite possible that ammonia may occur as the base of a phosphoric acid compound. The organic portions of the extract exist as kreatine, possibly kreatinine, and the colloid or gelatinous extractive. Lactic acid probably exists in some proportion in combination with one or other of the bases referred to. We shall confine our attention to such of the salts and principles we have above named whose presence may be readily recognised, and may be regarded as essential constituents of a well-made extract, especially to phosphate of potash, chloride of potassium, kreatine, and colloids.

Acid orthophosphate of potash (tribasic)

$$PO_5\left\{\begin{matrix}KO\\2HO\end{matrix}\right.$$

is readily soluble in water, insoluble in alcohol, the crystals taking the form of prisms with obliquely wedge-shaped ends, together with modifications of that form. It is a beautiful object under the microscope, and most brilliant when viewed by polarised light.

Chloride of potassium (KCl) exists in considerable quantities in extractum carnis, but from its extreme solubility in water is never conspicuous in microscopic preparations of the extract itself.

In order to observe the influence of extractive matter on the mode in which the crystals are deposited, a small quantity of vegetable extractive was added to a saturated alcoholic solution of the chloride, which was then allowed to evaporate spontaneously. The characters of the crystals under the different conditions are remarkably uniform, varying chiefly in size.

It is more soluble in water than common salt, scarcely at all soluble in absolute alcohol.

It crystallises in cubes, often prismatically elongated when formed slowly, but when more rapidly deposited on glass from a thin film of water, it takes the form of minute square plates, commonly aggregating in fours, or spreading into arborescent groups.

Belonging to the cubical system, it is not affected by polarised light, and may thus be distinguished from the phosphates, kreatine, and the other organic salts of extractum carnis.

Kreatine ($C_8N_3H_9O_4+2HO$) is one of the most abundant, as it is certainly the most important, of the crystalline bodies present in meat extract, so far as our knowledge at present extends. In the pure state it exists in prismatic crystals, modified variously into rectangular plates and parallelopipeds (?).

It is a neutral base, soluble in hot water, less so in cold, and sparingly soluble in alcohol. The appearance of the crystals, when viewed with polarised light, is remarkably beautiful.

Another crystalline body was observed by us, the nature of which we have not entirely made out. A portion of the meat solution made with cold water having been evaporated to the consistence of weak syrup was allowed to stand for about thirty-six hours in a porcelain basin. On removing it the surface of the porcelain was found coated with adherent, rather solid crystals, which on examination were found similar in many respects to kreatine, but differing somewhat from any specimens of that base which we have seen. Whether these be kreatine modified by the nature of the medium from which they are deposited, or whether, as we think possible, kreatinine in combination with an acid (phosphoric ?), we are scarcely prepared to say. On ignition the crystals left a scarcely perceptible residue, but as the quantity obtained was not sufficient for analysis, we have not thought it worth while to figure the salt.

The question of the existence of ammoniacal salts in the juice of flesh is one upon which we are not prepared to enter; we may, however, incidentally note that in a certain state of the evaporation—that is, at about the time when the fluid reaches the consistence of syrup—a certain amount of ammonia or other amines is invariably evolved, and the osmazome (roast meat) flavour is developed. We have thought it possible that this may be due to the splitting up of an ammoniacal phosphate. It is somewhat remarkable that during this evolution the fluid itself preserves an acid reaction.

We have endeavoured, by means of Professor Graham's process of dialysis, to determine the relative proportion of crystalloid and colloid bodies present in some of the samples operated upon. How much these may vary may be gathered from our notes on two of the specimens named. 250 grains of our preparation made with cold water yielded 18·58 grains of colloid, about 7½ per cent. of the whole weight. It is right to state that that prepared with hot water contained a much larger proportion. The Australian extract yielded from 250 grains no less than 97 grains, or nearly 39 per cent. of colloids. As these represent two extremes in quality, and our other experiments correspond with the indication they give, we may justly infer that dialysis affords a fair means of ascertaining the proximate value of commercial extracts. The diffusate on evaporation yielded a light brown residue on evaporation, which was a completely solid mass of crystals.

To obtain a further clue to the nature of the crystalloids, as they appear under the microscope, and in some measure to separate them, we have taken advantage of the different solubilities of the salts in alcohol. Portions of several of the extracts were digested in strong alcohol for some weeks, the alcoholic solutions decanted and evaporated to extract consistence. The remarkable differences which presented themselves in the various examples we shall have occasion to comment upon.

We look upon this, or indeed upon any other process by which the separation in any degree of one principle from another can be effected, as a most important matter, for the resemblance between the crystalline forms of some of the constituents proper to well-prepared extracts is so great as to make it at times a matter of extreme difficulty, depending even more upon experience and judgment than upon actual chemical data, to discriminate with certainty amongst them. We need not wish a better instance of this ambiguity than that afforded by the two most important constituents of ext. carnis, namely, kreatine and phosphate of potash. It would be exceedingly difficult to describe the forms assumed by these two bodies in their various modifications, in terms which would not apply almost equally to either; and though a little practice and observation would enable a microscopist to distinguish between them in most cases, we can scarcely help feeling the want of some more positive, if it be only to carry conviction to others. We have, since the greater portion of this paper was written, accidentally alighted upon a fact which may possibly be of value in this way. About a year ago, to avoid some trifling difficulties of manipulation, subsequently overcome by other means, we mounted a series of specimens of extract, having previously mixed them with a little pure glycerine, and set them aside without much intention of again referring to them; we have, however, on examining them, obtained an item of knowledge which may be of considerable service. The appearance the slides now present is that of an even film of brown extractive with a few large crystals here and there, evidently all of them of the same chemical nature. By subsequent experiment we have found that kreatine is soluble to a considerable extent in glycerine, and we therefore conclude the crystals in question to be those of phosphate of potash. Want of time has prevented our experimenting further in this direction, but the subject merits the attention of future observers.

We are now in position to speak of the actual appearances under the microscope of some of the specimens we have examined.

The conclusions to be drawn from our observations are as follows:—First, that, premising an accurate knowledge has been first obtained of the nature of the appearances of a reliable sample, the microscope does afford a ready means of ascertaining proximately the value of extractum carnis—the sensible characters, such as colour, taste, and odour, having been, as a matter of course, considered in the first place, and due weight assigned to them.

Secondly, that the value of a sample is in direct relationship to its crystalloids, and inversely to its colloid constituents, and these may be separated by the process of dialysis. In connexion with this we may state that the hygroscopic properties of the extract bear some relation to the amount of crystalloids contained in the samples, as we have found the specimens containing the most gelatinous matter keep their consistence best when freely exposed to the air; but of course the rate of deliquescence depends on the state of the atmosphere.

Finally, we must acknowledge the kind assistance of Dr. Attfield while making our experiments in dialysis, and of our friend Mr. A. Freire-Marreco for many hints in connexion with the purely chemical part of the subject.

On the Spirit Value of a few Purchased Tinctures, by* JOHN ATTFIELD, *Ph.D., F.C.S., Director of the Laboratory of the Pharmaceutical Society.*

THE value of the spirit in a specimen of a tincture or other spirituous preparation depends upon the nature and amount of that spirit. The standard of excellence in this respect is, for us, the British Pharmacopœia. According to that book, every tincture should be made with spirit composed of pure ethylic alcohol and water, either in the proportion of eighty-four parts, by weight, of the former, to sixteen of the latter (rectified spirit), or of forty-nine parts of the alcohol to fifty-one of the water (proof spirit). The spirit containing 16 per cent. of water is a common article of commerce; that containing 49 per cent. of water is ordered to be made by mixing one hundred volumes of the strong spirit with sixty of pure distilled water. These, at all events, are the proportions of spirit and water with which the proof-spirit tinctures of the British Pharmacopœia are directed to be made. But there can obviously be no objection to making proof-spirit by diluting with water rectified spirit of any other strength than that just referred to—than the "sixty over proof" (60° O.P.), as it is commonly and very conveniently termed. Thus, one hundred fluid ounces of a spirit of "seventy over proof" may have seventy ounces of water added, or the same quantity of a spirit of "fifty over proof" may have fifty ounces added. In either or any other similar case the result will be the true proof-spirit of the British Pharmacopœia. These statements may appear trite, but they are made to show that there can be no excuse for the manufacture of tinctures of inferior spirituous strength, a practice which, it is to be feared, is but too common. Of twelve specimens of proof-spirit tinctures recently purchased in different parts of the country and sent to me for examination, not one contained the right proportion of spirit. On being distilled to dryness, they all furnished distillates having specific gravities below that of proof-spirit. The following table shows the strength of each specimen as indicated by the above process:—

Name of tincture.	Initials of vendor.	Quantity sold for 4d.	Alcohol in 100 parts.
"Tincture of rhubarb"	B. & M.	1 fl. oz.	41·
,, ,,	P. W.	1 ,,	36·5
,, ,,	E. C. L.	2 ,,	44·5
"Laudanum"	P. W.	1¼ ,,	33·5
,,	J. Al.	1¼ ,,	41·
,,	B. & M.	1¼ ,,	34·
,,	H. & Q.	2 ,,	34·
,,	J.		41·
"Paregoric elixir"	B. & M.	1½ ,,	39·
,, ,,	P. W.	1½ ,,	45·5
"Paregoric elixir"	E. C. L.	1½ ,,	39·
,, ,,	J. Al.	2 ,,	45·5
Proof spirit, B. P.			49·
Rectified spirit, B. P.			84·

From this table it is evident that only three of the twelve contained an amount of alcohol even approaching that of proof-spirit. And even those, instead of 49 per cent., contained but 44½, and two 45½. Five varied from 39 to 41 per cent. The remaining four contained only 36½, two 34 and 33½ respectively.

In confirmation of the evidence afforded by the above figures, that the weaker tinctures are frequently made with spirit of inferior strength, several makers have admitted to me that they always mix their rectified spirit and water in the proportion of five to four, a few five to five. One of the latter actually seemed to be under the impression that rectified spirit was the same thing as alcohol, and that as proof-spirit contained forty-nine of alcohol to fifty-one of water, he only saved a little trouble, and at the same time gave the public a slight benefit, by mixing fifty with fifty, "half-and-half" as he termed it. It had not occurred to this individual that in adding (say) fifty fluid ounces of rectified spirit to the same quantity of water, he was mixing only forty-two ounces, by weight, of the spirit, with fifty ounces, by weight, of water; and that, moreover, the said spirit already containing six and three-quarter ounces of water, his ninety-two ounces, by weight, of mixture only contained about thirty-five ounces, by weight, of alcohol; that, in short, instead of having a diluted spirit containing 50 or even 49 per cent. of alcohol, he was using one containing only about 38 (38·3), and this in the face of the plain statement of the Pharmacopœia that proof-spirit is made from rectified spirit and water in the proportion of five pints to three.

With regard to the nature of the alcohol in these specimens of tinctures, it was in nine cases purely ethylic; the other three contained methylic alcohol. The presence of the latter was indicated by Tuck's iodohydrargyride of potassium, confirmed by Miller's oxidation tests. The three methylated tinctures came from one shop, that of P. W. It is unnecessary to make any remark concerning these three adulterated preparations; the extensive use of methylated spirit in the manufacture of tinctures is well known, the determination of the Legislature to stop the practice will probably be soon equally well known.

The price at which these tinctures were supplied, varies, surely, to an unnecessary extent? Two appear to have been sold at the rate of fourpence per ounce, three at about threepence, three at about twopence halfpenny, and three at twopence per ounce. I have before me a retail price list, published in 1865, apparently, by an important and influential "Committee," but having no name, address, or other distinguishing mark, except a trade price one —"MEL BORACIS," in which laudanum is marked at sixpence per ounce, and paregoric and tincture of rhubarb each at fivepence per ounce. The laudanum of the above specimens was only twopence or threepence per ounce, the paregoric twopence or twopence halfpenny, and the tincture of rhubarb twopence per ounce in one case, and fourpence in the others. Knowing but little of such matters, I would simply draw the attention of chemists and druggists to this point; manifestly, however, great inconsistency exists.

In conclusion, I would remark, that the results of the examination of these tinctures must not be taken as indicating the general practice of the trade concerning

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* Read before the Pharmaceutical Conference, Nottingham meeting.

the manufacture and sale of such preparations. Pharmacies could be mentioned in which only spirit of the officinal strength and quality is used, and where fairly remunerative prices for articles of best quality are readily obtained. It would be equally unfair, however, to name the vendors of good, as of bad articles, mere accident bringing their wares under my notice. Doubtless the honest or fortunate are not more honest or fortunate, nor the dishonest or unfortunate more dishonest or unfortunate, than hundreds of their brethren whose preparations do not chance to come under the scrutiny of the analyst.

17, Bloomsbury Square, London.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION.

Friday, June 8, 1866.

On the Source of Muscular Power, by Edward Frankland, *Ph.D., F.R.S., Professor of Chemistry, R.I.*

What is the source of muscular power? Twenty years ago, if this question had been asked, there were but few philosophers who would have hesitated to reply, "The source of muscular power is that peculiar force which is developed by living animals, and which we term the vital force;" but the progress of scientific discovery has rendered the view implied in such an answer so utterly untenable that, at the present moment, no one possessing any knowledge of physical science would venture to return such a reply. We now know that an animal, however high its organisation may be, can no more generate an amount of force capable of moving a grain of sand, than a stone can fall upwards or a locomotive drive a train without fuel. All that such an animal can do is to liberate that store of force, or potential energy, which is locked up in its food. It is the chemical change which food suffers in the body of an animal that liberates the previously pent-up forces of that food, which now make their appearance in the form of actual energy—as heat and mechanical motion.

From food, and food alone, comes the matter of which the animal body is built up; and from food alone come all the different kinds of physical force which an animal is capable of manifesting.

The two chief forms of force thus manifested are heat and muscular motion or mechanical work, and these have been almost universally traced to two distinct sources—the heat to the oxidation of the food, and the mechanical work to the oxidation of the muscles.

This doctrine, first promulgated, the speaker believed, by Liebig, occupies a prominent position in that philosopher's justly celebrated "Chemico-Physiological Essays."

In his work entitled "Die organische Chemie in ihrer Anwendung auf Physiologie und Pathologie" (Brunswick, 1842), Liebig says, "All experience teaches that there is only one source of mechanical power in the organism, and this source is the transformation of the living parts of the body into lifeless compounds. This transformation occurs in consequence of the combination of oxygen with the substance of the living parts of the body." And again, in his "Letters on Chemistry" (1851, p. 366), referring to these living parts of the body, he says, "All these organised tissues, all the parts which in any way manifest force in the body are derived from the albumen of the blood; all the albumen of the blood is derived from the plastic or sanguineous constituents of the food, whether animal or vegetable. It is clear, therefore, that the plastic constituents of food, the ultimate source of which is the vegetable kingdom, are the conditions essential to all production or manifestation of force, to all these effects which the animal organism produces by means of its organs of sense, thought, and motion." And again, at page 374, he says, "The sulphurised and nitrogenous constituents of food determine the continuance of the manifestations of force; the non-nitrogenous serve to produce heat. The former are the builders of organs and organised structures, and the producers of force; the latter support the respiratory process, they are materials for respiration."

This doctrine has since been treated as an almost self-evident truth in most physiological text-books; it has been quite recently supported by Ranke;[*] and, in his lecture "On the Food of Man in relation to his Useful Work," 1865, Playfair says, page 37, "From the considerations which have preceded, we consider Liebig amply justified in viewing the non-nitrogenous portions of food as mere heat-givers; . . while we have been led to the conclusion that the transformation of the tissues is the source of dynamical power in the animal." At page 30 he also says, "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. . . All these facts prove that transformation of the muscle through the agency of oxygen is the condition of muscular action." Finally, in a masterly review of the present relations of chemistry to animal life, published in March last,[†] Odling says, page 98, "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 this oxidation." And again, page 103, "The slow oxidation of so much carbon and hydrogen in the human body, therefore, will always produce its due amount of heat, or an equivalent in some other form of energy; for while the latent force liberated by 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."

Nevertheless, this view of the origin of muscular power has not escaped challenge. Immediately after its first promulgation, Dr. J. R. Mayer wrote,[‡] "A muscle is only an apparatus by means of which the transformation of force is effected, but it is not the material by the chemical change of which mechanical work is produced." He showed that the 15 lbs. of dry muscles of a man weighing 150 lbs. would, if their mechanical work were due to their chemical change, be completely oxidised in 80 days, the heart itself in 8 days, and the ventricles of the heart in 2½ days. After endeavouring to prove by physiological arguments that not one per cent. of the oxygen absorbed in the lungs could possibly come into contact with the substance of the muscles, Mayer says, "The fire-place in which this combustion goes on is the interior of the blood-vessels; the blood, however—a slowly burning liquid—is the oil in the flame of life. . . Just as a plant-leaf transforms a given mechanical effect, light, into another force, chemical difference, so does the muscle produce mechanical work at the cost of the chemical difference consumed in its capillaries. Heat can neither replace the sun's rays for the plant, nor the chemical process in the animal; every act of motion in an animal is attended by the consumption of oxygen and the production of carbonic acid and water; every muscle to which atmospheric oxygen does not gain access ceases to perform its functions."

But Mayer was not the first to conceive this view of muscular action. Nearly 200 years ago, a Bath physician, Dr. John Mayow,[§] distinctly stated that for the production of muscular motion two things are necessary—the conveyance of combustible substances to the muscle by

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[*] "Tetanus eine physiologische Studie." Leipzig: 1865.

[†] "Lectures on Animal Chemistry."

[‡] "Die organische Bewegung in ihrem Zusammenhange mit dem Stoffwechsel." 1845.

[§] "De Motu musculari." 1681. Mayow was born in 1645, and died 1679.

the blood, and the access of oxygen by respiration. He concluded that the chief combustible substance so used was fat. A century before Priestley isolated oxygen, Mayow was aware of its existence in the air, in nitre, and in nitric acid; he knew that combustion is supported by the oxygen of the air, and that this gas is absorbed in the lungs by the blood, and is absolutely necessary for muscular activity.

For two decades this doctrine sank into oblivion; and it is only within the last two years that it has been again advanced, chiefly by Haidenhain,[‖] Traube, and, to a limited extent, by Donders.[¶]

Experimental evidence was, however, still wanting to give permanent vitality to the resuscitated doctrine; for although the laborious and remarkable investigations of Voit[**] and of Edward Smith[††] point unmistakably in the direction of Mayow and Mayer's hypothesis, yet the results of these physiologists were not sufficiently conclusive to render the opposite view untenable. This want of data of a sufficiently conclusive character has been supplied by a happily conceived experiment undertaken by Fick and Wislicenus in the autumn of last year, and described in the *Philosophical Magazine*, vol. xxxi. p. 485. In the application of these data, however, to the problem now under consideration, one important link was found to be wanting, viz., the amount of actual energy generated by the oxidation of a given weight of muscle in the human body. Fick and Wislicenus refer to this missing link in the following words:—"The question now arises what quantity of heat is generated when muscle is burnt to the products in which its constituent elements leave the human body through the lungs and kidneys. At present, unfortunately, there are not the experimental data required to give an accurate answer to this important question, for neither the heat of combustion of muscle nor of the nitrogenous residue (urea) of muscle is known." Owing to the want of these data, the numerical results of the experiment of Fick and Wislicenus are rendered less conclusive against the hypothesis of muscle combustion than they otherwise would have been, whilst similar determinations, which have been made by Edward Smith, Haughton, Playfair, and others, are even liable to a total misinterpretation from the same cause.

The speaker stated that he had supplied this want by the calorimetrical determination of the actual energy evolved by the combustion of muscle and of urea in oxygen. Availing himself of these data, he then proceeded to the consideration of the problem to be solved, the present condition of which might be thus summed up:—It is agreed on all hands that muscular power is derived exclusively from the mutual chemical action of the food and atmospheric oxygen; but opinions differ as to whether that food must first be converted into the actual organised substance of the muscle, before its oxidation can give rise to mechanical force, or whether it is not also possible that muscular work may be derived from the oxidation of the food, which has only arrived at the condition of blood and not of organised muscular tissue.

The importance of this problem can scarcely be overrated; it is a corner-stone of the physiological edifice, and the key to the phenomena of the nutrition of animals. For its satisfactory solution the following data require to be determined:—

1st. The amount of force or actual energy generated by the oxidation of a given amount of muscle in the body.

2nd. The amount of mechanical force exerted by the muscles of the body during a given time.

3rd. The quantity of muscle oxidised in the body during the same time.

If the total amount of force involved in muscular action, as measured by the mechanical work performed, be greater than that which could possibly be generated by the quantity of muscle oxidised during the same time, it necessarily follows that the power of the muscles is not derived exclusively from the oxidation of their own substance.

As regards the first datum to be determined, it is necessary to agree upon some unit for the measurement of mechanical force. The unit most commonly adopted is that represented by the lifting of a kilogram weight to the height of one metre. The researches of Joule and Mayer have connected this standard unit with heat;—they prove that the force required to elevate this weight 425 times will, when converted into heat, raise the temperature of an equal weight of water 1° C. If this weight were let fall from a height of 425 metres, its collision with the earth would produce an amount of heat sufficient to raise the temperature of 1 kilogram of water 1° C. The same heating effect would also of course be produced by the fall of 425 kilograms through 1 metre. This standard of force is termed a metrekilogram;[‡‡] and 425 metrekilograms are equal to that amount of heat which is necessary to raise the temperature of 1 kilogram of water through 1° C. If then it be found that the heat evolved by the combustion of a certain weight of charcoal or muscle, for instance, raises the temperature of 1 kilogram of water through 1° C., this means, when translated into mechanical power, 425 metrekilograms. Again, if a man weighing 64 kilograms climbs to a height of 1,000 metres, the ascent of his body to this height represents 64,000 metrekilograms of work; that is, the labour necessary to raise a kilogram weight to the height of 1 metre 64,000 times.

In order to estimate the amount of actual energy generated by the oxidation of a given amount of muscle in the body, it is necessary to determine, first, the amount of actual energy generated by the combustion of that amount of muscle in oxygen, and then to deduct from the number thus obtained the amount of energy still remaining in the products of the oxidation of this quantity of muscle which leave the body. Of these products, urea and uric and hippuric acids are the only ones in appreciable quantity which still retain potential energy on leaving the body, and of these the two latter are excreted in such small proportions that they may be considered as urea without introducing any material error into the results.

These determinations were made in Lewis Thompson's calorimeter, which consists of a copper tube to contain a mixture of chlorate of potash with the combustible substance, and which can be enclosed in a kind of diving-bell, also of copper, and so lowered to the bottom of a suitable vessel containing a known quantity (2 litres) of water. The determinations were made with this instrument in the following manner:—19·5 grams of chlorate of potash, to which about $\frac{1}{8}$th of peroxide of manganese was added, was intimately mixed with a known weight (generally about 2 grams) of the substance whose potential energy was to be determined, and the mixture being then placed in the copper tube above mentioned, a small piece of cotton thread previously steeped in chlorate of potash and dried was inserted in the mixture. The temperature of the water in the calorimeter was now carefully ascertained by a delicate thermometer; and the end of the cotton thread being ignited the tube with its contents was placed in the copper bell and lowered to the bottom of the water. As soon as the combustion reached the mixture a stream of gases issued from numerous small openings at the lower edge of the bell, and rose to the surface of the water—a height of about 10 inches.

[‖] "Mechanische Leistung Wärmeentwickelung und Stoffumsatz bei der Muskelthätigkeit." 1864.

[¶] As this is passing through the press, the speaker has become aware that Messrs. Lawes and Gilbert advocated this doctrine in 1852, and repeatedly since, their opinions being founded upon experiments on the feeding of cattle.

[**] "Untersuchungen über den Einfluss des Kochsalzes, des Kaffeés und der Muskel-bewegungen auf den Stoffwechsel," p. 150. Munich: 1860.

[††] *Phil. Trans.*, 1861, p. 747.

[‡‡] I follow the example of the Registrar-General in abbreviating the French word *gramme* to gram.

At the termination of the deflagration, the water was allowed free access to the interior of the bell, by opening a stopcock connected with the bell by a small tube rising above the surface of the water in the calorimeter. The gases in the interior of the bell were thus displaced by the incumbent column of water, and by moving the bell up and down repeatedly a perfect equilibrium of temperature throughout the entire mass of water was quickly established. The temperature of the water was again carefully observed, and the difference between this and the previous observation determines the calorific power or potential energy, expressed as heat, of the substance consumed.

The value thus obtained is, however, obviously subject to the following corrections :—

1. The amount of heat absorbed by the calorimeter and apparatus employed, to be added.

2. The amount of heat carried away by the escaping gases, after issuing from the water, to be added.

3. The amount of heat due to the decomposition of the chlorate of potash employed, to be deducted.

4. The amount of heat equivalent to the work performed by the gases generated in overcoming the pressure of the atmosphere, to be added.

Although the errors due to these causes to some extent neutralise each other, there is still an outstanding balance of sufficient importance to require that the necessary corrections should be carefully attended to.

The amount of error from the first cause was once for all experimentally determined, and was added to the increase of temperature observed in each experiment.

The amount of heat carried away by the escaping gases after issuing from the water may be divided into two items, viz. :—

a. The amount of heat rendered latent by the water which is carried off by the gases in the form of vapour.

b. The amount of heat carried off by these gases by reason of their temperature being above that of the water from which they issue.

It was ascertained that a stream of dry air when passed through the water of the calorimeter, at about the same rate and for the same period of time as the gaseous products of combustion, depressed the temperature of the water by only 0·02° C.

By placing a delicate thermometer in the escaping gases, and another in the water, no appreciable difference of temperature could be observed. Both these items may, therefore, be safely neglected.

The two remaining corrections can be best considered together, since a single careful determination eliminates both. When a combustible substance is burnt in gaseous oxygen, the conditions are essentially different from those which obtain when the same substance is consumed at the expense of the combined or solid oxygen of chlorate of potash. In the first case the products of combustion, when cooled to the temperature of the water in the calorimeter, occupy less space than the substances concerned in the combustion, and no part of the energy developed is therefore expended in external work, that is, in overcoming the pressure of the atmosphere. In the second case, both the combustible and the supporter of combustion are in the solid condition, whilst a considerable proportion of the products of combustion are gases. The generation of the latter cannot take place without the performance of external work, for every cubic inch produced must obviously, in overcoming atmospheric pressure, perform an amount of work equivalent, in round numbers, to the lifting of a weight of 15 lbs. to the height of one inch. In performing this work the gases are cooled, and consequently less heat is communicated to the water of the calorimeter. Nevertheless, the loss of heat due to this cause is but small. Under the actual conditions of the experiments detailed below, its amount would only have increased the temperature of the water in the calorimeter by 0·07° C. Even this slight error is entirely eliminated by the final correction which we have now to consider.

(To be continued.)

ACADEMY OF SCIENCES.

September 3.

M. Leon Foucault read a paper "*On a Means of Weakening the Intensity of the Sun's Rays at the Focus of Telescopic Object Glasses.*" This has hitherto been done either by placing a dark glass before the eyepiece, by cutting off some of the area of the object glass by means of a diaphragm, or by lowering the intensity of the rays by polarising them, and then viewing through an analyser. All these plans are imperfect, and the latter two injure the optical perfection of the instrument. M. Foucault now proposes to deposit a layer of metallic silver on the outer surface of the object glass, by the means he has already so successfully adopted for silvering the concave glasses for reflecting telescopes. The metallic coating, whilst it possesses so brilliant a lustre, has also a transparency and limpidity which is comparable to the finest coloured glass; and as it may be regarded as a surface devoid of thickness, its addition to the object glass will not interfere with the accuracy of its surface. By its means the instrument is protected against the heat of the solar rays, which are almost entirely reflected back towards the sky, whilst a minute quantity of blue light only penetrates through the metal, and is refracted in the ordinary manner, and forms at the focus a steady and clear image which can be observed without injury to the observer's sight. The contour of the solar disk is projected sharply against a black sky, the spots are marked with precision, and the faculæ, as well as the decrease of light towards the edge of the sun, are distinctly shown. The true colour of the sun is a little altered, owing to the preponderance of blue rays; but the gradations of intensity are well preserved, so that no detail is lost, whilst the eye after a short time becomes accustomed to the blueness, and does not observe it. The only drawback appears to be that this plan necessitates the sacrifice of an instrument, at least for a time, and the question appears to be, Is the object to be gained worth the cost? M. Foucault thinks that it is.

Two papers "*On the Silkworm Disease*" were given respectively by M. F. E. Guérin-Méneville and M. A. Béchamp. The former considers that he has demonstrated that the diseases are of two kinds, one caused by too much acidity, and the other by too much alkalinity, in the blood of the worms, arising from errors of nourishment. M. Béchamp's communication was in the form of a reply to some observations made by M. Pasteur on a former note of the author's, and was followed, as a matter of course, by a counter reply from M. Pasteur.

M. André Sanson read a paper "*On the Characteristics of Race.*" M. C. Grad sent a note "*On the Rainfall in Alsace and the Vosges.*" M. Ch. Ste-Claire Deville read a letter which he had received from M. G. Delenda, and in which it was stated that the volcanic phenomena were still active at Santorin.

M. J. M. Philipeaux sent a paper, in which he shows that the spleen cut out of young mammiferous animals and then immediately replaced in the abdominal cavity will adhere and continue to live and develope. The last paper read was by M. J. Kunckel, "*On the Organs of Secretion in Insects of the Order of Hemiptera.*"

NOTICES OF BOOKS.

The Inductorium, or Induction Coil. By Henry M. Noad, Ph.D., F.R.S. London: Churchills.

It gives us pleasure to draw attention to this useful little volume. It has been written at the request of, and for Mr. Ladd, the well-known scientific instrument-maker, and supplies a want which has long been felt—that of a work which can be placed in the hands of persons possessing or desiring to possess an induction coil, a clear and succinct account of the electrical principles on which the instrument is constructed, with a description of the most beautiful series of experiments illustrative of the phenomena of the induced current. One thing about the book which deserves credit is, that there is no attempt at hiding its real character. It is a very legitimate, indeed praiseworthy, advertisement of Mr. Ladd's instruments, and the author has very properly not attempted to conceal this fact from his readers. The scientific position of Dr. Noad, and the authority with which he speaks as the author of one of the most popular series of lectures on electricity, are sufficient guarantee that the advertisement direct never degenerates into the puff oblique.

Those who have had the pleasure of witnessing the experiments with Mr. Atkinson's magnificent coil, containg nearly 70 miles of wire in the secondary helix, and giving sparks nineteen inches long, will be glad to find in this work a description of the construction of this and other large instruments, with full details as to the precautions necessary when experimenting with them.

It is known to most of our readers that both Hofmann and Buff have employed the spark current from the induction coil for the decomposition of gaseous compounds; in this way cyanogen, nitrous oxide, nitric oxide, carbonic acid, marsh gas, olefiant gas, sulphuretted and phosphuretted hydrogen, have been decomposed with results which show what a powerful, elegant, and useful agent of gaseous analysis the induction coil is likely to become.

The author quotes a description of an experiment tried by Mr. J. Barrett. It is a modification of Grove's fine experiment with phosphorus, by which he first discovered the stratifications in the electrical discharges *in vacuo*. After the tube is exhausted and supplied with phosphorus vapour, the connexion is made with the coil and the commutator turned on. On continuing to work the extra barrel of the air-pump, the light will become wider and fill the whole tube; the stream of electricity will assume a faint salmon colour, the stratifications becoming still more brilliant, until the colour becomes white or silver, and the effect, to a close observer, gorgeous in the extreme. The author continues:—

"Sometimes the effect produced is that of a number of cones of light chasing each other from below upwards and *vice versâ*; sometimes they are flat tables of light, an inch or more apart; sometimes they are rings, apparently revolving or oscillating, and vanishing one into the other, and not unfrequently the whole mass assumes the form of a cloud with no motion whatever; sometimes there are two clouds, and the effect of intercepting the current for a minute or so is to bring back the stratification, which lasts but for a very short time, and the cloud remains as before, resisting all endeavours to produce stratification, except for two or three seconds after the current is turned on. A very common effect is the formation of one large column of little cones in rapid motion, filling the whole tube, and reminding one of the ripple of the sea by moonlight; and, again, four or five streams of cones filling the tube from end to end all at the same time. On more than one occasion, after varying the effects for upwards of an hour, I have succeeded in obtaining from sixteen to twenty layers of stratification, each layer being composed of two colours distinctly divided in the centre, the upper half green, the lower magenta, and *vice versâ* according to the directions of the current."

The work is filled with engravings showing the various forms of luminous discharges and stratifications in vacuum tubes, and a description of the spectra of the light from the different gas vacua, with the best methods of observation, are also given. Although not part of the book proper, readers will find the price list, with references to the figures in the text, which is bound up with the book, very useful.

The kind of work of which this is an illustration is somewhat novel. Mr. Griffin has published one or two of a similar class, and we think, if leading manufacturers were to follow this example more generally, a great boon would be conferred upon the younger students of science.

Handbook of Natural Philosophy. By Dionysius Lardner, D.C.L.—*Electricity, Magnetism, and Acoustics.* Revised and Edited by G. C. Foster, B.A. London: Walton and Maberly.

Dr. Lardner's introductions to elementary physics are so well known that it will merely be necessary for us to draw attention to the present volume, which has been added to and brought down to the present state of knowledge by Mr. Foster. The object of the book is not so much to afford minute and detailed information to the scientific man, as to supply in a convenient, portable, and well-arranged form an accurate knowledge of the present state of physical science, with special application of its various branches to the industrial arts and to the practical business of life.

The changes which the editor has made have been very considerable. Thus, in Book II. the new matter added includes Ohm's law of the intensity of currents, the tangent galvanometer, the measurement of conducting powers, the rheostat, ozone, the polarisation of electrodes, the retardation of telegraphic signals by inductive action in submarine cables, and the laws of the development of heat in the voltaic circuit. Additions almost as great have been made in the other books of which the volume is composed.

Zeitschrift für Chemie, &c., Nos. 13 and 14. 1866.

The papers in No. 13 are the following:—"On Picric Ether," by Drs. Muller and Stenhouse; "On Oxypicric Ether," by Dr. Stenhouse; "On some Resins," by H. Hlasiwetz and L. Barth; "On Atropin," by W. Lossen; "On some Compounds of Cobalt and Nickel with Nitrous Acid," by O. L. Erdmann; "On the Separation of Zirconia from Titanic Acid and some other Substances," by R. Hermann; "On the Composition of Tschewkinite," by R. Hermann; "On Compounds of Magnesium and Calcium with Aluminium," by F. Wöhler; "On Vapour Densities," by H. Ste-Claire Deville and A. Cahours; "On the Action of Sodium on Camphor, and the Bodies formed thereby," by H. Baubigny; "On the Formation of some Compounds by long-continued Reactions," by Becquerel; "On the Ingredients of Senna Leaves," by Dragendorff and Kubly; "On Acetate of Albumen," by J. C. Lehmann; "On Albuminous Urine," by the same author; "On Fumarin," by G. Preuss; "Composition of the Water of the Dead Sea and surrounding Springs," by A. Terreil; "On the Behaviour of Lead towards Water," by Stahlmann; and "On the Occurrence of Leucin and Tyrosin in Healthy Bodies," by S. Radziejewsky. Most of these papers it will be seen that we have already noticed. In the paper "On Senna Leaves," the authors state that the active principle is an acid to which they have given the name *Cathartic acid*, and they mention that they have obtained a very similar, if not identical, compound from rhubarb and buckthorn. We shall give the process for obtaining the acid from senna in a future number. Cathartic acid is a glucoside which, under the influence of an acid, splits up into glucose and cathartogenic acid. The other ingredients mentioned are chrysophanic acid, senna-picrin, senna-crol, and a saccharine substance which the authors have named catharto-mannite.

With regard to albuminous urine, Lehmann states that carbonic acid produces in such urine a precipitate of globulin. He also confirms the opinion that the acid reaction of urine is not owing to free acid, but to the presence of an acid salt—acid phosphate of soda. In the paper "On the Behaviour of Lead to Water," Stahlmann states—what, by the way, is well known—that the presence of some salts—nitrates, for example, and ammonia—rather promotes the action. He states also that a piece of lead *standing* in a bottle of *active* water is quickly attacked at the places where it touches the glass; but if *suspended* in the water it will remain unattacked a week long.

No. 14 also contains for the most part papers we have noticed. The contents of this number are as follows:—"On Sulphocyanogen Compounds," by Dr. Hermes; "On the Absorption Spectrum of Didymium," by R. Bunsen; "On Pyrophosphodiamic Acid," by Dr. Gladstone; "On the Compounds of Tantalum," by C. Marignac; "A Method of Organic Analysis," by E. H. von Baumhauer; "On the Behaviour of Pimento Oil towards Hydriodic Acid," by E. Erlenmeyer; "On the Preparation of Chlorides of Cyanogen," by A. Gautier; "On some Derivatives of Paraoxybenzoic Acid," by Ladenburg and Fitz; "On the Cinchona Alkaloids, and Estimation of Nitrogen by Soda Lime," by E. A. v. der Burg; "On the Formation of Secondary Amines of the Phenyl and Toluol Series," by De Laire, Girard, and Chapoteaut; "Remarks on Frankland and Duppa's Synthetical Researches on Ethers," by A. Geuther; "Principles in the Root of *Sarracenia purpurea*," by St. Martin; "On Ozone in the Blood," by Lewisson; "Constituents of *Lignum colubrinum*," by B. v. Berlekom; "On the Occurrence of Sugar-forming Substances in the Organs of Diabetic Patients," by M. Jaffe; "On the Specific Gravity Test for Mercurial Ointment," by G. Pile; "Does Noria Exist?" by R. Hermann; "On Asperolite," by R. Hermann; "On the Amount of Ilmenic Acid in Columbite," by R. Hermann; "On Crystallised Sulphide of Sodium," by C. Rammelsberg; "Separation of Indium from the Flue-dust of Zinc Ovens," by R. Boettger; "On Peroxide of Hydrogen," by C. Schönbein; "On the Behaviour of Glauber Salt Solutions at Low Temperatures," by Dr. Lindig; "On the Composition of Wiserin," by Dr. v. Wartha; "On Means of Dissolving Gold," by J. Nicklès; "On the Bye-Products in the Preparation of Propylene," by H. Bassett; "On the Ashes of Cantharides," by Kubly; "On a Moist Way of Extracting Quicksilver," by R. Wagner; "On the Colouring Matters of Fluor Spar," by G. Wyrouboff; and "On the Detection of Alkaloids," by R. Wagner.

NOTICES OF PATENTS.

Patent for the Use of Carbolate of Soda.

Our attention has been drawn to the fact that in 1861 M. Bobœuf took out a patent for the employment of an alkaline solution of carbolic acid as a new hæmostatic and antiseptic agent; in the patent, No. 2441, he gives full directions for preparing a solution of carbolate of soda, and the specification, which M. Bobœuf has forwarded to us, is so worded as to include a mixture of any of the tar acids in any alkaline solution. This preparation, for which the patentee obtained the Montyon prize awarded by the French Institute, has a large sale in France, but the fact of its being patented in England appears to be quite unknown. A bottle of the preparation has been forwarded to us; it contains about half a pint of a dilute solution of carbolate of soda, and is sold retail for 1½ francs. The patentee has within the last few weeks been making inquiries in England as to whether an alkaline solution of the tar acids is sold in England for disinfecting purposes, and we believe it is his intention to protect his patent from infringement. As several firms are, to our certain knowledge, selling aqueous carbolate of soda as a disinfectant, they will thank us for this timely warning. We may mention that the only use to which M. Bobœuf proposes in the specification to apply his solution, which he calls phenate of soda (*Phénol sodique Bobœuf*) is for the purpose of stopping the flow of blood from wounds, &c., although, according to the label on the bottle, it is a cure for nearly every evil which flesh is heir to.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

1162. A. Upward, Goswell Road, Middlesex, and Honourable A. A. Cochrane, Westminster, "Improvements in the manufacture of gas."—Petition recorded April 25, 1866.

1823. J. N. Fournel, Faubourg St. Pierre, Nancy, France, "Improvements in the manufacture of iron and cast iron, and in the apparatus employed therefor."—July 11, 1866.

1940. H. A. Bonneville, Rue du Mont Thabor, Paris, "A new and improved explosive compound mixture." A communication from Baron A. A. de Cantillon de Ballyhigue, and E. Cookes, Rue St. Honoré, Paris.

1948. W. Weldon, West Hill, Highgate, Middlesex, "Improvements in the manufacture of chlorine."—July 26, 1866.

1956. P. Griess, Burton-on-Trent, Staffordshire, and H. Caro, Manchester, "Improvements in the preparation of bodies in which nitrogen is substituted for hydrogen."—July 28, 1866.

1966. A. Paraf, Manchester, "The application to medicine, for beverages, and for industrial purposes, of a new gaseous water." A communication from P. Schutzenberger, Paris.

1970. J. J. Bodmer, Newport, Monmouthshire, "Improvements in the manufacture of cements, concretes, and artificial stone."—July 31, 1866.

1978. A. Paraf, Manchester, "Improvements in deoxidation and precipitation." A communication from M. Paraf-Javal, Thann, Paris.—August 1, 1866.

2025. J. Hamilton, Glasgow, N.B., "Improvements in artificial materials for producing gas for illuminating purposes."

2026. W. E. Newton, Chancery Lane, "Improvements in the manufacture of carbonates and bicarbonates of soda and potash, the soluble and insoluble silicates of soda and potash, and muriatic acid, from chlorides of sodium and potassium." A communication from H. M. Baker, J. H. Poole, and W. R. Stace, Rochester, New York, U.S.A.—August 6, 1866.

2034. J. N. Browne, Elgin Crescent, Notting Hill, Middlesex, "Improvements in preserving wood." A communication from L. Robbins, New York, U.S.A.—August 7, 1866.

2046. A. Oldroyd, Clapton, Middlesex, and P. A. Godefroy, Homerton, Middlesex, "Improvements in the treatment of jute."—August 8, 1866.

2058. L. E. Williams, Pickskill, Westchester, New York, U.S.A., "Improvements in explosive shells."—August 10, 1866.

2067. J. J. Ensley, New York, U.S.A., "An improved apparatus for manufacturing illuminating gas and producing bone black and other valuable residuum."

2068. B. F. Weatherdon, Chancery Lane, "Improvements in thermometers and pyrometers." A communication from C. Leroy and J. J. M. Durand, Route de Fontainebleau, Seine, France, and C. Pichoin, Route d'Italie, Paris.—August 11, 1866.

2072. D. Marchal, Brussels, "Improvements in the combustion and prevention of smoke, and in increasing the heating power of fuel."—August 13, 1866.

2077. S. Rowbotham, Brookside, Penketh, near Warrington, Lancashire, "Making caustic soda from common salt or chloride of sodium by the action of lead or its oxide, and afterwards recovering the lead as oxide or otherwise for use again in making caustic soda from common salt."

2083. J. A. Wanklyn, London, and A. Paraf, Manchester, "Improvements in the production of green colouring matters for dyeing and printing textile fabrics and yarns."—August 14, 1866.

2095. J. Webster, Birmingham, "Improvements in coating and recovering metals from chlorides and other solutions of metals."

2101. J. Cameron, Barrow-in-Furness, Lancashire, "Improvements in the manufacture of iron and steel."—August 15, 1866.

2107. A. Kühne, Norfolk Street, London, "Improvements in the purification of water, and in the disinfection and preservation of putrescent and putrescible matters." A communication from Dr. W. Kühne, Berlin.

2110. G. Payne, Battersea, Surrey, "Treating fatty and oily matters."—August 16, 1866.

2114. E. T. Hughes, Chancery Lane, "The application of chlorine for the condensation of nitrous gas, and improvements in the apparatus connected therewith." A communication from C. Large, Lyons, France.

2115. A. Paraf, Manchester, "Improvements in the use and application of an inorganic glyceric ether."

2119. W. Clark, Chancery Lane, "Improvements in puddling furnaces." A communication from C. de Graff Baker, J. Harlan, and J. Bell, Wheeling, Ohio, West Virginia, U.S.A.—August 17, 1866.

Notices to Proceed.

1080. C. J. B. King, M.D., Stone, Staffordshire, "A new unfermented beverage."—Petition recorded April 17, 1866.

1093. C. A. Girard, Rue des Ecoles, Paris, and G. de Laire, Rue de Sévres, Paris, "Improvements in the preparation of diphenylamine and analogous substances."—April 18, 1866.

1108. G. Lunge, Ph.D., South Shields, Durham, "Improvements in the manufacture of carbonates and bicarbonates of soda and potash."

1116. J. Leigh, Manchester, "Improvements in the purification of coal gas."—April 20, 1866.

1162. A. Upward, Goswell-road, Middlesex, and Honourable A. A. Cochrane, Westminster, "Improvements in the manufacture of gas."

1163. G. E. Noone, Hastings, Sussex, "Improvements in machinery and processes for deodorising and treating sewage and other refuse, and manufacturing therefrom manure and other substances for chemical and other uses."—April 25, 1866.

1173. W. Edmond and A. Gwilt, Swansea, Glamorganshire, "Improvements in furnaces and apparatus for separating heated gases, fumes, or vapours from each other, and from solid or liquid bodies."

1174. A. Paraf, Manchester, "Improvements in printing and dyeing textile fabrics and yarns."—April 26, 1866.

1207. A. V. Newton, Chancery Lane, "Improvements in the manufacture of steel." A communication from E. L. Bomeisler, Philadelphia, Penn., U.S.A.

1209. W. P. Piggott, Argyle Street, Regent Street, Middlesex, "Improvements in preventing corrosion and fouling of iron ships."—April 28, 1866.

1232. J. Thomas, Battersea, Surrey, and A. Prince, Charing Cross, Middlesex, "Improvements in reverberatory blast and other furnaces for smelting oils, and in the means of extracting the precious metals therefrom."—May 1, 1866.

1470. B. F. Weatherdon, Chancery Lane, "Improvements in gas pyrometers, which may also be employed as thermometers." A communication from J. J. M. Durand, Rue de Fontainebleau, Gentilly, Seine, France, and C. Pichoin, Rue d'Italie, Paris.—May 26, 1866.

1938. W. E. Newton, Chancery Lane, "Improvements in treating iron for the purpose of converting it into steel or hard metal, and for plating or coating and hardening and tempering iron and steel." A communication from E. Savage, West Meriden, Conn., U.S.A.—July 25, 1866.

CORRESPONDENCE.

On the Proposed Doubling of the Received Chemical Formulæ.

To the Editor of the Chemical News.

Sir,—I have just read Mr. Newlands' second paper "On Certain Reasons for Doubling or otherwise Multiplying Chemical Formulæ;" and though the subject has necessarily lost some of its freshness from the length of time that has elapsed since the publication of that paper, I cannot let his strictures on my reply to his first paper pass without comment, inasmuch as he seems to have totally misapprehended my meaning. Prolonged absence on a tour must be my apology for not having answered his remarks earlier.

Mr. Newlands says that, because I state that his theory is, *a priori*, as likely to be true as any other, and then go on to remark that the presumption is in favour of the older and simpler formulæ, and that the burden of proof lies with him, I appear to possess information upon a subject on which one of the most illustrious of our modern chemists has not hesitated to plead his ignorance. Now, I lay no claim to the possession of any more information than that within Dr. Hofmann's or any other chemist's reach. Let us hear what an able writer says:—"A presumption in favour of any supposition means, not (as has been sometimes erroneously imagined) a preponderance of probability in its favour, but such a *pre-occupation* of the ground as implies that it must stand good till some sufficient reason is adduced against it; in short, that the *burden of proof* lies on the side of him who would dispute it."* I meant, and, I think, expressed, neither more nor less than this *logical* presumption; and it is, in my opinion, unfair of my opponent thus to wrest my use of the word in its usual sense, and to make it appear as if I spoke of probability. There is a wide difference between a presumption and a probability.

As I do not accept Mr. Newlands' definition of an atom, and as I am able to conceive that atoms have different sizes, his doubt as to my ability to conceive that one atom can occupy the same space as two atoms (of a different kind) has no weight.

I regret that, by a clerical error, when speaking of the vapours of NH_4Cl and PCl_5, I spoke of "those compounds" instead of "those other compounds," and thus fairly laid myself open to my opponent's charge of having misapprehended him. The sentence, as quoted by him betwixt inverted commas, is altered, and "those" changed into "these." By thus misquoting me, he converts, what would have appeared to most in its true character, into a great blunder, and one involving gross ignorance of two well-known vapour densities.

In replying to my question—what is the quantivalence of carbon in C_2H_8, &c.?—Mr. Newlands has entirely suppressed the second and conjoint question I there put—Can these (new atomicities) be assigned to C, N, and O in substitution compounds?—but refers me to a paper of his in the Chemical News of May 18, 1866. With this paper I was previously unacquainted; but, having perused it, I find no answer to the second and most important of the above questions; and we must hence assume that Mr. Newlands' hypothesis is devoid of that experimental confirmation which we might reasonably expect to find. I may here remark that were Mr. Newlands' hypothesis accepted, and our received formulæ multiplied by any number whatever, the theory of atomicity would practically become valueless. I am not writing in support of that theory, but merely wish to point out to what this chemist's views would lead.

Again, when he says that, in speaking of carbon exchanging two affinities, and being at least quinquivalent,

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* Whately's Rhetoric, Pt. I., ch. iii., sect. 2.

I evidently mean that the two atoms of carbon interchange one affinity, I reply just so; and will add that, in my humble opinion, one expression is as correct as the other. I am willing to acknowledge that I stand open to correction; but I used the term advisedly, and so worded it that it scarcely needed Mr. Newlands' explanation to render it intelligible to the readers of the CHEMICAL NEWS. I leave it to be decided by the balance of opinion whether, when two affinities of two atoms, one from each atom, mutually saturate each other, it be more correct to say that they exchange two affinities, or that they interchange one affinity. Here, again, Mr. Newlands has misquoted me, though the words he has imported into my sentence do not materially affect its sense.—I am, &c.,

THOMAS STEVENSON, M.D. Lond.

Laboratory, Guy's Hospital, Sept. 6, 1866.

MISCELLANEOUS.

Medicinal Preparations of Carbolic Acid.—We published in our last number an account of a death occasioned by drinking carbolic acid, and several instances have been brought before our notice of injury having been occasioned by the incautious use of this powerful antiseptic. Some of this inconvenience has been caused by the fact that the only available article readily obtainable by the public has been the acid itself in its concentrated form. Our attention has recently been directed to some carbolic acid lozenges, which are said to possess singularly efficacious properties. Their flavour is not too powerful to prevent their being used under circumstances where the antiseptic properties of carbolic acid are required internally, whilst they are sufficiently biting on the tongue to prevent their being consumed as a sweetmeat should the bottle containing them get into the hands of children, young or old. When carbolic acid is required for medicinal use, we think that these lozenges will afford a particularly convenient means of its administration.

Preservation of Meat by means of Paraffin.—Amongst the objects exhibited at the *soirées* and the Pharmaceutical Conference during the meeting of the British Association at Nottingham, few things attracted more attention than sundry amorphous-looking lumps, covered with a white coating, like twelfth-cakes in an incipient stage of manufacture. Labels told the visitors that one of these was a mutton chop, another a loin of mutton, a third a sirloin of beef, preserved by Redwood's process. This process has already been briefly described in our pages. It consists in the immersion of fresh meat in melted paraffin, at a temperature of 240° Fahr., for a sufficient time to effect a concentration of the juices of the meat and the complete expulsion of air; after which the meat, in its condensed state, is covered with an external coating of paraffin, by which air is excluded and decomposition prevented. The concentration of the juices may thus be carried to any required extent. If the meat is to be kept in hot climates, its weight should be reduced by evaporation to about one-half, in which state it will contain all the nutriment of twice its weight of fresh meat, the portion driven off by evaporation consisting only of water. Thus prepared it will be fully cooked (by the heat applied in the process), and it may not only be eaten without further preparation, but it will also be applicable for the preparation of a variety of made dishes, including stews, hashes, soups, gravies, &c. For cold climates a less amount of heating and concentration will suffice, so that the meat may retain its original juicy condition, and, when further cooked, present the appearance, and possess all the characters, of fresh unpreserved meat. The paraffin used in the process is perfectly innocuous, free from taste and smell, and is not subject to change from keeping. It may be removed from the surface of the meat by putting the latter into a vessel containing boiling water, when the paraffin as it melts will rise to the surface of the water, and may be taken off in a solid cake when cold, while, at the same time, the meat will become softened and prepared for cooking in any suitable way. Among the advantages claimed for the process may be mentioned its great simplicity, the facility with which it can be performed by unskilled workmen, and its inexpensive character, as the same paraffin can be used for an indefinite number of times, and the quantity required for coating the meat is very small. When the meat is concentrated, as described for hot climates, it is rendered very portable, and no special care is required in packing it. Samples of meat preserved by this process have been tested by the method adopted by Messrs. Gillon and Co., of Leith, the well-known preserved provision merchants, with perfectly satisfactory results. Messrs. Gillon have found from long experience that if the meat can be kept in a hot room at a temperature of about 100° Fahr. for eight or ten days without change, it will keep for lengthened periods in any climate, and they are accustomed to submit their preserved provisions to this method of testing before sending them out. The samples were seventeen days in the testing hot-room, and, judging from experience, Messrs. Gillon are confident that they would remain good in any climate, even in the tropics.

Chemistry and Physiology.—It is quite clear that what we call chemistry, with its attendants, heat and electricity, plays a most important part in the animal machine; and, probably, more information as to the nature of the organic processes is to be expected from their chemical study than in any other way. We have found out that there is a very close relation between a complete atomic formula and the vital processes, the amount of chemical tension which is expressed by the former being commensurate with the character of the latter, and the amount of chemical change which takes place in the textures being commensurate with the activity of the vital processes. There seems good reason to believe that a muscular fibre is the container of a given amount of chemical force compressed by the medium of a high chemical formula, and existing, therefore, in a high state of tension; that during its construction the compressed force is set free by the decomposition of its structure—that is, by the resolution of its component elements, chiefly by a process of oxidation, to a lower formula or a state of lower tension, at the same time that heat is evolved and electrical changes take place; though the latter are not yet distinctly defined. It is impossible, therefore, to avoid the application here of the doctrine of contractile force, which is being so clearly worked out in the inorganic world, and which seems to be the greatest advance that has for some time been made in our knowledge of the laws of matter. We can scarcely doubt that the chemical force which is set free during the decomposition attendant upon muscular action is the equivalent of the contractile force that is evinced and of the heat that is evolved. In other words, a muscle may be regarded as the medium by which force is accumulated, rendered latent, or condensed in a condition of high chemical tension, and is, from time to time, as occasion may require, set free and converted into muscular or contractile force and heat. It seems probable that such is the case, and we may look for the more clear demonstration of it, with some confidence, as a real gain to physiology, inasmuch as certain of the animal formations will be thus withdrawn from the mysterious region of life into the more intelligible domain of science.—*From the Inaugural Address of Professor Humphry, in Section D. British Association, Nottingham Meeting.*

ANSWERS TO CORRESPONDENTS.

Randleson and Forster.—The degrees are Centigrade.

Thomas W. B.—A series of articles by Dr. Lionel Beale on Microscopic Researches on Cholera is in course of publication in the *Medical Times and Gazette.*

Books Received.—The Technologist, for September.

DISINFECTION AND THE CHOLERA.

From an apathy in regard to sanitary matters which is almost culpable, the public mind appears to be in some danger of falling into the opposite extreme. Not very long ago the objects sought to be gained by disinfection were so little understood, that the employment of one of the best and most scientific disinfectants was officially condemned, by high Government authorities, on the ground that it would encourage dirt and foster habits of uncleanliness; and it has only been by the irresistible force of the lessons taught by two great public calamities, that the opinion is gaining ground, that disinfection does not always mean chloride of lime *usque ad nauseam.*

The striking results which attended the antiseptic method of cattle plague disinfection, and the successful manner in which the principles laid down on that occasion for the combating of zymotic poisons have since been applied to the treatment of cholera, have caused "disinfection" to become a household word; and there is every reason to hope that what is now used only as a word, will, before long, become the representative of a correct idea.

Disinfection is by no means so simple a process as is generally supposed. We cannot use one substance with equal efficacy in all imaginable cases. The process is one depending upon complicated chemical and physiological actions, and chemistry has placed at our disposal several substances which are applicable to the various requirements of the case; but to pin one's faith to one agent only, be it carbolic acid, chloride of lime, Condy's fluid, or McDougall's powder, is to limit one's powers of disinfection in a very unwise degree; whilst to recommend all these things, without discriminating in what cases they are severally to be used, is like sending a sick man to a druggist's shop, telling him neither what special drug to take nor how much for a dose.

It is highly important that the best plan of disinfection adapted to the present or like emergencies should be definitely settled by some competent authority, and its adoption then made imperative throughout the country. The various disinfectants ought always to supplement each other, so that when the contents of the adjacent sewers blend together, the purifying action of the disinfectants used should pervade the mass.

At present, however, owing to the want of accurate knowledge of the laws of disinfection, and the absence of combined action between the local self-governing authorities, the contrary result obtains. For instance, during the late outbreak of cholera, in the parishes of Putney, St. Giles, St. Luke's, Fulham, Wandsworth, and others, chloride of lime was preferred. In Clerkenwell, Condy's fluid was used; in St. Marylebone, St. George's (Hanover Square), Holborn, and others, carbolic acid and McDougall's power were employed; whilst in St. Pancras the height of absurdity was attained, and the authorities deluged the same sewers on alternate days with oxidising and with deoxidising agents.

Thus, the drainage of one thousand acres, saturated with a powerfully *oxidising* disinfectant, mingles in the sewers with the drainage from another thousand acres, to which a powerfully *deoxidising* agent has been applied with equal liberality; so that when the streams of sewage from these districts meet, the several agents exert reciprocally an antagonistic action, thus expending their energies in mutual destruction instead of uniting them in serviceable work.

The infected sewage of a parish expends but a small portion only of its baneful action in that parish. Its disinfection, therefore, concerns all districts of London, whose health is thus at the mercy of any vestry or local board who may choose to entertain heterodox views on the subject.

Vol. XIV. No. 355.—September 21, 1866.

ORGANIC MATTER IN WATER.

It is interesting to compare the amount of organic matter in some of the Cumberland lakes, whence Messrs. Hemans and Hassard propose to obtain the future water supply of London, with the organic matter existing in the water already supplied to the metropolis. According to Mr. Way, the grains of organic matter per gallon is in

River Lowther	0·62
Haweswater	0·62
Ulleswater	0·35
Thirlmere	0·77

giving an average of 0·59 grains.

According to Dr. Letheby, the grains of organic matter per gallon is in the

Grand Junction Waterworks	0·60
West Middlesex	0·48
Southwark and Vauxhall	0·64
Chelsea	0·56
Kent	0·03
New River	0·22
East London	0·56

showing an average of 0·44 grains; or a balance against Cumberland of 0·15 grains of organic matter per gallon.

It must, however, be borne in mind that in judging of organic matter *quality* rather than *quantity* must be looked at. The organic matter in the English lakes is principally derived from the peaty vegetation on the mountain sides, and is non-nitrogenous and comparatively harmless; whilst London organic matter is likely to consist chiefly of nitrogenised sewage.

It would greatly increase the value of the analyses of London waters, which Drs. Frankland and Letheby periodically publish, were they accompanied with a column giving the amount of *nitrogen* (other than ammoniacal) in the organic matter present.

It is not improbable that a simple relation would be seen to exist between the quantity of nitrogen and the prevalence of cholera or other pestilence.

The Atlantic Telegraph.—The New York *Independent* gives the following:—"On Monday, July 30, Mr. Field received a message of congratulation from Mr. Ferdinand de Lesseps, the projector of the Suez Canal. It was dated at Alexandria, in Egypt, the same day, at half-past one p.m., and received in Newfoundland at half-past ten a.m. Let us look at the globe, and see over what a space that message flew. It came from the land of the Pharaohs and the Ptolemies—it passed along the shores of Africa, and under the Mediterranean ocean, more than a thousand miles, to Malta—it then leaped to the continent of Europe and shot across Italy, over the Alps and through France, under the English Channel, to London—it then flashed across England and Ireland, till from the cliffs of Valentia it struck straight into the Atlantic, darting down the submarine mountain which lies off the coast, and over all the hills and valleys which lie beneath the watery plain, resting not till it touched the shore of the 'New World.' In that morning's flight it had passed over *one-fourth* of the earth's surface, and so far outstripped the sun in his course that *it reached its destination three hours before it was sent!* To understand this, it must be remembered that the earth revolves from west to east, and when it is sunrise here it is between eight and nine o'clock in Alexandria, in Egypt, and when it is sunset here it is nearly nine o'clock in the evening there."

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

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

PART III.

CONNEXION BETWEEN ORGANIC AND INORGANIC CHEMISTRY.

SECTION IV.—*Inorganic and Organic Chlorides, Bromides, &c.*

IN the preceding pages we have made apparent the analogies of structure and even of reactions that exist between the organic oxides, hydrates, and ethers, and the inorganic oxides, hydrates, and salts. These analogies may be traced in other classes of compounds. We have already compared the inorganic with the organic chlorides. Let us confine ourselves to this short remark, that it is not a question here of purely symbolic relations, bnt that the analogies expressed by the typical formulæ are founded upon the similitude of the reactions. Let us compare, in this respect, the chloride of sulphuryl with the chloride of succinyl. Both chlorides contain a radical of a bibasic acid. Both are decomposed in the same way under the influence of water, the one forming sulphuric acid, the other succinic acid.

$$\text{Ꞩ}\Theta_2,\mathrm{Cl}_2+\left.\begin{matrix}\mathrm{H}_2\\ \mathrm{H}_2\end{matrix}\right\}\Theta_2 \quad = \quad \left.\begin{matrix}\mathrm{S}\Theta_2\\ \mathrm{H}_2\end{matrix}\right\}\Theta_2 + 2\mathrm{HCl}$$

Chloride of sulphuryl. Sulphuric acid.

$$\text{Ꞓ}_4\mathrm{H}_4\Theta_2,\mathrm{Cl}_2+\left.\begin{matrix}\mathrm{H}_2\\ \mathrm{H}_2\end{matrix}\right\}\Theta_2 \quad = \quad \left.\begin{matrix}\text{Ꞓ}_4\mathrm{H}_4\Theta_2\\ \mathrm{H}_3\end{matrix}\right\}\Theta_2 + 2\mathrm{HCl}$$

Chloride of succinyl. Succinic acid.

Similarly the chlorides, bromides, and iodides of the alcohol radicals may be compared to the metallic chlorides, bromides, and iodides. The analogy of the following reactions cannot be mistaken:—

$$(\text{Ꞓ}_2\mathrm{H}_5)'\mathrm{I} \;+\; \left.\begin{matrix}\text{Ꞓ}_2\mathrm{H}_3\Theta\\ \mathrm{Ag}\end{matrix}\right\}\Theta \;=\; \mathrm{AgI} \;+\; \left.\begin{matrix}\text{Ꞓ}_2\mathrm{H}_3\Theta\\ (\text{Ꞓ}_2\mathrm{H}_5)'\end{matrix}\right\}\Theta$$

Iodide of ethyl. Acetate of silver. Acetate of ethyl.

$$\mathrm{KI} \;+\; \left.\begin{matrix}\text{Ꞓ}_2\mathrm{H}_3\Theta\\ \mathrm{Ag}\end{matrix}\right\}\Theta \;=\; \mathrm{AgI} \;+\; \left.\begin{matrix}\text{Ꞓ}_2\mathrm{H}_3\Theta\\ \mathrm{K}\end{matrix}\right\}\Theta$$

Iodide of potassium. Acetate of potassium.

$$(\text{Ꞓ}_2\mathrm{H}_4)''\mathrm{I}_2 \;+\; 2\left[\left.\begin{matrix}\text{Ꞓ}_2\mathrm{H}_3\Theta\\ \mathrm{Ag}\end{matrix}\right\}\Theta\right] = \; 2\mathrm{AgI} \;+\; \left.\begin{matrix}2(\text{Ꞓ}_2\mathrm{H}_3\Theta)\\ (\text{Ꞓ}_2\mathrm{H}_4)''\end{matrix}\right\}\Theta_2$$

Diniodide of ethylene. Dinacetate of ethylene.

$$\text{Ꞓ}\mathrm{a}''\mathrm{I}_2 \;+\; 2\left[\left.\begin{matrix}\text{Ꞓ}_2\mathrm{H}_3\Theta\\ \mathrm{Ag}\end{matrix}\right\}\Theta\right] = \; 2\mathrm{AgI} \;+\; \left.\begin{matrix}2(\text{Ꞓ}_2\mathrm{H}_3\Theta)\\ \text{Ꞓ}\mathrm{a}''\end{matrix}\right\}\Theta_2$$

Iodide of calcium. Dinacetate of calcium.

It seems to me useless to insist upon these relationships, which are evident and accepted by all chemists. I will give some others that are newer and more remarkable.

There exists, independently of M. Regnault's dichloride of sulphuryl, a compound intermediate between the latter and sulphuric acid. This is chlorosulphuric acid, obtained by Dr. Williamson* by treating concentrated sulphuric acid with perchloride of phosphorus.

$\left.\begin{matrix}(\text{Ꞩ}\Theta_2)''\\ \mathrm{H}_2\end{matrix}\right\}\Theta_2$	$\begin{matrix}\left.\begin{matrix}(\text{Ꞩ}\Theta_2)''\\ \mathrm{H}\end{matrix}\right\}\Theta\\ \mathrm{Cl}\end{matrix}$	$(\text{Ꞩ}\Theta_2)''\mathrm{Cl}_2$
Sulphuric acid.	Chlorosulphuric acid. (Sulphuric chlorhydrine.)	Dichloride of sulphuryl.

Chlorosuccinic acid—

$$\begin{matrix}\left.\begin{matrix}(\text{Ꞓ}_4\mathrm{H}_4\Theta_2)''\\ \mathrm{H}\end{matrix}\right\}\Theta\\ \mathrm{Cl}\end{matrix}$$

corresponding to chlorosulphuric acid, has not yet been obtained, to my knowledge, although theory foresees the existence of such a compound. But in the lactic acid series we know of compounds intermediate between the dichlorides and the acids.

$\left.\begin{matrix}(\text{Ꞓ}_2\mathrm{H}_2\Theta)''\\ \mathrm{H}_2\end{matrix}\right\}\Theta_2$	$\begin{matrix}\left.\begin{matrix}(\text{Ꞓ}_2\mathrm{H}_2\Theta)''\\ \mathrm{H}\end{matrix}\right\}\Theta\\ \mathrm{Cl}\end{matrix}$	$(\text{Ꞓ}_2\mathrm{H}_2\Theta)''\mathrm{Cl}_2$
Glycolic acid.	Chloroglycolic acid (monochloracetic).	Dichloride of glycolyl.
$\left.\begin{matrix}(\text{Ꞓ}_3\mathrm{H}_4\Theta)''\\ \mathrm{H}_2\end{matrix}\right\}\Theta_2$	$\begin{matrix}\left.\begin{matrix}(\text{Ꞓ}_3\mathrm{H}_4\Theta)''\\ \mathrm{H}\end{matrix}\right\}\Theta\\ \mathrm{Cl}\end{matrix}$	$(\text{Ꞓ}_3\mathrm{H}_4\Theta)''\mathrm{Cl}_2$
Lactic acid.	Chlorolactic acid (monochloropropionic).	Dichloride of lactyl.

Such intermediate compounds exist also in the series of the polyatomic alcohols. The first were obtained by M. Berthelot,† who described, under the name of monochlorhydrine and dichlorhydrine, compounds intermediate between glycerine and trichloride of glyceryl (trichlorhydrine)—

$\left.\begin{matrix}(\text{Ꞓ}_3\mathrm{H}_5)'''\\ \mathrm{H}_3\end{matrix}\right\}\Theta_3$	$\begin{matrix}\left.\begin{matrix}(\text{Ꞓ}_3\mathrm{H}_5)'''\\ \mathrm{H}_2\end{matrix}\right\}\Theta\\ \mathrm{Cl}\end{matrix}$	$\begin{matrix}\left.\begin{matrix}(\text{Ꞓ}_3\mathrm{H}_5)'''\\ \mathrm{H}\end{matrix}\right\}\Theta\\ \mathrm{Cl}_2\end{matrix}$	$(\text{Ꞓ}_3\mathrm{H}_5)'''\mathrm{Cl}_3$
Glycerine.	Monochlorhydrine.	Dichlorhydrine.	Trichloride of glyceryl.

With glycol I have similarly obtained an intermediate compound, which I have called chlorhydric glycol, or monochlorhydrine of glycol.

There are some metallic compounds which possess an analogous constitution, and which may be considered as intermediate between the hydrates and the chlorides, bromides, and fluorides.

Berzelius has described, under the name of oxyfluoride of copper, a well crystallised body, whose composition he expressed by the formula CuFl,CuO,HO. If we adopt for oxygen and copper, atomic weights double their equivalents, this formula becomes—

$$\text{Ꞓ}\mathrm{u}''\Theta.\mathrm{HFl}.$$

Fluorhydrate of oxide of copper.

Now, it is easy to see that there exist between hydrate of copper, fluoride of copper, and this body, the same relations as those which exist between chlorhydric glycol, glycol, and chloride of ethylene.

$\left.\begin{matrix}\text{Ꞓ}\mathrm{u}''\\ \mathrm{H}_2\end{matrix}\right\}\Theta_2$	$\begin{matrix}\left.\begin{matrix}\text{Ꞓ}\mathrm{u}''\\ \mathrm{H}\end{matrix}\right\}\Theta,\\ \mathrm{Fl}\end{matrix}$	$\text{Ꞓ}\mathrm{u}''\mathrm{Fl}_2$
Hydrate of copper.	Cupric monofluorhydrine.	Cupric difluoride.
$\left.\begin{matrix}(\text{Ꞓ}_2\mathrm{H}_4)''\\ \mathrm{H}_2\end{matrix}\right\}\Theta_2$	$\begin{matrix}\left.\begin{matrix}(\text{Ꞓ}_2\mathrm{H}_4)''\\ \mathrm{H}\end{matrix}\right\}\Theta\\ \mathrm{Cl}\end{matrix}$	$(\text{Ꞓ}_2\mathrm{H}_4)''\mathrm{Cl}_2$
Glycol.	Monochlorhydric glycol.	Ethylenic dichloride.

M. Debray‡ observed this important fact, that when molybdic acid is heated in a current of hydrochloric acid gas to 150° or 200°, it forms a white, crystalline, and very volatile substance. This is a chlorhydrate of molybdic acid, the composition of which he expresses by the formula $\mathrm{MoO_3,HCl}$. I look upon this body as being a molybdic chlorhydrine, and I should define in the following manner its connexion with molybdic hydrate. Molybdenum may be considered as hexatomic in molybdic acid

$$\mathrm{Mo}\Theta_3.$$

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* *Annales de Chimie et de Physique*, 3rd series, vol. xli., p. 486.

† *Annales de Chimie et de Physique*, 3rd series, vol. xli., p. 296.

‡ *Comptes-Rendus*, vol. xlvi, p. 1093.

Normal molybdic hydrate would be—

$$\left.\begin{matrix}Mo^{vi}\\H_6\end{matrix}\right\}\Theta_6.§$$

M. Debray described the first anhydride of this normal hydrate, viz., the dihydrate—

$$\left.\begin{matrix}Mo^{vi}\\H_4\end{matrix}\right\}\Theta_5.‖$$

The molybdic chlorhydrine, described by M. Debray, is derived from this dihydrate—

$$\left.\begin{matrix}Mo^{vi}\\H_4\end{matrix}\right\}\Theta_5, \qquad \begin{array}{l}\left.\begin{matrix}Mo^{vi}\\H_2\end{matrix}\right\}\Theta_3\\ \qquad Cl_2.\end{array}$$

Molybdic dihydrate. Molybdic dichlorhydrine.

We may similarly consider the fluoxytungstates of M. Marignac. This chemist has described a fluoxytungstate of ammonia,¶ the composition of which he represents in equivalents by the formula—

$$NH_4,WO_2Fl_2.$$

In our notation, adopting for tungsten the atomic weight 184, this formula becomes—

$$2(NH_4)W\Theta_2Fl_4.$$

The substance in question forms, according to M. Friedel, a tungstic fluorhydrine—

$$\begin{array}{l}\left.\begin{matrix}W^{vi}\\(NH_4)_2\end{matrix}\right\}\Theta_2\\ \qquad\quad Fl_4\end{array}$$

derived from the hydrate—

$$\left.\begin{matrix}W^{vi}\\H_6\end{matrix}\right\}\Theta_6$$

As to the other fluoxytungstates described by M. Marignac, they are derived from a ditungstic hydrate.

There are chromic chlorhydrines and ferric chlorhydrines. In an important article, M. H. Schiff[**] justly remarked that the hydrated oxychlorides of chromium, obtained by M. Moberg by the desiccation of the hydrated perchloride, are derived from chromic hydrate by the substitution of several atoms of chlorine for several groups of HΘ.

$$\left.\begin{matrix}Cr_2\\H_6\end{matrix}\right\}\Theta_6, \quad \begin{array}{l}\left.\begin{matrix}Cr_2\\H_4\end{matrix}\right\}\Theta_4\\ \quad Cl_2\end{array} \quad \begin{array}{l}\left.\begin{matrix}Cr_2\\H_2\end{matrix}\right\}\Theta_2\\ \quad Cl_4\end{array} \quad \begin{array}{l}\left.\begin{matrix}Cr_2\\H\end{matrix}\right\}\Theta+4aq.\\ \quad Cl_5\end{array} \quad Cr_2Cl_6$$

Chromic hydrate. Chromic dichlorhydrine. Chromic tetrachlorhydrine. Chromic pentachlorhydrine. Chromic chloride.

We know, on the other hand, that ferric hydrate dissolves freely in a solution of ferric chloride. The oxychlorides which are thus formed, and to which M. Béchamp[††] has called attention, are doubtless ferric chlorhydrines, or rather mixtures of ferric chlorhydrines.

Metastannic hydrate dissolves in hydrochloric acid, and the solution thus obtained differs notably, according to H. Rose,[‡‡] from the aqueous solution of stannic chloride. We may, in fact, imagine that by the action of hydrochloric acid upon metastannic hydrate there may be formed polystannic chlorhydrines (see page 61).

Condensed chlorhydrines exist, derived from the polyethylenic or polyglyceric alcohols. Thus diethylenic alcohol may give birth to two derived bodies of this class, viz.:—

$$\left.\begin{matrix}C_2H_4\\C_2H_4\\H_2\end{matrix}\right\}\Theta_3 \qquad \begin{array}{l}\left.\begin{matrix}C_2H_4\\C_2H_4\\H\end{matrix}\right\}\Theta_2\\ \qquad Cl\end{array} \qquad \begin{array}{l}\left.\begin{matrix}C_2H_4\\C_2H_4\end{matrix}\right\}\Theta\\ \qquad Cl_2\end{array}$$

Diethylenic alcohol. Monochlorhydrine of diethylenic alcohol. Dichlorhydrine of diethylenic alcohol.

The second may be looked upon as a combination of oxide of ethylene and of chloride of ethylene. By heating for a long time bromide of ethylene with oxide of ethylene, I obtained a small quantity of a bromised liquid whose composition was sensibly that of a bromoxide of ethylene.[§§]

$$C_2H_4Br_2+2\Theta_2H_4\Theta = \begin{array}{l}\left.\begin{matrix}\Theta_2H_4\\\Theta_2H_4\\\Theta_2H_4\end{matrix}\right\}\Theta_2\\ \qquad Br_2\end{array}$$

The chlorides or bromides of oxides of inorganic chemistry have a constitution analogous to that of this latter body. The following examples will make this analogy evident.

Hydrate of lime dissolves in a solution of chloride of calcium, and the alkaline liquid properly concentrated deposits on cooling hydrated crystals, to which H. Rose assigns the composition,

$$3CaO,CaCl+16HO.$$

In our notation this formula becomes—

$$3Ca\Theta,\Theta aCl_2+16aq.‖‖$$

and may be written—

$$\begin{array}{l}\left.\begin{matrix}Ca\\Ca\\Ca\\Ca\end{matrix}\right\}\Theta_3+16\ aq.\\ \ Cl_2\end{array}\text{ analogous to }\begin{array}{l}\left.\begin{matrix}C_2H_4\\C_2H_4\\C_2H_4\\C_2H_4\end{matrix}\right\}\Theta_3\\ \qquad Cl_2\end{array}$$

Dichlorhydrine of tetrethylenic alcohol.

There are oxychlorides of lead possessing an analogous constitution. Thus *mendipite*, which is a well crystallised mineral, contains—

$$2Pb\Theta.PbCl_2=\begin{array}{l}\left.Pb_3\right\}\Theta_2\\ \quad\ Cl_2\end{array}$$

Atacamite is an oxychloride of hydrate of copper, the composition of which is expressed in equivalents by the formula—

$$CuCl+3CuO+HO.$$

By adopting for copper an atomic weight double the equivalent, this formula becomes—

$$\begin{array}{l}\left.\begin{matrix}2Cu''\\H\end{matrix}\right\}\Theta_2\\ \quad Cl\end{array}\text{ derived from the hydrate }\left.\begin{matrix}2Cu''\\H_2\end{matrix}\right\}\Theta_3.$$

Dicupric monochlorhydrine.

(To be continued.)

PHARMACY, TOXICOLOGY, &c.

On a New Macerating Apparatus,[*] *by Mr.* R. W. GILES.

THE unostentatious arrangement exhibited before the Conference, for the more convenient exhaustion of vegetable substances in a minimum quantity of water, having proved very satisfactory in the preparation of infusum cinchonæ spissatum, and other allied liquors of ordinary and extensive use in pharmacy, I have thought it worthy of a few remarks at the present meeting. I do not desire to see pharmaceutical chemists become manufacturers, but I strongly believe that the natural mode of advancing the practice of pharmacy amongst the many in our profession is to give them a practical interest in the processes of the art, beginning

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§ $Mo = 96$.

‖ MoO_3+2HO in the old notation.

¶ *Annales de Chimie et de Physique,* 3rd series, vol. lxix., p, 66.

[**] *Ibid.*, 3rd series, vol. lxvi., p. 142, October, 1861.

[††] *Ibid.*, vol. lvii., p. 286.

[‡‡] Poggendorff's *Annalen*, vol. cv., p. 564.

[§§] *Annales de Chimie et de Physique*, vol. lxix., p. 342.

‖‖ aq. $= H_2\Theta$.

[*] Read before the Pharmaceutical Conference, Nottingham meeting.

with the most simple; and that the communication of simple forms of apparatus which will have the advantage of rendering ordinary processes easy and profitable, is one of the best means of attaining this object. I may take this opportunity of saying that the establishment of a Museum of Pharmaceutical Apparatus at Bloomsbury Square has long been an object of solicitude to me; and I trust that the present exhibition may ultimately result in such an institution, which we may hereafter consult with advantage and economy, and the origin of which we may pleasantly associate with this our agreeable visit to Nottingham.

The apparatus needs little description to those who have seen the model. It consists of a series of eight cone-shaped macerators, each provided with its receiver, and the water used for maceration is passed successively through the material divided amongst the eight cones—the material being reduced to a convenient state of pulverisation, and each maceration being continued for such periods (varying from one hour to twelve hours) as may be appropriate to the character of the particular substance treated.

The advantage of this arrangement is that—with little more water than is required to moisten the whole—each of the eight portions receives eight successive macerations, which is sufficient to exhaust even such stubborn materials as cinchona bark. Other substances are exhausted with greater facility, and, of course, require a correspondingly smaller quantity of water. If it is said that a similar result may be attained by a process of percolation in a single vessel, I can only reply that I shall be obliged to any gentleman who will teach me how to avoid the practical difficulties of accomplishing this. I have utterly failed to do so, and out of these failures and by successive steps I have arrived at the present expedient, which, according to my experience, leaves nothing to be desired.

I regret that I cannot submit a satisfactory table of results obtained from the arrangement in the form in which it is now recommended, as, unfortunately, I find they have not been recorded. I can, however, give the results obtained from an intermediate apparatus, consisting of four macerators only. I hope to substitute a more complete table at some future meeting.

Twenty-four pounds cort. cinchonæ cord., divided into four portions, and macerated successively, gave:—

		Sp. gr.	Different density.
1st maceration,	10 pints.	1021·8	
2nd ,,	12 ,,	1012·3	9·5
3rd ,,	12 ,,	1008·3	4·0
4th ,,	11 ,,	1005·6	2·7
5th ,,	10 ,,	1004·0	1·6
6th ,,	8 ,,	1003·6	0·4

On Weights, Measures, Coins, and Numbers,[*] *by* JOHN ATTFIELD, *Ph.D., F.C.S., Director of the Laboratory of the Pharmaceutical Society of Great Britain.*

I HAVE been at some trouble in collecting actual specimens of metric decimal weights and measures, with allied coins, &c., for temporary display at the Exhibition of Objects relating to Pharmacy now (August, 1866) open at the Assembly Rooms, Nottingham, in connexion with the British Pharmaceutical Conference, and for more frequent reference should a similar exhibition be held annually in the towns visited by that Association.[†] I have done this in the hope of aiding in familiarising at least one section of the community—chemists and druggists—with a system destined, without doubt, at no distant period to displace the present barbarous confusion of weights, measures, and coins in use in this country. For, though habit prevents us from fully and constantly realising the inconveniences attending the use of existing weights and measures, their incongruity with each other and with our monetary and numerical systems is none the less real.

It is now, happily, scarcely necessary to say anything in favour of the universal adoption of the metric decimal system of weights and measures and a corresponding decimal system of coinage. Most persons who have thought over the matter agree that such a proceeding would be to the immense advantage of education, labour, trade, science, and the general interests of society. Pharmaceutists have frequently indicated their desire for change from the existing inharmonious methods of weighing, measuring, buying, selling, and calculating, to a system in which either of these operations should bear a simple relation to the rest. They, in common with other people, recognise the convenience of the relation of grosses and dozens to shillings and pence, that so many sovereigns per ton must be the same number of shillings per hundredweight, &c., &c., and, whenever opportunity has arisen, have agreed to welcome a system which should bind weights, measures, coins, and numbers into one harmonious whole, characterised by a single relation equal in simplicity to either of the two illustrations just mentioned. Every volume of the *Pharmaceutical Journal* contains allusions to this subject in the form of reports of meetings, discussions, papers, letters, &c., and the Proceedings of our own Conference include an elaborate report on weights and measures, by Mr. Barnard S. Proctor.

What is asked of chemists and druggists is to aid in promoting the general adoption of a system of weights, measures, and coins which shall be in accord with the existing universal system of numbers. It is, perhaps, impossible to realise, much more express, the advantages we enjoy from the fact that in every country of the world the system of numeration is identical. That system is a decimal one. There are those who tell us an octavial would have been more convenient, but the universality of the decimal method of counting must obtain for it unquestioned preference. Whatever language a man speaks, his method of numbering is decimal; his talk concerning number is decimal; his written or printed signs signifying number are decimal. With the figures 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, he represents all possible variation in number, the position of a figure in reference to its companions alone determining its value, a figure on the left hand of any other figure in an allocation of numeral symbols (for example, 1866) having ten times the value of that figure, while the figure on the right hand of any other has a tenth of the value of that other. When the youngest apprentice is asked how many units there are in 1866, he smiles at the simplicity of the question, and says 1866. How many tens? 186, and 6 over. How many hundreds? 18, and 66 over. How many thousands? 1, and 866 over. But if he is asked how many scruples there are in 1866 grains, how many drachms, how many ounces—he must probably bring out his slate and pencil. And so with the pints or gallons in 1866 fluid ounces, or the feet and yards in 1866 inches, or the pence, shillings, and pounds in 1866 farthings; to say nothing of cross questions, such as the value of 1866 articles at 9s. 6d. per dozen; and to say nothing of perplexity caused by

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[*] Read before the Pharmaceutical Conference, Nottingham meeting.

[†] During the intervals of the yearly meetings, the collection will be open to inspection in the rooms of the Pharmaceutical Society, Bloomsbury Square, London.

the varying values of several individual weights or of measures of length, capacity, and surface in different parts of the country. What is desired, then, is that there should be an equally simple decimal relation among weights and measures and coins as already universally exists among numbers. This condition of things having already been accomplished in other countries, there is no good reason why it should not be accomplished in this. It is, doubtless, possible to decimalise our own weights, measures, and coins, but such a course would be difficult, added to which the day has passed for the consideration of such a scheme. France, Holland, Belgium, Italy, Spain, Portugal, Switzerland, Greece, and South America generally have all adopted a decimal system founded on a measure of length (about eleven-tenths of our yard) appropriately called the metre; the United States,‡ Austria, Prussia, Switzerland, Sweden, Norway, Denmark, and Russia give indications of adopting it sooner or later, and the same system was legalised by Act of Parliament in our own country in 1864. From the metre are derived the unit measure of weight, the gramme; the unit measure of capacity, the litre; and the unit measure of surface, the are. 1866 metres contain 186 decametres and 6 over, or one kilometre and 866 over. 1866 grammes contain 1 kilogramme and 866 over. And so on, the prefixes deca-, hecto-, kilo-, myrio-, indicating multiples, deci-, centi-, milli-, submultiples. The coins attached to the system have a similar decimal relation, and may indeed be used as metrical weights if not much worn. This metrical (*i.e.*, metre-ical) system having been adopted in every case in which change has been made, it is incumbent on us to adopt it in preference to any other decimal system.

There are, doubtless, serious difficulties attendant upon a change affecting the daily, nay hourly, transactions of every individual in a kingdom—difficulties caused even more by association than calculation, for the latter is only a matter of education, easily and quickly acquired, while it takes years to associate our requirements of articles with the quantities in which those articles can be obtained. Yet what other peoples have done the English can do. And probably, by an extension of that class of terms which are independent of all systems and compatible with any, such as a bottle of wine, a glass of beer, a round of beef, half of this, a quarter of that, a shilling's worth of one thing, a franc's worth of another, so much per cent. of a whole, the change will not prove so formidable as it appears. So far as chemists and druggists are concerned, the transition will be comparatively easy, most dispensers having made up French prescriptions, in which the quantities are metrical.

In short, the only questions which probably need be discussed in the Pharmaceutical Conference are, how and when the metric decimal system of weights and measures should be introduced into pharmacy. In the British Pharmacopœia there is a table showing the relations of the system, and in the forthcoming edition of that work we are to have an enlarged table, as well as, I believe, some additional allusions to the system. I trust that the table will include the English equivalents of the metric decimal units and multiples. It is only fair that the formidable appearance of a whole string of figures necessary to show the metric value of a pound, &c., should be balanced by the equally formidable appearance of the string of figures necessary for the indication of the English value of a kilo-, &c. If not in the next, in the third edition let us hope to see metrical equivalents of the weights, &c., given in every formula. There would be no great difficulty in doing this, as already pointed out by Mr. Squire (*Pharmaceutical Journal*, May 2, 1859); indeed, it has already been done in a former edition of a Continental Pharmacopœia.

To memorialise the Medical Council, the body under whose direction the Pharmacopœia is published, with a view to the adoption of this course; to resolve that it would be desirable to ultimately use the metric decimal system of weights and measures in pharmacy, to the exclusion of all others; and to constantly, individually, make efforts to promulgate a knowledge of the nature and advantages of the system among friends and acquaintances—are probably the only ways in which at present the members of the British Pharmaceutical Conference can aid in promoting that desirable object, a simple universal relation between weights, measures, and coins, and the existing universal system of numbers.

17, Bloomsbury Square, London.

*On the Calamine of Pharmacy,** *by Mr.* R. H. Davis.

The subject I have undertaken to investigate for this Conference is the quality of calamine as now supplied by the ordinary class of dispensing chemists in the kingdom.

Previous examinations have shown that formerly an article so called was almost invariably composed of sulphate of baryta with small quantities of carbonate of lime and oxide of iron.

The results now placed before you will, I think, be gratifying in exhibiting a great advance in the purity of this preparation, as generally supplied by the retail druggist at this present time.

The analyses I have made of the specimens of calamine are arranged in a table, for convenience of comparison, as follows. The results obtained have been calculated for oo grains:—

	1.	2.	3.	4.	5.	6.	7.	8.	9.
Oxide of Zinc	73·64	67·64	56·25	17·29	13·15	...	...	...	...
Peroxide of Iron	5·89	3·65	6·43	·51	·57	2·31	1·35	2·00	·90
Oxide of Copper	trace	·54	...	...	...	...	...	...	...
Carbonate of Lime	5·30	10·61	10·79	3·46	8·34	4·92	4·74	3·17	1·97
Carbonate of Magnesia	...	trace	...	...	trace	trace	trace	trace	trace
Sulphate of Baryta	...	...	...	75·56	73·19	86·03	88·69	92·99	94·66
Silica, &c.	7·05	14·95	23·33	...	...	...	...	...	...
Water	1·44	2·61	·98	1·80	1·75	1·28	·92	·88	·77
Loss	6·68	...	2·22	1·38	3·00	5·46	4·30	·96	1·70
Total	100·00	100·00	100·00	100·00	100·00	100·00	[illegible]	[illegible]	[illegible]

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‡ There is a coin of the United States in the collection 5 cents in value, 5 grammes in weight, and 2 centimetres in diameter.

* Read before the Pharmaceutical Conference, Nottingham meeting.

No. 1. Purchased in the suburbs of London. 2. From Leeds. 3. From Dr. Attfield, marked No. 10. 4. From a medicine chest, supposed to be about thirty years old. Labelled as from a well-known West-end London house. 5. From Dr. Attfield, marked No. 1. 6. From a London wholesale house, sent out, seven years since, as P. L. 7. From Newcastle. 8. From Dr. Attfield, marked No. 3. 9. From Leeds.

Mr. Challoner, of Derby, a large manufacturer of calamine, kindly communicated to me the following information respecting it:—"The native calamine is met with in Derbyshire, in porous veins twenty inches or less in thickness, and imbedded in a hard kind of sandstone (called Dawstone by the miners); frequently a vein of lead ore, and occasionally sulphate of baryta, is found attached."

Mr. Challoner concludes by saying, "The genuine is never sent except when especially ordered."

Referring to the table of analyses, Nos. 1, 2, and 3 may be considered genuine. Their appearance, as may be observed from the specimens exhibited, is not so pleasing as the salmon-coloured old-fashioned variety with which the public is conversant.

Nos. 4 and 5 are peculiar; the small quantity of oxide of iron and the comparatively large quantity of oxide of zinc found gives rise to the suspicion that they are special preparations, possibly mixtures of oxide of zinc and the barytic calamine.

Nos. 6, 7, 8, and 9 correspond, and are of the ancient quality, innocent of any admixture with the genuine preparation, and are of a kind which was once universally supplied throughout the trade. Several analyses have been made from time to time of this barytic calamine. Mr. Brett was the first person to publish an account of it.[†]

At a later period, David Murdoch, Esq., read a paper on this substance before the Philosophical Society of Glasgow.[‡] In 1848 Mr. Edward Moore furnished analyses of six specimens of calamine obtained from the most respectable drug houses in London. With one exception they all correspond in a marked degree with Nos. 6, 7, 8, and 9 in the present table of analyses; the exceptional specimen contained 58·6 per cent. of oxide of zinc.[§]

In the same year Mr. Jacob Bell gave an interesting paper on the same subject,[‖] in which we are informed that six specimens of calamine procured at some of the most respectable shops in Paris were examined and found to be fair specimens of calamine. The English specimens which had been obtained shortly before from the most respectable houses in London by Mr. E. Moore contrast very unfavourably with those supplied by the pharmaciens of Paris.

From the analyses now supplied, it is pleasing to note the decided improvement in the quality of the English calamine since that period, and it is to be hoped that when a future examination, after a corresponding period, is made of the calamine of pharmacy, not a single specimen of the barytic compound will be found for sale in any establishment in the kingdom.

Harrogate, August 18.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION.

Friday, June 8, 1866.

On the Source of Muscular Power, by Edward Frankland, *Ph.D., F.R.S., Professor of Chemistry, R.I.*

(Continued from page 128.)

It is well known that the decomposition of chlorate of potash into chloride of potassium and free oxygen is attended with the evolution of heat. If a few grains of peroxide of manganese, or better, of peroxide of iron, be dropped into an ounce or two of fused chlorate of potash which is slowly disengaging oxygen, the evolution of gas immediately proceeds with great violence, and the mixture becomes visibly red hot, although the external application of heat be discontinued from the moment when the metallic peroxide is added. The latter remains unaltered at the close of the operation. It is thus obvious that chlorate of potash, on being decomposed, furnishes considerably more heat than that which is necessary to gasify the oxygen which it evolves. It was therefore necessary to determine the amount of heat thus evolved by the quantity of chlorate of potash (9·75 grams) mixed with one gram of the substance burnt in each of the following determinations. This was effected by the use of two copper tubes, the one placed within the other. The interior tube was charged with a known weight of the same mixture of chlorate of potash and peroxide of manganese as that used for the subsequent experiments, whilst the annular space between the two tubes was filled with a combustible mixture of chlorate and spermaceti, the calorific value of which had been previously ascertained. The latter mixture was ignited in the calorimeter as before, and the heat generated during its combustion effected the complete decomposition of the chlorate in the interior cylinder, as was proved by a subsequent examination of the liquid in the calorimeter, which contained no traces of undecomposed chlorate. The following are the results of five experiments thus made, expressed in units of heat, the unit being equal to 1 gram of water raised through 1° C. of temperature:—

	Units of Heat.
1st experiment.	340
2nd "	300
3rd "	375
4th "	438
5th "	438
	5)1891
Mean	378

This result was confirmed by the following experiments:—

1. Starch was burnt, firstly, in a current of oxygen gas, and secondly, by admixture with chlorate of potash and peroxide of manganese.

Heat units furnished by one gram of starch burnt with 9·75 grams chlorate of potash	4290
Heat units furnished by the same weight of starch burnt in a stream of oxygen gas	3964
Difference	326

2nd. Phenylic alcohol was burnt with chlorate of potash, and the result compared with the calorific value of this substance as determined by Favre and Silbermann.

Heat units furnished by one gram of phenylic alcohol burnt with 9·75 grams chlorate of potash	8183
Heat units furnished by one gram of phenylic alcohol when burnt with gaseous oxygen (Favre and Silbermann)	7842
Difference	341

These three determinations of the heat evolved by the decomposition of 9·75 grams of chlorate of potash, furnish-

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[†] "British Annals of Medicine," vol. i., p. 483.

[‡] *Pharmaceutical Journal*, vol. iv., p. 31.

[§] *Ibid.*, vol. viii., p. 70.

[‖] *Ibid.*, vol. viii., p. 321.

ing the numbers 378, 326, and 341, agree as closely as could be expected, when it is considered that all experimental errors are necessarily thrown upon the calorific value of the chlorate of potash.

The mean of the above five experimental numbers was, in all cases, deducted from the actual values read off in the following determinations.

It was ascertained by numerous trials that all the chlorate of potash was decomposed in the deflagrations, and that but mere traces of carbonic oxide were produced.

Joule's mechanical equivalent of heat was employed, viz., 1 kilogram of water raised 1° C. = 423 metrekilograms.

The following results were obtained :—

Actual Energy developed by One Gram of each Substance when burnt in Oxygen.

Name of substance dried at 100° C.	Heat Units.					Metrekilograms of force. (Mean.)
	1st experiment	2nd experiment.	3rd experiment.	4th experiment.	Mean.	
Beef muscle purified by repeated washing with ether . . .	5174	5062	5195	5088	5103	2161
Purified albumen . .	5009	4987	...	...	4998	2117
Beef fat . . .	9069	...	...	...	9069	3841
Hippuric acid . .	5330	5437	...	...	5383	2280
Uric acid . . .	2645	2585	...	...	2615	1108
Urea[*]	2121	2302	2207	2197	2206	934

It is evident that the above determination of the actual energy developed by the combustion of muscle in oxygen represents more than the amount of actual energy produced by the oxidation of muscle within the body, because, when muscle burns in oxygen, its carbon is converted into carbonic acid, and its hydrogen into water ; the nitrogen being, to a great extent, evolved in the elementary state ; whereas, when muscle is most completely consumed in the body, the products are carbonic acid water and urea ; the whole of the nitrogen passes out of the body as urea—a substance which still retains a considerable amount of potential energy. Dry muscle and pure albumen yield, under these circumstances, almost exactly one-third of their weight of urea, and this fact, together with the above determination of the actual energy developed on the combustion of urea, enables us to deduce with certainty the amount of actual energy developed by muscle and albumen respectively when consumed in the human body. It is as follows :—

Actual Energy developed by One Gram of each Substance when consumed in the Body.

Name of substance dried at 100° C.	Heat units. (Mean.)	Metrekilograms of force. (Mean.)
Beef muscle purified by ether .	4368	1848
Purified albumen . . .	4263	1803

We have thus ascertained the first of our three data—viz., the amount of force or actual energy generated by the oxidation of a given amount of muscle in the body ; and we now proceed to ascertain the second—viz., the amount of mechanical force exerted by the muscles of the body during a given time. For this purpose we have only to avail ourselves of the details of Fick and Wislicenus's conclusive experiment already referred to, and which consisted in the ascent of the Faulhorn in Switzerland from the Lake of Brienz. This mountain can be ascended by a very steep path from Iseltwald, which was of course favourable for the experiment, and there is an hotel on the summit which allowed the experimenters to pass the following night under tolerably normal circumstances. The following is their own description and estimate of the amount of work performed in the ascent :[†]—

"Let us now inquire how much work was really done by our muscles. One item necessary for the reply is already at hand—viz., the height of the summit of the Faulhorn above the level of the Lake of Brienz multiplied by the weight of the body—the former reckoned in metres, the latter in kilograms. The weight of the body with the equipments (hat, clothes, stick) amounted to 66 kilograms in Fick's case, and 76 in Wislicenus's. The height of the Faulhorn above the level of the Lake of Brienz is, according to trigonometric measurements, exactly 1956 metres. Therefore Fick performed 129,096 and Wislicenus 148,656 metrekilograms of muscular work."

But, in addition to this measurable external work, there is another item of force " which can be expressed in units of work ; and though its value cannot be quite accurately calculated, yet a tolerable approximation can be made. It consists of the force consumed in respiration and the heart's action. The work performed by the heart has been estimated, in a healthy full-grown man, at about 0·64 metrekilogram[‡] for each systole. During the ascent, Fick's pulse was about 120 per minute. That gives for the 5·5 hours of the ascent an amount of work which may be estimated at 25,344 metrekilograms, entirely employed in the maintenance of the circulation. No attempt has yet been made to estimate the labour of respiration. One of us has shown, however, in the second edition of his 'Medical Physics' (p. 206), that Donders' well-known investigations concerning the conditions of pressure in the cavity of the thorax give sufficient data for such an estimate. He has there shown that the amount of work performed in an inspiration of 600 cubic centims. may be rated at about 0·63 metrekilogram. Fick breathed during the ascent at an average rate of about 25 respirations per minute, which gives, according to this estimation, an amount of respiratory work for the whole ascent of 5197 metrekilograms. If we add this, and the number representing the work of the heart, to the external work performed by Fick, we obtain a total of 159,637 metrekilograms. If we suppose that Wislicenus's respiratory and circulatory work bore the same proportion to Fick's as his bodily weight did to Fick's—*i.e.*, 7 : 6—we obtain for Wislicenus's amount of work, as far as it is possible to calculate it, a total of 184,287 metrekilograms.

"Besides these estimated (and certainly not over-estimated) items, there are several others which cannot be even approximately calculated, but the sum of which, if it could be obtained, would probably exceed even our present large total. We will try to give at least some sort of an account of them. It must first be remembered that in the steepest mountain path there are occasional level portions or even descents. In traversing such places the muscles of the leg are exerted as they are in ascending, but the whole work performed is transformed back into heat. The same force-producing process, however, must be going on in the muscles as if work were being performed which did not undergo this transformation. In order to make this point yet clearer, we may take into consideration that the whole work of the ascent only existed temporarily as work. On the following day the result was reversed ; our bodies approached the centre of the earth by as much as they had receded from it the day before, and, in consequence, on the second day an amount of heat was liberated equal to the amount of work previously performed. The two parts of the action, which in this case were performed on two separate days, take place in walking on level ground in the space of a footstep.

"Let us observe, besides, that in an ascent it is not only those muscles of the leg specially devoted to climbing

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[*] The speaker showed the combustibility of urea by burning it upon asbestos in a jar of oxygen gas.

[†] *Phil. Mag.*, vol. xxxi., p. 456, 1866.

[‡] 0·43 is here assigned as the work of the left, and 0·21 as that of the right ventricle.

which are exerted; the arms, head, and trunk are continually in motion. For all these movements force-generating processes are necessary, the result of which cannot, however, figure in our total of work, but must appear entirely in the form of heat, since all the mechanical effects of these movements are immediately undone again. If we raise an arm, we immediately let it drop again, &c.

"There was, besides, a large portion of our muscular system employed during the ascent, which was performing no external work (not even temporary work, or mechanical effects immediately reversed), but which cannot be employed without the same force-generating processes which render external work possible. As long as we hold the body in an upright position, individual groups of muscles (as, for instance, the muscles of the back, neck, &c.) must be maintained in a state of continual tetanus in order to prevent the body from collapsing. We may conceive of a tetanised muscle as holding up a weight which would immediately fall if the supply of actual energy were to cease. It is active, but it performs no work, and therefore all the force produced is liberated in the form of heat."

Thus the total amount of measured and estimable work performed in 5·5 hours in the experiments before us was 159,637 metrekilograms for Fick, and 184,287 metrekilograms for Wislicenus. This is our second datum.

The third—viz., the amount of muscle oxidised in the body during the performance of this work—has been carefully determined by the same experimenters, as well as the rate of muscle consumption before and after the ascent. For the details of these determinations the speaker referred his hearers to the *Philosophical Magazine* for 1866, vol. xxxi., page 488; but the following is a condensed summary of the results:—

Ascent of the Faulhorn.

	Fick. Gram.	Wislicenus. Gram.
Amount of Nitrogen secreted in Urine per hour before ascent	·63	·61
Weight of dry Muscle corresponding to Nitrogen	4·19	4·05
Amount of Nitrogen secreted per hour during ascent	·41	·39
Weight of dry Muscle corresponding to Nitrogen	2·70	2·56
Amount of Nitrogen secreted per hour during six hours after the ascent	·40	·40
Weight of dry Muscle corresponding to Nitrogen	2·63	2·63
Amount of Nitrogen secreted per hour during the following night	·45	·51
Weight of dry Muscle corresponding to Nitrogen	3·06	3·39
Total amount of Nitrogen secreted during ascent	3·31	3·13
Ditto during six hours after ascent	2·43	2·42
	5·74	5·55
Weight of dry Muscle corresponding to Nitrogen secreted during ascent	20·98	20·89
Ditto during six hours after ascent	16·19	16·11
	37·17	37·00

The results of these determinations add a new link to the chain of experimental evidence, that muscular exertion does not necessarily increase the excretion of nitrogen through the urine. From mid-day before the ascent (August 29, 1865) to the following evening at seven o'clock (August 30) both gentlemen abstained from all nitrogenous food. During these thirty-one hours they had nothing in the way of solid food except starch, fat, and sugar. The two former were taken in the form of cakes. Starch was made up with water into a thin paste, which was then made into small cakes and fried with plenty of fat. The sugar was taken dissolved in tea. In addition to this there was the sugar contained in the beer and wine, which were taken in quantities usual in mountain excursions. It was doubtless owing to this absence from food containing nitrogen that the amount of this element secreted through the urine declined tolerably regularly from the 29th of August till the evening of the 30th. Even in the night of the 30th to the 31st, in spite of the plentiful meal of albuminous food on the evening of the 30th, the secretion of nitrogen was less than on the preceding night. The reason of this is probably to be sought for in the circumstance that during the period of abstinence the secretion of nitrogen was carried on at the expense of tissues, and now these tissues required reparation.

It is perhaps scarcely worthy of record that during the ascent neither of the experimenters perspired perceptibly, since it has been proved by Ranke that no appreciable amount of nitrogen leaves the system in the matter of perspiration; and as Thiry has also shown that no nitrogen is got rid of by respiration, it follows that in addition to the nitrogen contained in the urine, the only other mode of exit for this element is through the fæces. Now, the proportion secreted through the fæces has been estimated by Ranke at about one-twelfth of that in the urine; but inasmuch as all experiments on the subject tend to show that this alvine nitrogen is, as voided, a constituent of unoxidised compounds—that is, of compounds that have not yielded up their force—it has no claim upon our attention.

(To be continued.)

CHEMICAL SOCIETY OF PARIS.

July 20, 1866.

M. Berthelot *in the chair.*

Mr. Charles Murray, Professor of Pharmacy at the Faculty of Medicine at Buenos Ayres, and Member of the Society, presented a "*Traité de Pharmacie et de Pharmacognosie*," which he had just published in Spanish.

M. Roussille described the modifications which he has introduced into M. Guillermond's method for the estimation of morphia in opium. (This paper will appear in full in an early number of the Chemical News.)

M. Maumené presented to the Society his second volume on the theory of the exercise of affinity.

M. F. Leblanc, the secretary, gave a verbal analysis of a new printed memoir forwarded to the Society by M. Marignac, entitled "*Researches on the Combinations of Tantalum.*" M. Leblanc stated that the new determinations of vapour density, hitherto unpublished, made by MM. Henri Ste.-Claire Deville and Troost, on chloride of tantalum, perfectly pure and free from niobium, agreed completely with the new formulæ given by M. Marignac for tantalic acid, TaO_3, and chloride of tantalum, $TaCl_5$.

M. Berthelot, referring to the communication previously presented to the Society by M. Ladenburg, offered some remarks on the constitution of *anethol.* All the reactions of this body appeared to him easy to explain by regarding it as a derivative, by dehydration, of an ethylic ether of anisic alcohol:

$$C_4H_4(C_{16}H_{10}O_4)-H_2O_2,$$

a constitution capable of synthetical verification.

M. Friedel communicated several crystallographic determinations made by him: 1. On *chloroplatinate of isoamylamine,* a compound which is not isomorphous with chloroplatinate of amylamine. 2. On *thymotic acid,* obtained by M. A. Naquet. 3. On a *citrate of magnesia,* prepared by M. Perrel, the crystals of which present the form of double oblique rhomboidal prisms.

The Society then adjourned, for the vacation, until November 2.

ACADEMY OF SCIENCES.

September 10.

One or two matters of interest to chemists were brought forward at this sitting. M. Pasteur gave a paper "*On the Silkworm Disease*," in which he spoke of the different results obtained when testing the eggs for acidity or alkalinity. In the discussion M. Chevreul said that he had long known the difficulty which was presented when using blue litmus paper as a test for acidity, but which did not occur when using red paper to test for alkalies. The most delicate blue paper owes its colour to the red principle of litmus united with subcarbonate of potash; and when a body reddens this, it only signifies that the substance has more affinity for potash than the red colouring matter of litmus has. But in the preparation of ordinary blue litmus paper, instead of using paper free from mineral matter, the makers use paper containing subcarbonate of lime, sesquioxide of iron, &c. Now subcarbonate of lime also colours litmus blue, and this compound gives up its base to acids with much greater difficulty than the blue potash compound does. Therefore, in order to prepare the most delicate blue litmus paper, the latter should be first soaked in hydrochloric acid, and then well washed, before applying the litmus. Ordinary red litmus paper is much more sensitive to alkaline reaction than blue paper is to acid. M. Chevreul said that the most delicate means to detect acidity was to put a freshly cut piece of Campeachy wood into distilled water. If free from alkali the colour will be yellow, but if there is a trace of alkali present the tint is purple; then add a minute quantity of acetic acid on the point of a quill, when the colour will turn yellow. This liquid becomes purple with a trace of alkali, and acids change the purple to yellow. M. Béchamp gave a paper "*On the Action of Chalk in Butyric and Lactic Fermentations, and on the actually Living Organisms which it contains.*" We will give this paper, which is no less interesting than important, in full in an early number. This was followed by a paper by M. Senistal, "*On Researches in Geometric Optics*," and a memoir by M. H. Violette "*On Resins*," an abstract of which we shall shortly publish. M. Joly finished the sitting with another paper on the interminable subject of "*Silkworm Disease*."

NOTICES OF BOOKS.

Bibliothèque Universelle et Revue Suisse. Archives des Sciences Physiques et Naturelles. Nos. 97 to 101, January to May, 1866.

We have received the numbers of this journal for the first half of the present year. In future we hope to place before our readers a monthly summary of the contents of each number as far as they relate to chemistry or physics.

No. 97 commences with an important memoir by M. C. Marignac, entitled "*Researches on the Compounds of Niobium*." The first chapter is devoted to a discussion of the probability of the existence of ilmenium, and the author brings forward a considerable amount of analytical research to prove its non-existence. He is satisfied that the niobic acid extracted from columbite is not a mixture, that its density is about 4·5, and that the two products obtained by M. Hermann, having densities of 5 and 3·8, are mixtures of this acid with bodies of a greater and less density, chiefly tantalic and titanic acids. This conclusion is perfectly in accordance with that arrived at by M. Blomstrand. The second chapter is on the separation of niobic and tantalic acid. Neither Rose's nor Hermann's methods are at all satisfactory, and M. Marignac has devised one which is based on the difference of solubility between fluotantalate and fluoxyniobate of potash. This does not yield perfectly accurate results, but they are a near approximation, and it has the advantage that the compounds so separated have such decided characters, that their nature, and to a certain point their purity, cannot be doubted. The following is the analytical plan adopted:—Having obtained a mixture of niobic and tantalic acids, they must first be re-fused with bisulphate of potash (if they have been ignited), and then boiled several times in water to remove as much as possible of the sulphuric acid; then redissolve the residue in hydrofluoric acid. Add to the boiling solution, hydrofluate of fluoride of potassium, at first in quantity not more than one-fourth of the weight of the metallic acids under treatment. If the solution does not give crystals on cooling, concentrate by ebullition until it occupies no greater bulk than about 7 cubic centimetres for each gramme of metallic acid, and on cooling, fluotantalate of potash will be obtained if the mixture originally contained tantalic acid. Collect the precipitate on a tared filter, wash till the filtrate no longer precipitates infusion of galls of an orange colour, and dry at 100° C. Proceed in the same manner with the filtrates by adding more fluoride of potassium. The moment will be easily seen when the acicular crystals of fluotantalate are mixed with the lamellar crystals of fluoxyniobate, and these may then be redissolved by the addition of a little water before collecting the fluotantalate on a filter. The whole of the niobic acid remaining may now be converted into the lamellar crystals of fluoxyniobate, and collected in that state, or the solution may be decomposed by evaporation with sulphuric acid and treatment with water to separate the niobic acid. The author finds that all columbites contain, along with niobic acid, tantalic, titanic, and stannic acids, but he brings forward arguments to show that this association is purely accidental.

The third chapter contains analyses of several niobiferous minerals. The composition of columbites and tantalites is represented by the formula

$$\left.\begin{matrix}FeO\\MnO\end{matrix}\right\},\ \left\{\begin{matrix}Nb_2O_5\\Ta_2O_5,\end{matrix}\right.$$

and the extreme limits of their composition will be—

Tantalite.		Niobite.	
Ta_2O_3 .	85·5	Nb_2O_5 .	78·8
FeO .	14·5	FeO .	21·2
	100·0		100·0

Tantalic, titanic, and niobic acids have been found in wolfram. Euxenite appears to contain about 49 per cent. of niobic acid and 44 per cent. of titanic acid—the rest being water, and the loss incidental to this method of analysis.

No. 98 contains a paper by M. Marc Delafontaine, entitled "*Contributions to the History of the Metals of Cerite and Gadolinite*." He criticises the results obtained by MM. Bahr and Bunsen and M. Mosander, and comes to the conclusion that yttria and erbia certainly do exist, possessing all the properties which Mosander has ascribed to them; and that the erbia of MM. Bahr and Bunsen is a new earth, which should have its name altered.

Yttria is the earth about which there is least difference of opinion. It is white even after strong ignition. The sulphate and yttriopotassic sulphate, the nitrate and oxalate are fully described. The atomic weight is between 460 and 470 (O = 100). Erbia, according to M. Delafontaine, is of a yellow colour. The sulphate, the erbiopotassic sulphate, carbonate, and oxalate are described. When the double sulphate of erbium and potassium is washed with a cold saturated solution of sulphate of potash, it is noticed that the salt becomes less and less rose-coloured, and *at last its solution will not give an absorption spectrum.* To prepare an earth rich in erbia, the author recommends to prepare a concentrated solution of the mixed yttria, erbia, terbia, ceria, &c., and add an excess of a boiling saturated solution of sulphate of potash, and some crystals of the same. The whole is then allowed to cool; a crystalline deposit is formed, which is separated from the mother liquor, and digested again in fresh quantities of cold sulphate of potash. This latter dissolves a double salt, consisting chiefly of sulphate of erbia and potash; ceria and the other earths remain in the insoluble portion. Respecting the hypothetical terbia, M. Delafontaine brings forward reasons which tend to show that the earth which gives an absorption spectrum (the erbia of MM. Bahr and Bunsen) is a distinct body, and probably is terbia.

We have therefore in gadolinite (besides the cerium metals) *at least* three distinct earths—

1. Yellow erbia.
2. Rose-coloured terbia.
3. White yttria;

and there is some probability of there being a fourth.

The author has redetermined the atomic weight of yttria, and makes it 74·5.

No. 99 contains "*Researches on Earth Currents of Electricity*," by M. L. Dufour; "*On the various Modes of Coloration of the Feathers of Birds*," by M. Victor Fatio; and an article by M. H. Ste.-Claire Deville "*On Affinity and Heat*."

In No. 100, M. F. Craneri describes "*A New Anemometer*," and M. W. Hankel gives a "*Determination of Electromotive Forces*."

No. 101 contains an article by M. P. J. Ruprecht "*On the Scientific Importance of Tschornozome, or Black Earth*," and one by M. L. Dufour "*On the Secondary Polarisation of Metallic Conductors buried in the Earth*."

Chemisches Central Blatt. Nos. 35, 36, and 37.

These numbers are entirely filled with articles translated from other periodicals, most of them having already appeared in the Chemical News. Thus the first article in No. 35 is one by Dr. Martius "*On Amido-dinaphthylimid and Diazo-amidonaphtol*," which we gave in April. The next article is one by Dr. Fleck "*On the Separation of Cobalt and Nickel*," an abstract of which appeared in the Chemical News for June 22. Then follows a paper by Dr. Gräger "*On the Estimation of Potash in the Presence of Soda*," noticed in our number for August 3. The last paper is by Dr. G. Lunge "*On Swan's Carbon Printing Process in Photography*," copied from a Breslau journal for 1865; it is a *résumé* of the process which is now so well known to all photographers. The rest of the number consists of short notices from the *Comptes Rendus* and other papers.

In No. 36 the first article is one by W. Müller "*On the Reactions between Oxysalts and Sulphide of Carbon, Sulphuretted Hydrogen and Hydrochloric Acid at a High Temperature*." By putting chromate of potash in a red-hot tube and passing over it the vapour of bisulphide of carbon, combination takes place, and on extracting with water sesquisulphide of chromium Cr_2S_3 is left behind, insoluble in water, only slightly attacked by hydrochloric, but readily and completely dissolved by strong nitric acid and aqua regia. The reaction is expressed by

$$2(KO,CrO_3) + 5CS_2 = 2KS_3 + Cr_2S_3 + 4CO + CO_2 + 2SO_2.$$

With antimoniate of potash the reaction is

$$2(KO,SbO_5) + 5CS_2 = 2(KSSbS_3) + 3CO_2 + 2CO_2 + 2SO_2.$$

With manganate of potash the reaction is

$$KO,MnO_3 + 2CS_2 = KS_3 + MnS + 2CO_2.$$

The author has examined the reaction between sulphide of carbon and manganate of baryta, paraphosphate of soda, and phosphate of potash; between sulphuretted hydrogen and chromate of potash, and oxalate of potash; and between hydrochloric acid and antimoniate of potash and chromate of potash. The next article is one on Lenk's "*Gun-cotton*." This is followed by one by R. Schneider "*On a new Compound of Sulphide of Mercury with Sulphide of Potassium*," and by Dr. Wurtz's paper on the "*Synthesis of Chloride of Thionyle*," which appeared in our number for March 9.

No. 37 is also filled with papers which have 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.

2125. G. E. Moore, Birmingham, "Improvements in apparatus for filtering and purifying water and other fluids."—August 18, 1866.

2145. W. E. Newton, Chancery Lane, "Improvements in the mode of, and apparatus for, the distillation, rectification, and disinfection of mineral and vegetable oils, applicable also to the purification and rectification of fatty and other products of such oils." A communication from J. B. Lahore, Rue St. Sébastien, Paris.—August 21, 1866.

2148. W. Wield, Manchester, "Improvements in treating carrageen or Irish moss, sea weed, and like plants, to reduce them into a state of powder or meal, and in arrangements and apparatus to be used for the purpose."

2153. H. Caro, Manchester, "Improvements in the preparation of colouring matters."—August 22, 1866.

1355. W. Weldon, West Hill, Highgate, Middlesex, "Improvements in the production of sulphide of sodium, and in the treatment thereof for the manufacture of soda."—Petition recorded May 11, 1866.

2062. W. Mosley, jun., Salford, Lancashire, "Improvements in furnaces."—August 11, 1866.

2201. W. Pierce, Over Darwen, Lancashire, "Certain improvements in the method of purifying gas, whereby its illuminating properties are improved, and in the apparatus connected therewith."

2204. H. A. Dufrené, Rue de la Fidélité, Paris, "Improvements in the manufacture of beer and other alcoholic liquids, and in the apparatus employed therefor."—A communication from C. Tellier, Rue Boulainvilliers, Passy, Paris.—August 27, 1866.

2215. W. E. Newton, Chancery Lane, "An improved mode of preventing oxidation of lead balls in fixed ammunition."—A communication from B. H. Jenks, Bridesburgh, Penn, U.S.A.

2218. R. Irvine, Magdalen Bridge, near Musselburgh, Midlothian, N.B., "Improvements in treating and purifying water."—August 28, 1866.

2225. J. C. Dickinson, Boston, Lincolnshire, "An improved dipping mixture for sheep and lambs."

2230. J. Davis, Sussex Road, Southsea, Hants, "An improved method of treating limestone and applying the products for purifying and rendering water palatable, and for imparting a briskness to other beverages, as also for utilising the substances to the various purposes of the builder."—August 29, 1866.

2241. H. E. Newton, Chancery Lane, "An improved process for treating and preserving beer and other fermented liquors." A communication from E. Velten, Boulevart Beaumarchais, Paris.—August 30, 1866.

Notices to Proceed.

1257. S. Bourne, Harrow, Middlesex, "Improvements in treating india-rubber and india-rubber compounds, and also india-rubber fabrics."—Petition recorded May 3, 1866.

1263. A. T. Becks, Birmingham, "Improvements in the manufacture or treatment of iron."

1274. J. G. Hope, Edinburgh, N.B., "An improved composition for destroying vermin on sheep and other animals, and for preserving them therefrom."

1278. W. Young, Straiton, Midlothian, and P. Brash, Leith, Midlothian, "Improvements in the distillation of coal, shale, and other bituminous substances, to obtain oily matters therefrom, also in the redistillation of products thereby obtained."—May 4, 1866.

1291. H. K. York, Cardiff, "Improvements in the manufacture of iron and steel."—May 5, 1866.

1320. J. L. Norton, Ludgate Hill, London, and A. Giles, Manchester, "Improvements in apparatus to be employed in evaporating volatile and combustible liquids to obtain light or heat therefrom."—May 8, 1866.

1341. J. H. A. Bleckmann, Solingen, Prussia, "An improved explosive compound."—A communication from W. Fehleisen and E. Fehleisen, Cilli, Styria, Austria.—May 10, 1866.

1395. W. Clark, Chancery Lane, "Improvements in furnaces and other fireplaces."—A communication from F. M. Piret and E. Michel, Boulevart St. Martin, Paris.—May 16, 1866.

1471. J. D. Whelpley and J. J. Storer, Boston, Suffolk, Massachusetts, U.S.A., "Improvements in the use and application of fuel, and of chemical reagents to eliminate its impurittes or those of the substances it is to heat."—May 26, 1866.

1493. J. D. Whelpley and J. J. Storer, Boston, Suffolk, Massachusetts, U.S.A., "An improved process and apparatus for obtaining metals and saleable products from ores and minerals, adapted particularly to the reduction of sulphurets."—May 29, 1866.

1888. M. A. F. Mennons, Rue Laffitte, Paris, "Improvements in the mode of, and apparatus for, generating gas for lighting, heating, and other purposes."—A communication from J. Z. Paszkowsk and O. Sabinski, Brussels, Belgium.—July 20, 1866.

CORRESPONDENCE.

On Certain Reasons for Doubling or otherwise Multiplying Chemical Formulæ.

To the Editor of the Chemical News.

Sir,—In reply to my argument showing that the probabilities were greatly against the formulæ at present employed for water, hydrochloric acid, &c., Dr. Stevenson stated that the presumption was in their favour. I therefore naturally understood him to mean that there was at least some preponderance of probability in favour of the system he had so warmly defended. It now seems, however, that when he stated that the "presumption was in favour of the simpler formulæ," he did not mean to assert that there was "a preponderance of probability in its favour, but such a preoccupation of the ground as implies that it must stand good till some sufficient reason is adduced against it." He supports the present formulæ, therefore, not because he can adduce any proof of their absolute correctness, nor even because he considers the preponderance of probability to be in their favour, for he has already virtually admitted that there are millions of chances to one against them, but simply because they are at present in use—because, so to speak, they preoccupy the ground.

With reference to the present formulæ, I may say that I consider them as convenient modes of expressing the relative number, and not the absolute number, of atoms in a given molecule. Dr. Stevenson, on the other hand, appears to regard them as expressing the absolute number of atoms in a given molecule. Hence the difference between us. We are both agreed about the propriety of leaving the present formulæ untouched for all ordinary uses; but whilst I see no harm in multiplying the formulæ for some special purposes, Dr. Stevenson seems to regard them as containing some truth which must at all hazards be preserved inviolate. I look upon the formulæ just as I regard the atomic weights themselves, as embodying a relative and not an absolute expression. Dr. Stevenson says that exchanging two affinities amounts to the same thing as interchanging one affinity. I would, however, beg leave to remind him that he seems to use the expression exchanging two affinities when he appears to mean interchanging two affinities, and that, too, in the same paper in which he speaks of exchanging two affinities as equivalent to interchanging one affinity.[*]

With regard to the alleged misquotations, I do not see that I have in any way materially altered the sense of Dr. Stevenson's remarks, and I think that any one who takes the trouble to peruse our correspondence will perceive that I have endeavoured to elicit the true meaning of the Doctor's observations.

I am, &c.

John A. R. Newlands, F.C.S.

Laboratory, 19, Great St. Helens, E.C., Sept. 17.

Reduction of Magnesium, Chromium, &c.

To the Editor of the Chemical News.

Sir,—Your correspondent, "A Novice," asks the reason "why magnesium and aluminium are not reduced from their oxides by carbon like other metals." In seeking for an explanation of this anomaly a few further considerations present themselves which I beg in turn to submit to the notice of your readers.

I am inclined to believe that magnesium, like the other metals of the alkaline earths, barium, strontium, and calcium, is incapable of reduction by carbon, in consequence of the infusible nature of its oxide and the practical impossibility of bringing the two substances into absolute contact. The same difficulty presents itself in attempting the reduction of aluminic oxide by carbon, and we should probably have expected no different result in the case of chromium had not Deville and others already stated the contrary. I quote from Fownes' "Manual of Chemistry," 8th edition, p. 318:—"The metal itself (chromium) is got in a half-fused condition by mixing the oxide with one-fifth of its weight of charcoal powder, enclosing the mixture in a crucible lined with charcoal, and then subjecting it to the very highest heat of a powerful furnace. Deville has prepared metallic chromium by reducing pure sesquioxide of chromium, by means of an insufficient quantity of charcoal in a lime crucible."

The above explanation, if true in the instances of magnesium, aluminium, &c., leaves us still unable to account for the reduction of chromium under similar circumstances. Is lime capable of forming a fusible combination with chromic oxide; or are small quantities of foreign metallic oxides in admixture, particularly those of iron and manganese, likely to aid in the reduction? The chemical properties of the metallic chromium thus obtained are described as being nearly identical with iron, and suggest the possibility of that metal sharing with it the power of combining with carbon, silicium, &c., and of having its fusing point thereby considerably reduced, and such analogy may likewise indicate a similar mode of reduction—viz., by the operation of gaseous carbonic oxide. Zinc oxide, although not itself fusible, gives up its metal by heating with carbon, but in this case the well-known reducing action of carbonic oxide certainly comes into play, and the volatile nature of the products has no doubt an influence in determining the chemical change.

It would be interesting to know whether mixtures of carbon with aluminic and chromic oxides respectively would furnish the corresponding metals in a properly regulated (reducing) atmosphere, and at the excessively high temperature of Deville's gas furnace.

I am, &c., F. C. S.

MISCELLANEOUS.

Prospects for the Dundee Meeting of the British Association.—The *Glasgow Herald* contains the following report of proceedings at the meeting of the Brechin Town Council on Wednesday last:—"The clerk

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[*] "By making C_2 in carbonic acid" (probably a misprint for carbonic oxide) "exchange two affinities, we get rid of the apparent exception to the quadrivalence of carbon in that compound, which is what Mr. Newlands wishes to do."—Dr. Stevenson, Chemical News, July 27, 1866.

read a letter from the local secretaries of the British Association at Dundee, requesting the co-operation of the Council in order to make next year's meeting a successful one, and to appoint a committee for endeavouring to insure that object. The Provost: They are looking for a sum of money, that is quite clear. Mr. P. Guthrie: I think the money might be spent in a better way. All that I know is that at the meeting at Nottingham this year they have propagated infidel principles, and that is the only thing I know they have done. The Provost: Yes; I think that on some other points, again, they have given us additional information. Bailie Craig: There is one thing to be said; if men spread infidel opinions, there is sufficient information in the public press to put it down; and I believe that religion will never collapse by any attack of so-called science. Mr. P. Guthrie: I quite agree with you. The question is, are we to encourage it? Bailie Craig: I would not encourage anybody to propagate and disseminate infidel opinions, but I believe that science, properly so called, must always be consistent with religion, and what is in the Bible; and there are sufficient defenders of the faith to refute any charges that may be brought against the truths contained in the Bible. There are so many much abler defenders of the faith than those who attack it that, in my opinion, the truth will come out untarnished. My motto is, '*Magna est veritas et prævalebit.*' The Provost: There is one thing I am very glad to see, that Bishop Forbes has prepared and published a letter encouraging all parties to study in order to be able to meet these infidel opinions at the next meeting, when there will be a fair battle. Mr. P. Guthrie: I quite agree with you; but I don't see that it is necessary for us to encourage such an association. Bailie Craig: We don't encourage anybody to propagate heretical opinions. We rather encourage individuals to defend what we call the doctrines of the faith, which will be done at the subsequent meeting, I have not the slightest doubt. I see a very great deal of discussion has taken place upon Grove's speech, and very able arguments have already been brought forward against it. I don't think we need be at all discouraged. Mr. P. Guthrie: I don't believe but that these people will be driven down very shortly; but if that association is for the purpose of inculcating infidel doctrines, I don't see what necessity we have to encourage it. As I have said already, I believe these men will be thoroughly driven down. Mr. Mill: The association takes all and sundry. It is just as well that their opinions should be ventilated and exposed. Mr. P. Guthrie: If you like to encourage that sort of thing. Mr. Mill: I will encourage the association; but not infidelity. Mr. P. Guthrie: Very well; if you will encourage it just do it, Mr. Mill. Mr. Mill: But you cannot help it. The Provost: It is but a small section of the association. I don't know how many sections there may be. I was just in a small section. Mr. P. Guthrie: It is the section that bears upon the truth of the Bible. The Provost: Grove, being president of the association, should never have led off with that sort of thing. If he had confined the subject to his being the convener of the section, it would not have been so objectionable. But it is rather a question we should not enter into just now. I move that the letter lie on the table till next meeting. This was unanimously agreed to."

The Royal Observatory.—For some time past Mr. John Browning, a gentleman well known in scientific circles, has been erecting, under the supervision of the Astronomer Royal and Mr. Glaisher, a new set of instruments for registering the speed and pressure of the wind. As the instruments are both near completion, and are, indeed, in operation, a description of them cannot be read without interest. The first, for registering the force of the wind, consists of a circular plate of metal of a diameter equal to two square feet in area, supported by eight tempered steel springs. When the wind impinges on the circular plate the springs are brought consecutively into action, the stronger coming into play before the weaker have received any strain. The plate is kept constantly facing the wind by means of a direction vane. From the plate a fine flexible wire is carried down through a hollow pillar which supports the vane, the whole apparatus being in a room below. The wire governs the motion of a pencil, which is made to traverse a table covered with slate, on which is strained a sheet of paper marked with the hours. This table is moved by clockwork, and the pencil being regulated by the pressure-plate registers on the paper the pressure of the wind during every portion of the twenty-four hours. The instrument, which is capable of registering as light a pressure as even two or three ounces on the square foot, will in strong gales have to withstand a force of 40 lbs. to the square foot.—*Times*, September 13, 1866.

Novel Remedy for Steam-Boiler Incrustations.—The members of the British Association were recently favoured, at Derby, with the following description of a new mode of preventing the formation of calcareous deposits in steam-boilers, told, not as a joke, but seriously:—Within the dome of a stationary boiler are mounted a series of small horse-shoe magnets, carefully insulated by electric non-conductors from the adjacent metallic parts and anterior portion of the boiler, but connected with each other by copper wires, and by the same means placed in communication with the back part of the boiler, so that the magneto-electric current generated by the action of the steam may be conducted from front to rear and induce opposite electrical states or polarity, whereby it is believed that the tendency to crystallisation of the calcareous particles thrown down upon ebullition will be overcome or counteracted by the unfavourable electrical condition in which both the plates and contents of the boiler are maintained, and that no adherent crust will, under such circumstances, be formed. It was further stated that this ingenious process was still under trial, but already the preliminary indications were said to be giving great promise of success, and the magnets only required occasionally retouching.

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. B. wishes to know the best market for purchasing paraffin wax.

Vulcan.—An immense fortune could be made by any one who succeeded in doing what you ask.

O. O.—Consult the index of our last volume.

Thomas Davies.—Angelic acid is prepared by saponifying essence of camomile with hydrate of potash.

A Manufacturer asks if any one can supply him with a formula for making green and yellow ink that will dye cotton spots in woollen pieces.

P. H. R.—Liebig has written several works on agricultural chemistry. Lawes and Gilbert's paper is published in the *Transactions* of the Royal Agricultural Society. Messrs. Clowes and Sons will probably give you information.

F. C. Y.—Dr. Percy has found gold in almost every sample of commercial lead and its salts which he has examined. See his paper on the subject in the *Phil. Mag.* for February, 1864.

James.—No process is known for estimating traces of carbolic acid when dissolved in water. If you are certain no other organic matter but carbolic acid is present, you may estimate it by means of a standard solution of permanganate of potash.

Brewer's Man.—Picric acid may be detected in beer by pouring into the liquid an excess of tribasic acetate of lead, and filtering. Pure beer is almost immediately decolorised, whilst if picric acid is present the solution will remain of a citron-yellow colour.

J. H. Myers.—Permanganate of potash is made by adding a solution of 10 parts of caustic potash, in a very small quantity of water, to a finely divided mixture of 8 parts of peroxide of manganese and 7 parts of chlorate of potash. Evaporate to dryness; ignite at a low red heat; reduce to coarse powder; boil in water; filter through asbestos; evaporate; filter again, if necessary, and allow to crystallise.

STAMPING OUT THE CATTLE PLAGUE.

Notwithstanding the steady decline in the weekly returns of cattle plague cases, testifying to the success of the measures recommended by the Cattle Plague Commission and carried out by the Government, there is great reason to apprehend that the evil is by no means diminished to the extent which a reference to the bare statistics would justify us in assuming. From all that we are able to learn, the disease has lost little, if any, of its virulence. When it appears on a farm, it is as likely to go through the whole stock as when it was at the height in February last; and were the cattle allowed to linger on as in the early days, there is no doubt that the proportion of deaths to recoveries would be equally great. The plague is simply being kept under by main force, and probably part of its rapid decline may be due to the fact that during the last few months the cattle have been almost entirely in the fields instead of being tied up in sheds. The time, however, is rapidly approaching when the supply of green food will fall off, and the greater part of the stock will be concentrated in the farm buildings. Now, whatever may be the amount of safety conferred upon cattle by strict isolation in thoroughly disinfected sheds—and, with the plague in the neighbourhood, it is generally admitted that a well-disinfected shed is the safest place for an animal—it is self-evident that, when the disease does attack one of a herd, it will pass from one to another with far greater rapidity when they are shut up together, than when they are in open fields; and there is danger that, if the disease is not entirely stamped out within the next six or eight weeks, it will begin to spread again; and although the experience and organisation which has now been acquired may probably prevent it from again assuming serious proportions, this immunity can only be purchased with the continuance of the irksome, though most necessary, regulations now in force. We wish to call attention to a plan which is the result of some successful attempts to stamp out the cattle plague from a considerable tract of country in the neighbourhood of Stafford, where it was raging with great virulence when our operations were commenced.

Until the publication of the Third Report of the Cattle Plague Commission, it was universally considered that an animal, after being infected, passed through a period of incubation, which varied from three to five days; and it was only towards the end of this period that the disease could be detected. At this stage the alteration of the mucous membranes had commenced, and the exhalations and discharges were loaded with virus, and were highly infectious. It followed, therefore, that the disease could not be detected in an animal until it was so far advanced as to be highly dangerous to others; and even were the most rigorous measures of isolation and killing adopted, it would scarcely prevent the plague going right through a herd when once introduced; for the disease could not be observed in the first animal, until it had infected a second, and the second would not appear ill until it had communicated the plague to a third, and so on. The disease would commence with a start of at least forty-eight hours, and would keep this much ahead until the last animal had succumbed. The precautionary measures might closely follow, but would never outstrip its progress.

Recent researches, and especially those of Dr. Sanderson, have now placed us in possession of a method of getting ahead of the disease in its progress through a herd. The judicious use of the thermometer[*] will now point out when the animal is *about to take* the disease, whilst it is still in the exercise of its healthy functions. We are by this means placed in possession of the ground almost before the enemy approaches. We can seize upon an animal, and separate it from the rest when it is in the first initial stage of the disease, and at least twelve hours before it becomes capable of communicating infection to another. To use a not uncommon simile, let us compare a herd of cattle to a row of cards on end. If the first is overthrown, it strikes against the second, and causes it to fall; the second overthrows the third; and so on to the end of the pack. The measures hitherto adopted in an infected district are similar to those of a person following the falling cards, and quickly removing one *after* it has struck down the one in front of it. But, by the employment of the thermometer, we are enabled to adopt measures which may be compared to the arresting of a card at the very commencement of its fall, and *before* it could touch the one before it.

Armed, therefore, with the thermometer, possessed of the responsibility instantly to kill apparently healthy animals on the strength of its indications, and supplementing this with vigorous disinfecting measures, the stamping out of the cattle plague on any infected farm, district, or county, is, in theory, reduced to a mathematical certainty.

The average normal temperature of a healthy animal is about 102°F., but this may vary in different herds, sometimes rising as high as 103·5° without danger. A certain temperature, say 103°, should be fixed upon as an arbitrary limit between health and disease, and the stock in an infected district should be carefully examined with the thermometer once or twice a day at milking time.

A thoroughly well disinfected shed should be set apart, as far as possible removed from the healthy stock; and when a temperature is recorded of above 103°, the animal should be placed in this shed in quarantine. If on subsequent examination the temperature of an animal in quarantine were found to sink to below the fixed limit, it might be considered to show that it was not in an incipient stage of the disease, and it might be replaced amongst the general stock; but if its temperature were found to be rising, it should be slaughtered without a moment's delay as soon as the thermometer registered—say 103·5° or 104°. At this point, the animal, if on an infected farm, is pretty certain to be in an early stage of the disease; but as no outward signs of it whatever are apparent, as the most skilful expert in the country would probably pronounce it healthy upon ordinary inspection, there is no reason to fear that it has arrived at the infectious stage of the disease.

It may, however, be urged that a rise in temperature may take place without its being due to cattle plague. This is true; but in an infected herd it is very much more probable that the increased temperature is due to the particular disease to which the animals are exposed than to any other;[†] and when there are nine chances in favour of the rise in temperature being caused by incipient cattle plague, and only one chance in favour of its being due to some other cause, it is certainly worth while to secure the safety of the rest of the herd at the risk of occasionally slaughtering an animal which, after all, might not be sickening for the disease.

The plan of disinfection, which should in all cases go hand in hand with the above system of detection and slaughter, is similar to the one already described in the

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[*] See Dr. Sanderson's Report, page 17.

[†] Dr. Sanderson's Report, page 16.

Third Report of the Cattle Plague Commission, with such alterations as further experience has shown to be necessary. They have now been too fully tested in every infected county in the kingdom, to leave any doubt as to their efficacy.

So long as the deaths from the plague were several hundreds per week, it was hopeless to attempt its stamping out by any such stringent measures as are here suggested; but now that the centres of infection are few in number, it becomes a question whether the time has not arrived for such a system of intelligent but uncompromising slaughter to be carried into successful operation. If simultaneously adopted all over the country by a sufficient staff of skilled officers, there is every human probability that the Cattle Plague would be extirpated in less than a month's time.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

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

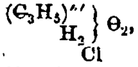
PART III.

CONNEXION BETWEEN ORGANIC AND INORGANIC CHEMISTRY.

SECTION IV.—*Inorganic and Organic Chlorides, Bromides, &c.*

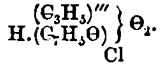
(*Continued from page 135.*)

IN all the chlorhydrines which still contain one or more atoms of typical hydrogen, this hydrogen may be replaced by radicals of acids. M. Berthelot* has described, under the name of benzochlorhydrine, a glyceric compound which may be looked upon as chlorhydrine in which 1 atom of typical hydrogen has been replaced by the benzoyl radical.



$$\begin{array}{c}\left.\begin{array}{r}(C_3H_5)'''\\ H_2\end{array}\right\}\Theta_2,\\ Cl\end{array}$$

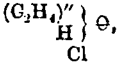
Monochlorhydrine.



$$\begin{array}{c}\left.\begin{array}{r}(C_3H_5)'''\\ H.(C_7H_5\Theta)\end{array}\right\}\Theta_2.\\ Cl\end{array}$$

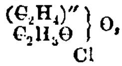
Benzochlorhydrine.

Mr. Maxwell Simpson† has likewise prepared an analogous ethylenic compound—viz., acetochlorhydrine of glycol, or acetochlorhydric glycol; he obtained it by submitting glycol to the simultaneous action of hydrochloric and acetic acids. This body represents chlorhydric glycol, whose typical hydrogen has been replaced by the acetylic radical.



$$\begin{array}{c}\left.\begin{array}{r}(C_2H_4)''\\ H\end{array}\right\}\Theta,\\ Cl\end{array}$$

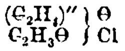
Chlorhydric glycol.



$$\begin{array}{c}\left.\begin{array}{r}(C_2H_4)''\\ C_2H_3\Theta\end{array}\right\}\Theta,\\ Cl\end{array}$$

Acetochlorhydric glycol.

or



$$\left.\begin{array}{r}(C_2H_4)''\\ C_2H_3\Theta\end{array}\right\}\begin{array}{l}\Theta\\ Cl\end{array}$$

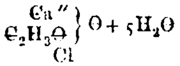
Ethylenic acetochlorhydrine.

We know a certain number of inorganic compounds that possess an analogous constitution.

When we evaporate an aqueous solution of equivalent quantities of acetate of lime and of chloride of calcium, we obtain large crystals permanent in the air, which contain, according to the analysis of M. Fritzsche—

$$CaCl + C_4H_3CaO_4 + 10HO.$$

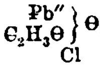
This substance is a calcic acetochlorhydrine,



$$\begin{array}{c}\left.\begin{array}{r}Ca''\\ C_2H_3\Theta\end{array}\right\}\Theta + 5H_2\Theta\\ Cl\end{array}$$

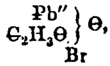
Calcic acetochlorhydrine.

M. Carius‡ has lately described some plumbic compounds anologous to the preceding, and has perfectly ascertained and defined their constitution. These compounds are formed by the direct addition of chloride, bromide, or iodide of lead to a solution of acetate of lead made acid with acetic acid. Their composition may be expressed by the following formulæ:—



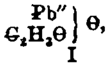
$$\begin{array}{c}\left.\begin{array}{r}Pb''\\ C_2H_3\Theta\end{array}\right\}\Theta,\\ Cl\end{array}$$

Plumbic acetochlorhydrine.



$$\begin{array}{c}\left.\begin{array}{r}Pb''\\ C_2H_3\Theta\end{array}\right\}\Theta,\\ Br\end{array}$$

Plumbic acetobromhydrine.

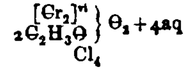


$$\begin{array}{c}\left.\begin{array}{r}Pb''\\ C_2H_3\Theta\end{array}\right\}\Theta,\\ I\end{array}$$

Plumbic aceto-iodhydrine.

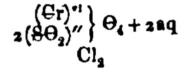
Let us here remark that the existence of these calcic and plumbic compounds furnishes a good argument in favour of the diatomicity of calcium and of lead, which may be compared in this respect to ethylene.

By dissolving the basic tetrachloride of chromium in ammonia (page 6), M. Hugo Schiff§ obtained a salt which he calls acetotetrachloride of chromium, and whose composition he represents by the formula—



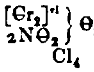
$$\begin{array}{c}\left.\begin{array}{r}[Cr_2]^{vi}\\ 2C_2H_3\Theta\end{array}\right\}\Theta_2 + 4aq.\\ Cl_4\end{array}$$

He also describes a sulphodichloride—



$$\begin{array}{c}\left.\begin{array}{r}(Cr)^{vi}\\ 2(S\Theta_2)''\end{array}\right\}\Theta_4 + 2aq.\\ Cl_2\end{array}$$

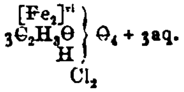
and a nitrotetrachloride—



$$\begin{array}{c}\left.\begin{array}{r}[Cr_2]^{vi}\\ 2N\Theta_2\end{array}\right\}\Theta_2\\ Cl_4\end{array}$$

which possesses an analogous constitution.

Further, he justly proposes to consider the ferric acetochloride described by M. Scheurer-Kestner|| as an acetochlorhydrine—

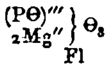


$$\begin{array}{c}\left.\begin{array}{r}[Fe_2]^{vi}\\ 3C_2H_3\Theta\\ H\end{array}\right\}\Theta_4 + 3aq.\\ Cl_2\end{array}$$

There are a certain number of minerals which possess a constitution analogous to that of the acetochlorhydrines just mentioned. Thus there are wagnerite and apatite, well-defined kinds of minerals. Their composition is usually represented by the formulæ—

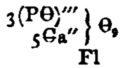
$$PO_5, 3MgO + MgFl; \text{ and } 3(PO_5,3CaO) + CaFl;$$

and they are looked upon as double compounds of phosphates and of fluorides or of chlorides. If we adopt for oxygen, magnesium, and calcium, atomic weights double their equivalents, the preceding formulæ become, in the typical notation—



$$\begin{array}{c}\left.\begin{array}{r}(P\Theta)'''\\ 2Mg''\end{array}\right\}\Theta_8\\ Fl\end{array}$$

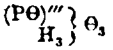
Magnesian phosphofluorhydrine (wagnerite).



$$\begin{array}{c}\left.\begin{array}{r}3(P\Theta)'''\\ 5Ca''\end{array}\right\}\Theta_9\\ Fl\end{array}$$

Calcic triphosphofluorhydrine (apatite).

Here there is an important remark to be made. Ordinary phosphoric acid



$$\left.\begin{array}{r}(P\Theta)'''\\ H_3\end{array}\right\}\Theta_3$$

requires, to saturate it, more than 1 molecule of magnesia—

$$Mg''\Theta. \quad (Mg = 24),$$

for

$$Mg'' \text{ only equals } H_2;$$

but 2 molecules of magnesia, which contain 2 atoms of magnesium, are too much for saturation—in fact,

$$2Mg'' \text{ equals } H_4$$

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[*] *Annales de Chimie et de Physique*, 3rd series, vol. xli., p. 301.

[†] *Proceedings of the Royal Society*, vol. ix., p. 725.

[‡] *Annales de Chimie et de Physique*, 3rd series, vol. xviii., p. 207.

[§] *Annales de Chimie et de Physique*, 3rd series, vol. lxvi., p. 147.

[||] *Ibid.*, 3rd series, vol. lxiii., p. 422.

and phosphoric acid only contains H_3. Now, wagnerite contains exactly 2 atoms of magnesium: it would then be supersaturated if the fourth unit of combination of the group

$$2Mg''$$

was not saturated by fluorine. The same reasoning applies to apatite and to the calcium which it contains. We see that, when looked at from the dualistic point of view, the fluorine or chlorine plays an important and necessary part in these compounds, whose composition appears at first so strange. I may add that the presence of such a monatomic element in these compounds furnishes an argument in favour of the diatomicity of magnesium and calcium. If magnesium were monatomic, the fluorine would be useless, for

$$3Mg(Mg=12)$$

could replace 3H in ordinary phosphoric acid $PH_3\Theta_4$. But this metal, together with calcium, being diatomic, and therefore of even atomicity, the presence of a monatomic element is necessary to complete the uneven atomicity of the phosphoryl $(P\Theta)'''$.¶

We may extend this point of view to other compounds. There is a chlorophosphate of lead whose composition is exactly analogous to that of apatite. It is pyromorphite—

$$\begin{array}{c}\left.\begin{matrix}3(P\Theta)''' \\ 5Pb''\end{matrix}\right\}\Theta_9 \\ Cl\end{array}$$

Pyromorphite.

a mineral in which calcium and fluorine may replace a certain quantity of lead and chlorine. Mimetese offers an analogous constitution, except that a certain quantity of phosphoric acid is replaced by arsenic acid.

Cerasine, or horn lead, forms a chlorocarbonate of the form—

$$\begin{array}{c}\left.\begin{matrix}2Pb'' \\ \Theta\Theta\end{matrix}\right\}\Theta_2 \\ Cl_2\end{array} \quad \text{derived from the hypothetical hydrate} \quad \left.\begin{matrix}2Pb'' \\ H_4\end{matrix}\right\}\Theta_4$$

I should likewise point out that this formula may be written—

$$\left.\begin{matrix}2Pb'' \\ \Theta\Theta\end{matrix}\right\}\begin{matrix}\Theta_2 \\ Cl_2.\end{matrix}$$

And the same remark applies to the formulæ of all the organic and inorganic chlorhydrines. The notation I have hitherto preferred to employ** shows more clearly than the preceding formula the relations of these chlorhydrines to the corresponding hydrates.

Gerhardt has analysed a mercurous nitrophosphate which contains one molecule of mercurous phosphate united to one molecule of mercurous nitrate. This compound, represented in equivalents by the formula—

$$NO_5,Hg_2O + PO_5,3Hg_2O + 2HO,$$

may be considered as a kind of wagnerite in which the magnesium is replaced by mercurosum ($Hg_2 = 400$) and the fluorine by nitrous gas—

$$\left.\begin{matrix}(P\Theta)''' \\ 2[Hg_2]''\end{matrix}\right\}\begin{matrix}\Theta_3 \\ (N\Theta_2)'\end{matrix} + H_2\Theta.$$

(To be continued.)

On the Detection of Iodine, by M. Carey Lea.

Where iodine exists in the form of hydriodic acid or the iodide of a base, two methods are commonly employed to put it into a condition to be detected by the starch test. One of these is by the action of nitric acid, the other by chlorine or bromine water; the latter is the more delicate, but has the disadvantage that if the chlorine or bromine be added in excess the reaction is missed.

It occurred to me while engaged in testing for iodine that the facility with which that body is eliminated from its hydrogen and metallic combinations by chromic acid would make the latter substance a valuable means of bringing about the starch reaction, and a few experiments completely confirmed this view.

If, for example, we take an extremely dilute solution of iodide of potassium, such that the addition of nitric acid and starch produces no perceptible effect, the further addition of a single drop of very dilute solution of bichromate of potash will instantly bring about the characteristic reaction. When chlorhydric acid is substituted for nitric, the effect of the bichromate is (as was to be expected) still more marked. The test has, then, the full delicacy at least of the chlorine test, with this great advantage, that an excess of the reagent does not prevent the reaction.

As to the delicacy of this test, the following observations were made:—With solutions of iodide of potassium up to $\frac{1}{100000}$th. the precipitate was abundant, becoming less blue and more tawny as the dilution increased. Beyond this point the distinctness rapidly fell off. The indications were observable at $\frac{1}{400000}$th. With a solution of $\frac{1}{800000}$th it was doubtful whether any effect was evident, though still it was thought that a darkening was produced. The experiment can be made in two ways, according to the result desired.

If it is wished to observe the effect of the chromic acid in increasing the delicacy of the indication, add the acid and starch to the very dilute solution of iodide, and then, when the extreme dilution is such that no reaction appears, a drop of solution of bichromate instantly produces it. But in employing the reagent in the search for iodine, add the starch to the liquid to be tested, stir it up, add a drop of dilute solution of bichromate, enough to communicate a pale yellow colour, and finally add a few drops of chlorhydric acid. The test is then the production of the characteristic precipitate, or in case of great dilution, approaching to a half-millionth, merely a tawny shade given to the solution.

It seems scarcely necessary to say that if a very great excess of acid is used, and too much bichromate, the starch may be made to reduce the bichromate. Even this, however, cannot deceive, for a bluish-green solution is thereby produced, whereas the indications of iodide are in the order of their strength — blue precipitate, tawny precipitate, tawny solution. Unless in the case of very exceptional dilution above spoken of, a well-marked blue precipitate is always obtained.

¶ My friend, Dr. Odling, has called my attention to a salt described by M. Briegleb (*Annalen der Chemie und Pharmacie*, vol. xcviii., p. 95), and represented by the formula $3NaO,PO_5+NaFi+24HO$. Without attempting to deny that the existence of this salt weakens the argument drawn from the constitution of wagnerite in favour of the diatomicity of magnesium, I would, however, point out:—

1. That this salt is very unstable, for boiling water decomposes it into a phosphate and a fluoride. We know, on the other hand, that wagnerite and apatite possess great stability, and that, when they contain chlorine, boiling water never extracts from them chloride of magnesium or calcium.

2. That it is impossible to obtain the corresponding fluophosphate of potassium.

3. That the salt in question contains water of crystallisation, and that, even in this respect, it is not comparable to wagnerite.

We owe to M. Cannizzaro another argument in favour of the diatomicity of calcium and barium. This is it—There is neither a quadroxalate of calcium nor a quadroxalate of barium, whilst there is a quadroxalate of potassium. In fact, an atom of hydrogen may be replaced in two molecules of oxalic acid by an atom of potassium, but not by a diatomic atom of calcium—

$$(\text{Ca}'' = 40).$$

As the latter displaces two atoms of hydrogen, the product of the substitution can be only a binoxalate or a neutral oxalate.

** M. Weltzien proposed this notation the same time that I did.

The examination of the delicacy of the reaction with very dilute solutions was made at a temperature of 65° F., or thereabouts. This fact requires to be taken into account, as according to some experiments of Fresenius, to be found in the *Jahresbericht* for 1857, the delicacy of the starch test increases as the temperature falls, so that at 0° C. a fainter trace can be rendered evident than at 12° C., and so on; the difference is asserted to be material. Fresenius's experiments were made with sulphuric acid and hyponitric acid, and the delicacy of the reaction obtained by him at corresponding temperatures seems to fall a little short of the above.—*Amer. Jour. of Science*, vol. xlii., No. 124.

TECHNICAL CHEMISTRY.

On a New Process in the Manufacture of White Lead,* *by* PETER SPENCE, *Esq.*

WHITE LEAD is one of the staple chemical products of almost first necessity. It has long been in use as the basis of nearly all the pigments employed in oil painting, few, if any, of the colouring bodies having the qualities that are required for painting in oil; and although, from its susceptibility to discoloration on the slightest contact with sulphuretted hydrogen and also from its poisonous character, substitutes for it have been eagerly sought after, as yet nothing has been found to supersede it. Anhydrous oxide of zinc has to a certain extent been introduced, but does not appear to make any way. It has not an equal covering quality with carbonate of lead; but its chief defect is its want of permanency. White lead forms an almost indestructible compound with the oil, while oxide of zinc forms only a mixture. The various modes that have more or less been adopted in the manufacture of white lead are historically known to those interested in chemical manufactures. Almost all of these processes are based on the action of acetic acid upon lead or lead oxide, with the exception of the process patented by Pattison in 1841, which is founded on the decomposition of galena by hydrochloric acid, the formation of chloride of lead, and the decomposition of the chloride by alkalies or by alkaline earths, such as lime or magnesia. Practically, this process is now confined to the production of oxychloride of lead, which seems to act with oil to a great extent like white lead. The oldest, most successful, and most generally practised mode of producing white lead, is that called the Dutch process; by this mode the object is accomplished by placing castings of pure lead of a suitable form one over another in stoneware pots, in the bottoms of which acetic acid or vinegar is poured; the pots are then loosely covered and piled in masses, the whole being then covered over with spent tan or some other slowly fermenting body, which will generate a small degree of heat for a considerable period. This evaporates the acetic acid, which acts on the lead, oxidising it and partially carbonating the oxide, and in about eight weeks the greater part of the lead is corroded and converted into oxide and carbonate of lead, the acetic acid is spent, and the crude lumps of white lead are ground. Any metallic lead left being picked out, and after washing, the article is ready for use. Nearly all the white lead now made in this country is by this mode. The German and Austrian process is the same in principle as the Dutch, but differs in detail. A good many attempts at the manufacture of white lead have been founded on the fact that acetate of lead in solution has the property of dissolving lead oxide, forming a basic compound.

My reasons for presenting to the Chemical Section of the British Association a process which may at first sight appear only as one of the many futile attempts to improve upon the established mode of producing white lead are two:—First, that the process is new, being in altogether a different direction from any attempt that I can find recorded, and although based upon a known law, yet that law never having been seen to point to this process, it is technologically a discovery. My second reason, is that a very important feature of the process as distinguished from all others is, that by it white lead can be manufactured from materials now useless. All other modes deal either with the purest metallic lead or equally pure oxide of lead. Pattison's process must deal either with the purest galena, free from iron or copper, or the chloride of lead must subsequently be freed from contamination by these metals or others, before it is used for the precipitating of oxychloride. By the process I shall now describe, any ore or mineral that contains eight or ten ounces of lead can be used for the production of white lead, and it is of no consequence what other metal the mineral contains; the process separates the lead directly without touching the other constituents of the mineral, and the white lead is perfectly pure. This being so, practically, I expect that all the white lead required may be made from ores or minerals now consigned to the rubbish heap as being too poor to work, and I know of large quantities of minerals useless as lead ores which will be economically adapted for the production of white lead. The process is based on the fact that oxide and carbonate of lead are soluble in solutions of caustic soda or potash, and are insoluble in the carbonates of these alkalies; the process, therefore, is effected by taking any mineral that contains oxide or carbonate of lead, or lead in any form that can by calcination or otherwise be converted into oxide or carbonate of lead, and by either macerating or boiling the mineral in a caustic solution all the lead is dissolved and extracted in a limpid and colourless solution. If the mineral contains oxide of iron, copper, or zinc, the caustic solution does not touch any of these oxides, and only attacks the lead. The lead solution has now passed into it carbonic acid gas, by which the alkali being carbonated, the lead is instantly precipitated as oxide and carbonate. The alkaline solution is now causticised by quick lime, and is ready for a second action on mineral containing lead oxide. The precipitated white lead has only to be washed to separate the solution of carbonated alkali, and then dried for use. A sample of it is on the table. It has been tried for painting, and is said by the painter, who had it used in various ways by his workmen, to be equal to any white lead he could procure. It has also been tried as a glaze in the potteries, and declared to be equal to any white lead the firm had in stock. As the process, at least in the laboratory, is a rapid one, if it would at all gratify the Section, I have the materials at hand, and can show it all in half an hour. The substance from which I shall now extract pure white lead had the following composition before calcination. I have brought the materials already calcined, as the calcination could not have been done here. Analysis—Zinc, 30·656; sulphur, 26·483; silica, 19·154; lead, 13·148; iron, 9·121; copper, 1 027; alumina, 0·216; silver, 0·022; moisture, 0·122; total, 99·949.

Mr. Spence then demonstrated by experiment the manufacture of white lead upon the principle given in the paper.

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* Read before the British Association, Nottingham meeting.

In the discussion which followed, Professor Playfair said the precipitation of oxide of lead by carbonic acid was described upwards of twenty-five years ago by Thenard, and it was even carried into manufacturing process before; but it was abandoned on account of its being too crystalline and not sufficiently opaque. The plan, however, of getting oxide of lead out of minerals by means of alkaline solution was novel, and appeared to give promise of very useful application, whether the precipitate was found adapted to painting purposes or not.

PHYSICAL SCIENCE.

*On the Refraction and Dispersion Equivalents of Chlorine, Bromine, and Iodine,** by Dr. GLADSTONE, *F.R.S.*

THE refraction equivalent of a substance is the product of its atomic weight with its specific refractive index—that is, its refractive index minus one, divided by its density. Its dispersion equivalent is the difference between the refraction equivalents as calculated for the two extreme lines of the spectrum A and H. From data previously published by the author and the Rev. T. P. Dale, many determinations of these equivalents for chlorine, bromine, and iodine had been made. The following are from compounds of the halogens with methyl, ethyl, &c., and show that in each case the number for bromine lies between those for the other two:—

	Chlorine.	Bromine.	Iodine.
Refraction equivalent .	9·8	15·5	24·2
Dispersion " .	0·5	1·3	2·6

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION.

Friday, June 8, 1866.

On the Source of Muscular Power, by EDWARD FRANKLAND, *Ph.D., F.R.S., Professor of Chemistry, R.I.*

(Continued from page 140.)

THERE is still another circumstance which requires to be taken into consideration before we proceed to apply our three data to the solution of the problem before us. It is this—Is it possible that at the termination of the ascent of the Faulhorn there might be a considerable quantity of the nitrogenous products of decomposition retained in the body? Considering the physiological effect of the retention of urea in the system, as exemplified whenever the secretion of urine is interrupted, it is difficult to imagine the possibility of any considerable quantity of urea being retained in the system of a healthy man. It is, however, otherwise with creatin, another of the products of the metamorphosis of tissue; for it has been repeatedly shown that a muscle which has been hard worked contains more creatin than one that has been at rest. Thus the quantity of creatin contained in the heart of an ox was found to be ·14 per cent. (Gregory), and that in other ox-flesh only ·06 per cent. (Staedeler). Now the muscles which extend the leg in walking, and which do the essential work in ascending, have been estimated by Weber to weigh in both legs 5·8 kilograms, and if we assume that before the ascent these muscles contained ·06 per cent. of creatin, whilst after the ascent the percentage had increased to ·14 per cent., then the amount of creatin thus exceptionally retained would amount to 4·64 grams, which would be derived from 8·4 grams of muscle.

The speaker had been unable to determine the calorific effect of creatin, and consequently the actual energy developed by the transformation of muscle into creatin; for, although he was kindly furnished with an ample supply of this material by Dr. Dittmar, yet all attempts to burn it in the calorimeter were fruitless. Even when mixed in very small proportions with chlorate of potash and other combustibles of known value, the mixture invariably exploded violently on ignition. Although actual determination thus fails us, there can be no doubt that the transformation of muscle into creatin and other non-nitrogenous products must be attended by the liberation of far less actual energy than its transformation into urea, carbonic acid, and water. To be convinced of this, it is only necessary to compare (under equal nitrogen value) the formulæ of muscle, creatin, and urea, remembering at the same time that the nitrogen probably possesses no thermal value, and that each atom of oxygen destroys approximately the thermal effect of two atoms of hydrogen.

	Comparable formulæ.	Powerful or unburnt matter.
Muscle . .	$C_{24}\ H_{27}\ N_6\ O_7$	$C_{24}\ H_{23}$
Creatin . .	$C_8\ H_{18}\ N_6\ O_4$	$C_8\ H_{10}$
Urea . .	$C_3\ H_{12}\ N_6\ O_3$	$C_3\ H_6$

Thus it is evident that the amount of creatin exceptionally retained in the system could not greatly affect the result of the experiment as regards the possible amount of actual energy derivable from the metamorphosed tissues during the ascent; firstly, on account of the small quantity of creatin so retained, and, secondly, because creatin still contains about one-third of the potential energy of tho muscle from which it is derived. But as this point cannot be experimentally demonstrated, the speaker followed the example of Fick and Wislicenus, and made a very liberal allowance on this score. He allowed, as they had done, that the whole of the nitrogen secreted during the six hours after the ascent was exceptionally retained in the system *as urea* during the ascent. This is equivalent to an admission that the muscles of the legs contained at the end of the ascent eleven times as much creatin as was present in them before the ascent. In the above tabular statement of results provision has been made for this allowance by adding together, on the one hand, the amounts of nitrogen secreted during the ascent and six hours after it, and, on the other, the weights of dry muscle corresponding to these two amounts of nitrogen.

Having thus far cleared the ground, let us now compare the amount of measured and calculated work performed by each of the experimenters during the ascent of the Faulhorn, with the actual energy capable of being developed by the maximum amount of muscle that could have been consumed in their bodies, this amount being represented by the total quantity of nitrogen excreted in each case during the ascent and for six hours afterwards.

	Fick.	Wislicenus.
	Grams.	Grams.
Weight of dry Muscle consumed .	37·17	37·00
	Metrekilograms.	Metrekilograms.
Actual energy capable of being produced by the consumption of 37·17 and 37·00 grams of dry Muscle in the body	68,690	68,376
Measured work performed in the ascent (external work)	129,096	148,656
Calculated circulatory and respiratory work performed during the ascent (internal work)	30,541	35,631
Total ascertainable work performed .	159,637	184,287

It is thus evident that the muscular power expended by these gentlemen in the ascent of the Faulhorn could not be exclusively derived from the oxidation, either of their

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[illegible] before the British Association, Nottingham meeting.

muscles, or of other nitrogenous constituents of their bodies, since the maximum of power capable of being derived from this source even under very favourable assumptions is, in both cases, less than one-half of the work actually performed. But the deficiency becomes much greater if we take into consideration the fact that the actual energy developed by oxidation or combustion cannot be wholly transformed into mechanical work. In the best constructed steam-engine, for instance, only one-tenth of the actual energy developed by the burning fuel can be obtained in the form of mechanical power; and in the case of man, Helmholtz estimates that not more than one-fifth of the actual energy developed in the body can be made to appear as external work. The experiments of Haidenhain, however, show that, under favourable circumstances, a muscle may be made to yield in the shape of mechanical work as much as one-half of the actual energy developed within it, the remainder taking the form of heat. Taking, then, this highest estimate of the proportion of mechanical work capable of being got out of actual energy, it becomes necessary to multiply by 2 the above numbers representing the ascertainable work performed, in order to express the actual energy involved in the production of that work. We then get the following comparison of the actual energy capable of being developed by the amount of muscle consumed, with the actual energy necessary for the performance of the work executed in the ascent of the Faulhorn.

	Fick. Metre-kilograms.	Wislicenus. Metre-kilograms.
Actual energy capable of being produced by Muscle metamorphosis .	68,690	68,376
Actual energy expended in work performed	319,274	368,574

Thus, taking the average of the two experiments, it is evident that scarcely one-fifth of the actual energy required for the work performed could be obtained from the amount of muscle consumed.

Interpreted in the same way, previous experiments of a like kind prove the same thing, though not quite so conclusively. To illustrate this I will here give a summary of three sets of experiments; the first, made by Dr. E. Smith, upon prisoners engaged in treadmill labour; the second, by the Rev. Dr. Haughton, upon military prisoners engaged in shot drill; and the third, adduced by Playfair and made upon pedestrians, piledrivers, men turning a winch, and other labourers.

TREADWHEEL EXPERIMENTS.

A treadwheel is a revolving drum with steps placed at distances of 8 inches, and the prisoners are required to turn the wheel downwards by stepping upwards. Four prisoners, designated below as A, B, C, and D, were employed in these experiments, and each worked upon the wheel in alternate quarters of an hour, resting in a sitting posture during the intervening quarters. The period of actual daily labour was 3½ hours. The total ascent per hour 2160 feet, or per day 1·432 mile. The following are the results:—

Treadwheel Work.—(E. Smith.)

	Weight in Kilograms.	Ascent in Metres.	Days occupied in Ascent.	External work performed in Metrekilograms.	Total Nitrogen evolved.	Weight of dry Muscle corresponding to Nitrogen.
					Grams.	Grams.
A	47·6	23,045	10	1,096,942	171·3	1101·2
B	49	23,045	10	1,129,205	174·5	1121·7
C	55	20,741	9	1,140,755	168·0	1080·1
D	56	20,741	9	1,161,496	159·3	1024·3

In these experiments the measured work was performed in the short space of three hours and a half, whilst the nitrogen estimated was that voided in the shape of urea in twenty-four hours. It will, therefore, be necessary to add to the measured work that calculated for respiration and circulation for the whole period of twenty-four hours. This amount of internal work was computed, from the estimates of Helmholtz and Fick, to be as follows:—

Internal Work.—(Helmholtz and Fick.)

	Work performed. Metrekilograms.	Actual energy required. Metrekilograms.
Circulation of the blood during 24 hours, at 75 pulsations per minute	69,120*	138,240
Respiration for 24 hours, at 12 respirations per minute .	10,886	21,772
Statical activity of muscles	not determd.	not determd.
Peristaltic motion . . .	,, ,,	,, ,,
	80,006	160,012

Taking this estimate for internal work, the average results of the treadwheel experiments may be thus expressed:—

Treadwheel Work.

Average external work per man per day	119,605 mks.
Average nitrogen evolved per man per day	17·7 grams.
Weight of dry muscle corresponding to average nitrogen evolved per day .	114 ,,
Actual energy producible by the consumption of 114 grams of dry muscle in the body	210,672 mks.
Average actual energy developed in the body of each man, viz.:—	
External work 119,605 × 2 = 239,210	,,
Circulation . 69,120 × 2 = 138,240	,,
Respiration . 10,886 × 2 = 21,772	,,
	399,222 ,,

In these experiments the conditions were obviously very unfavourable for the comparison of the amount of actual energy producible from muscle metamorphosis with the quantity of actual energy expended in the performance of estimable work; since, during that portion of the twenty-four hours not occupied in the actual experiment, a large amount of unestimable internal work, such as the statical activity of the muscles, peristaltic motion, &c., was being performed. Nevertheless, these experiments show that the average actual energy developed in producing work in the body of each man was nearly twice as great as that which could possibly be produced by the whole of the nitrogenous matter oxidised in the body during 24 hours. It must also be remarked that the prisoners were fed upon a nitrogenous diet containing six ounces of cooked meat, without bone; a diet which, as is well known, would favour the production of urea.

SHOT-DRILL EXPERIMENTS.

The men employed for these experiments were fed exclusively upon vegetable diet, and they consequently secreted a considerably smaller amount of nitrogen than the flesh-eaters engaged in the treadwheel work. The other conditions were, however, equally unfavourable for showing the excess of work performed over the amount derivable from muscle metamorphosis.

In shot-drill, each man lifts a 32 lb. shot from a tressel to his breast, a height of 3 feet; he then carries it a distance of 9 feet, and lays it down on a similar support, returning unloaded. Six of these double journeys occupy one minute. The men were daily engaged with—

Shot drill	3	hours
Ordinary drill . . .	1½	,,
Oakum picking . .	3½	,,

The total average daily external work was estimated by Haughton at 96,316 metrekilograms per man.

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* Since making use of this number, I find that Donders estimates the work of the heart alone, for 24 hours, at 86,000 metrekilograms, a figure which is higher than that above for the combined work of circulation and respiration.

The following is a condensed summary of the results of these experiments:—

Military Vegetarian Prisoners at Shot Drill.—(Haughton.)

Average external work per man per day		96,316 mks.
Average nitrogen evolved per man per day		12·1 grams.
Weight of dry muscle corresponding to average nitrogen evolved per day .		77·9 „
Actual energy producible by the consumption of 77·9 grams of dry muscle in the body		143,950 mks.
Average actual energy developed daily in the body of each man, viz.:—		
External work, 96,316 × 2 =	192,632	„
Internal work . .	160,012	„
	352,644	„

Owing chiefly to the vegetable diet of these prisoners, the result is more conclusive than that obtained upon the treadwheel, the amount of work actually performed being considerably more than twice as great as that which could possibly be obtained through the muscle metamorphosis occurring in the bodies of the prisoners.

Playfair's Determinations.

In these determinations the number 109,496 metre-kilograms was obtained as the average amount of daily work performed by pedestrians, pile-drivers, porters, paviors, &c.; but, as the amount of muscle consumption is calculated from the nitrogen taken in the food, the conditions are as unfavourable as possible with regard to the point the speaker was seeking to establish; for it is here assumed, not only that all the nitrogen taken in the food enters the blood, but also that it is converted into muscle, and is afterwards oxidised to carbonic acid, water, and urea.

The following are the results expressed as in the previous cases:—

Hard-worked Labourer.—(Playfair.)

	Work performed. Mks.	Actual energy required. Mks.
Daily labour (external work) .	109,496	218,992
Internal work	80,006	160,012
	189,502	379,004
Actual energy capable of being produced from 5·5 oz. (155·92 grams) of flesh-formers contained in the daily food of the labourer	..	288,140

Thus, even under the extremely unfavourable conditions of these determinations, the actual work performed exceeded that which could possibly be produced through the oxidation of the nitrogenous constituents of the daily food by more than 30 per cent.

We have seen, therefore, in the above four sets of experiments, interpreted by the data afforded by the combustion of muscle and urea in oxygen, that the transformation of tissue alone cannot account for more than a small fraction of the muscular power developed by animals; in fact, this transformation goes on at a rate almost entirely independent of the amount of muscular power developed. If the mechanical work of an animal be doubled or trebled, there is no corresponding increase of nitrogen in the secretions; whilst it was proved on the other hand by Lawes and Gilbert, as early as the year 1854, that animals, under the same conditions as regarded exercise, had the amount of nitrogen in their secretions increased twofold by merely doubling the amount of nitrogen in their food. Whence, then, comes the muscular power of animals? what are the substances which, by their oxidation in the body, furnish the actual energy, whereof a part is converted into muscular work? In the light of the experimental results detailed above, can it be doubted that a large proportion of the muscular power developed in the bodies of animals has its origin in the oxidation of non-nitrogenous substances? for whilst the secretion of nitrogen remains nearly stationary under widely different degrees of muscular exertion, the production of carbonic acid increases most markedly with every augmentation of muscular work, as is shown by the following tabulated results of E. Smith's highly important experiments regarding the amount of carbonic acid evolved from his own lungs under different circumstances.[†]

Excretion of carbonic acid during rest and muscular exertion:—

	Carbonic acid per hour.
During sleep	19·0 grams.
Lying down and sleep approaching . .	23·0 „
In a sitting posture	29·0 „
Walking at rate of 2 miles per hour . .	70·5 „
„ „ 3 „ „ . .	100·6 „
On the treadwheel, ascending at the rate of 28·65 feet per minute . . .	189·6 „

It has been already stated as a proposition upon which all are agreed, that food, and food alone, is the ultimate source from which muscular power is derived; but the above determinations and considerations, the speaker believed, prove conclusively, firstly, that the non-nitrogenous constituents of the food, such as starch, fat, &c., are the chief sources of the actual energy, which becomes partially transformed into muscular work; and secondly, that the food does not require to become organised tissue before its metamorphosis can be rendered available for muscular power; its digestion and assimilation into the circulating fluid—the blood—being all that is necessary for this purpose. It is, however, by no means the non-nitrogenous portions of food alone that are capable of being so employed; the nitrogenous also, inasmuch as they are combustible, and consequently capable of furnishing actual energy, might be expected to be available for the same purpose, and such an expectation is confirmed by the experiments of Savory upon rats,[‡] in which it is proved that these animals can live for weeks in good health upon food consisting almost exclusively of muscular fibre. Even supposing these rats to have performed no external work, nearly the whole of their internal muscular work must have had its source in the actual energy developed by the oxidation of their strictly nitrogenous food.

It can scarcely be doubted, however, that the chief use of the nitrogenous constituents of food is for the renewal of muscular tissue; the latter, like every other part of the body, requiring a continuous change of substance, whilst the chief function of the non-nitrogenous is to furnish by their oxidation the actual energy which is in part transmuted into muscular force.

The combustible food and oxygen coexist in the blood which courses through the muscle, but when the muscle is at rest there is no chemical action between them. A command is sent from the brain to the muscle, the nervous agent determines oxidation. The potential energy becomes active energy, one portion assuming the form of motion, another appearing as heat. Here is the source of animal heat, here the origin of muscular power! Like the piston and cylinder of a steam-engine, the muscle itself is only a machine for the transformation of heat into motion; both are subject to wear and tear and require renewal, but neither contributes in any important degree by its own oxidation to the actual production of the mechanical power which it exerts.

From this point of view it is interesting to examine the various articles of food in common use, as to their capabilities for the production of muscular power. The speaker had therefore made careful estimations of the calorific value of different materials used as food, by the same apparatus and in the same manner as described above

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[†] *Phil. Trans.* for 1859, p. 709.

[‡] The *Lancet*, 1863, pages 381 and 412.

for the determination of the actual energy in muscle, urea, uric acid, and hippuric acid.

The results are embodied in the following series of tables, but it must be borne in mind that it is only on the condition that the food is digested and passes into the blood, that the results given in these tables are realised. If, for instance, sawdust or paraffin oil had been experimented upon, numbers would have been obtained for these substances, the one about equal to that assigned to starch, and the other surpassing that of any article in the table; but these numbers would obviously have been utterly fallacious, inasmuch as neither sawdust nor paraffin oil is, to any appreciable extent, digested in the alimentary canal. Whilst the force values experimentally obtained for the different articles in these tables must therefore be understood as the maxima assignable to the substances to which they belong, yet it must not be forgotten that a large majority of these substances appear to be completely digestible under normal circumstances.

Actual Energy developed by One Gram of Various Articles of Food when burnt in Oxygen.

NAME OF FOOD.	Heat units.		Metrekilograms of force.		Percent. of water.
	Dry.	Natural condition.	Dry.	Natural condition.	
Cheese (Cheshire)	6114	4647	2589	1969	24·0
Potatoes	3752	1013	1589	429	73·0
Apples	3669	660	1554	280	82·0
Oatmeal	...	4004	...	1696	...
Flour	...	3941	...	1669	...
Pea-meal	...	3936	...	1667	...
Ground rice	...	3813	...	1615	...
Arrowroot	...	3912	...	1657	...
Bread crumb	3984	2231	1687	945	44·0
Ditto crust	...	4459	...	1888	...
Beef (lean)	5313	1567	2250	664	70·5
Veal ,,	4514	1314	1912	556	70·9
Ham ,,	4343	1980	1839	839	54·4
Mackerel	6064	1789	2568	758	70·5
Whiting	4520	904	1914	383	80·0
White of egg	4896	671	2074	284	86·3
Hard-boiled egg	6321	2383	2677	1009	62·3
Yolk of egg	6460	3423	2737	1449	47·0
Gelatin	4520	...	1914	...	...
Milk	5093	662	2157	280	87·0
Carrots	3767	527	1595	223	86·0
Cabbage	3776	434	1599	184	88·5
Cocoa nibs	...	6873	...	2911	...
Beef fat	9069	...	3841	...	...
Butter	...	7264	...	3077	...
Cod-liver oil	...	9107	...	3857	...
Lump sugar	...	3348	...	1418	...
Commercial grape sugar	...	3277	...	1388	...
Bass's ale (alcohol reckoned)	3776	775	1599	328	88·4
Guinness's stout	6348	1076	2688	445	88·4

(To be continued.)

ACADEMY OF SCIENCES.

September 17.

THE following papers were brought forward:—

M. Payen, "*On the Composition and Economical Use of Two Species of Vegetable Leguminous Seeds in China.*" These are used as detergents in many parts of China where soap is unknown. They belong to a *Dialium*, and contain a natural soap, which communicates the property of frothing to water under agitation.

T. Graham, "*On the Absorption and Dialytic Separation of Gases by means of Colloid Diaphragms.*" This paper has already been before our readers.

M. A. d'Abbadie, "*On Hypsometry.*"

M. Dancel, "*On the Influence of Water and Liquid Food on the Production of Milk.*" This is a valuable paper from a cowkeeper's point of view, although we don't think the author can teach our London tradesmen much. He finds that by causing cows to drink more water, by exciting their palates with salt, he can increase the yield of milk several quarts a day without injuring its quality. But in order to do this the cow must be made to drink 20 to 25 quarts of water a day beyond her customary quantity. It therefore becomes a question whether the plan adopted in London is not better—that of adding the desired quantity of water to the milk *after* it leaves the cow instead of pouring six times the needful quantity down the unfortunate animal's throat. As far as regards the question of adulteration, there cannot be much difference between the two plans.

M. J. Riban, "*On Coriamyrtine and its Derivatives.*"

M. Delerue wrote in praise of *bicarbonate of magnesia*, as being the most energetic antidote against the cholera poison.

M. Berthelot, "*On the Polymeres of Acetylene. First Part—Synthesis of Benzol.*" This is a very important paper, and we intend to give it in full in an early number. The author shows that one litre of benzol vapour contains the same elements as three litres of acetylene—

$$C_{12}H_6 = 3C_4H_2.$$

By passing acetylene through a red-hot tube, he finds that a yellowish liquid is produced in small quantity, which contains benzol, styrol, fluorescent carbides, retene, &c. The benzol has been studied minutely, and is found to agree in every respect with ordinary benzol.

M. A. Leplay, "*On a New Liquid Pulveriser by means of Carbonic Acid Gas.*"

M. M. de Brettes, "*On the Influence of the Rotation of the Earth on the Deviation of Projectiles from Rifled Ordnance.*" He finds that this influence may become sufficiently great to be taken into consideration and receive useful applications in the artillery service.

C. Mène, "*Analysis of the Principal Marbles of Jura.*"

M. F. Plateau, "*On the Vision of Fishes and Amphibia.*"

M. Guérin-Méneville, "*The Principal Localities where the Culture of the Ailanthus Silkworm has commenced to be developed.*"

M. C. Decharme, "*On the Solar Halo observed at Angers, August 30, 1866.*"

M. G. Rayet, "*On the Earthquake of September 14, 1866.*" This is accompanied by a lithographed chart, showing the localities where the phenomenon was noticed and the direction and number of shocks.

Preparation of Pure Caustic Alkalies.—M. Graeger, having brought the alkaline carbonates to such a state of purity that they only contain traces of chlorides, first treats them with carbonate of silver, and then boils them with lime from calcined marble. The ley is then filtered through a funnel, in the bottom of which are placed fragments of marble and powdered marble, first pouring distilled water through till it passes perfectly limpid.—*Journal für praktische Chemie.*

Detection of Free Sulphuric Acid in Acetic Acid or Vinegar.—Boil about 50 cubic centimetres of the acid to be tested in a retort with a very small quantity of starch, until half the liquid is distilled; after it has cooled add a drop of tincture of iodine. If, under these circumstances, a blue coloration be produced, no sulphuric acid is present. If the blue colour does not appear, it may be concluded that sulphuric acid is present, which, by reacting on the starch, will have transformed it to glucose. With tincture of iodine, glucose gives no particular coloration. Sulphuric acid, thus detected, may be estimated by the ordinary processes.—*Boettger's polytechnisches Notizblatt.*

NOTICES OF BOOKS.

On Crystal Cod-liver Oleine. By J. and A. Bedford. London: 155, Leadenhull Street.

This essay is published for the purpose of making known a new importation of cod-liver oil, which, for the sake of distinguishing it by its properties of colour and transparency, as well as by its composition, is named by the proprietors "Crystal Cod-liver Oleine." The writers disclaim for it any specific curative virtue over other first-rate specimens of cod liver oil, but urge that, while it possesses all the therapeutic value of any other similar oil, it has properties of its own which render it peculiarly advantageous. They say that it is refined by a new and effective process; that being expressed and refined from the fresh liver of the fish, there is in it no trace of decomposing organic matter, nor of volatile product of decomposition; that it is free from fishy or other disagreeable odour, and that the sense of smell of the most delicate person cannot be affected by it in the least degree. Further, the writers say, the oil is entirely free from rancidity—almost tasteless—drinks as blandly as new milk, and leaves no unpleasant flavour behind. The oleine has been submitted to physicians of practical experience and judgment, and proved to be not only of first quality in a medicinal sense, but, as an oil, more agreeable to patients than any that has been before imported.

Bibliothèque Universelle et Revue Suisse. Archives des Sciences Physiques et Naturelles. No. 102. June 25.

The only original paper in this number which in any way bears upon chemistry or physics, is one by M. Marignac, "*On the Combinations of Tantalum.*" The author had already come to the conclusion that the formula of tantalic acid was Ta_2O_5. These new researches entirely confirm this view. The greater part of the tantalic acid used in these experiments was obtained from the columbite of Haddam, which contains 31·5 per cent. of it. The *atomic weight* was determined by treating perfectly pure fluotantalate of potash by pure strong sulphuric acid; gradually drive off the excess of acid, and finally heat to 400° C. Boil with water, which dissolves the bisulphate of potash and leaves the tantalic sulphate in small granular crystals; these by strong calcination leave tantalic acid. This gave $Ta = 182·3$ and $Ta_2O_5 = 444·6$. Tantalic acid has a density of 7·60 to 7·64. There are two modifications: one monobasic, which yields salts of the composition

$$MO,Ta_2O_5$$

(to this type the tantalites belong), and another quadribasic, giving salts,

$$4MO,3Ta_2O_5.$$

The tantalates of potash and soda belong to this type; they crystallise well. The *brown oxide of tantalum*, TaO_2, is obtained by heating the acid in a charcoal crucible. *Sulphide of tantalum*, TaS_2, is formed by strongly heating tantalic acid in bisulphide of carbon vapour. *Chloride of tantalum*, $TaCl_5$, ought, according to M. Marignac, have a vapour density of 12·84, but M. Deville found it to be much less. We understand, however, that more recent determinations, made since M. Marignac's paper was written, have yielded in M. Deville's hands the density of 12·42. The results are the same whether operating at a temperature of 350° or 440° C. The determination quoted by M. Marignac was performed on a chloride containing niobium. Tantalic acid dissolved in hydrofluoric acid gives soluble and well-crystallised fluosalts. Fluoxytantalates, analogous to fluoxyniobates, do not appear to exist. *Fluotantalate of potash*, $TaFl_5,2KFl$, crystallises in right rhombic prisms: by prolonged ebullition it changes to an insoluble salt, $Ta_2O_5 + 2(2KFl,TaFl_5)$. The formation of this insoluble salt gives a means of detecting the smallest quantity of fluotantalate in fluoxyniobate of potash. The fluotantalates of soda, ammonia, zinc, and copper are also described. All the fluotantalates obtained by the author belong to the same type. There can now remain no longer any doubt as to the composition of fluoride of tantalum, and of tantalic acid.

Among the extracts from foreign journals given in this number we find the following:—

Prof. Ryhe "*On the Diffusion of Gases through Caoutchouc.*" The author finds that when hydrogen gas is passed through india-rubber tubes it always contains traces of air and aqueous vapour. MM. Aronstein and Sirks examined this more fully, and found that common vulcanised, brown devulcanised, and pure non-vulcanised caoutchouc were all easily pervious to hydrogen, but that they could be rendered impermeable by a coating of asphalt dissolved in coal oil.

Prof. Rammelsberg "*On the Lower Degrees of Oxidation of Molybdenum.*" Molybdic acid reduced by hydrogen gives first the blue oxide, then the brown (MoO_2), and lastly the metal. Zinc in a solution of molybdic acid or molybdate of ammonia in presence of *aqua regia* gives a sesquioxide of molybdenum. Other oxides are given, and their mode of preparation described. The series is as follows:—

$$Mo_2O_3$$
$$MoO_2$$
$$MoO_3$$
$$Mo_2O_5 = MoO_2,\ MoO_3$$
$$Mo_3O_8 = MoO_2,\ 2MoO_3$$
$$Mo_3O_{14} = MoO_2,\ 4MoO_3.$$

Chemisches Central Blatt. Nos. 38, 39, and 40.

No original paper is to be found in any of these numbers. No. 38 contains articles by—

O. L. Erdmann, "*On the Double Nitrites of Nickel and Potash;*"

Dr. K. Frisch, "*On the Atomicity of Tartaric Acid;*"

Dr. C. Winkler, "*On Colorific Estimation of Cobalt and Nickel.*"

All these are from the *Journ. für prakt. Chem.*, noticed in our number for July 20.

Nos. 39 and 40 go still further back, and devote 17 pages to an article by—

Dr. A. Remelé, "*On the Sulphur Compounds of Uranium,*" which we noticed in May last. The other articles are by—

E. Linnemann, "*On the Production of Glycerin from Trichlorhydrin;*"

F. Wöhler, "*On a new Mineral from Borneo,*"

$$12(Ru_2S_3) + OsS_4$$

Described in our number for May 25 last;

Dr. U. Hallwachs, "*On the Estimation of Tannic Acid in Substances containing it.*"

The usual short notices of papers contributed to other journals are given at the end of each number.

Journal für praktische Chemie. No. 12. July, 1866.

This number contains articles by—

R. L. Maly, "*On an Ether of Tungstic Acid.*" The author thought that an examination of tungstic ether would serve to fix the atomic weight of tungsten. As is well known, this ether has not yet been prepared either by reacting on an acid ether by a compound of tungstic acid, or by mixing iodide of ethyl with tungstate of silver. M. Maly succeeded in forming it by causing alcohol to react on the oxychloride of tungsten, WCl_2O (or $\genfrac{}{}{0pt}{}{W}{W}Cl_4\Theta$), which sublimes in beautiful cinnabar-red glittering needles. By adding this to strong alcohol and agitating, the mixture, at first clear, gradually becomes turbid, and in a short time there is an abundant white flocculent precipitate. In 24 hours filter, and wash with alcohol till the acid reaction has disappeared; then dry in the air, and afterwards over sulphuric acid. Tungstic ether forms a hard, brittle, glassy mass, insoluble in water, alcohol, and ether; heated on platinum, it decomposes with a smoky flame, leaving a black mass which ultimately burns to yellow tungstic acid. The author gives to it the following formula:—

$$W_2\Theta_5\left\{\begin{matrix}H\\C_2H_5\end{matrix}\right.\Theta+H_2\Theta.$$

A. Cahours, "*On the Sulphuretted Radicals.*" An abstract of this paper appeared in the Chemical News in June 1865.

"*On the Products of the Distillation of Lactate of Lime.*"

R. Otto, "*On the Reaction between Sulphobenzid and Chloride of Phosphorus.*" The author finds that the products are monochlorobenzol and sulphochlorobenzol.

$$\left.\begin{matrix}C_{12}H_5\\S_2O_4\\C_{12}H_5\end{matrix}\right\}+PCl_5=\left.\begin{matrix}C_{12}H_5\\Cl\end{matrix}\right\}+\left.\begin{matrix}C_{12}H_5\\S_2O_4\\Cl\end{matrix}\right\}+PCl_3$$

Dr. F. Rochleder, "*On the Constituents of the Root-bark of Apple-trees,*" and "*On the Leaves of the Epacris.*"

O. Reinhold, "*On Aloisol,*" and "*On the Preparation of Chloride of Succinyl from Oil of Bitter Almonds.*"

H. Hlasiwetz, "*On Scoparin.*" "*On the Purification of Iodide of Potassium and its Action on Starch.*"

All the other papers in this number are from the *Comptes-Rendus*, or English journals, and have already been fully noticed in our pages.

NOTICES OF PATENTS.

No. 85. *An Improved Method of producing Oxygen.* A communication by Charles Raphael Maréchal and Cyprien Marie Tessié du Motay, of Metz, France. Dated January 10, 1866.

The patentees state that manganates and permanganates of potassa, soda, and baryta, ferrates of potassa, soda, and baryta, chromates of potassa, soda, and baryta, and in general all metallic oxides or acids which will form with potassa, soda, and baryta binary combinations capable of superoxidising, possess the property of yielding their oxygen at a more or less elevated temperature when they are submitted to the action of a current of steam. These bodies thus deoxidised also possess the property of becoming reoxidised when they are exposed to the action of a current of air at a temperature more or less great. The present invention, consisting in the direct production of oxygen by means of atmospheric gas, is based upon the double property just cited. The patentees place in a retort or other distillatory vessel one of the binary compounds above mentioned, whether at the minimum or at the maximum state of oxidation. If the binary compound is at the minimum state of oxidation, they superoxidise it by means of a current of air drawn or impelled mechanically, or drawn by a chimney serving the purpose of producing draught. If the compound is at the maximum state of oxidation, they deoxidise it by means of a current of steam or by injecting water; the oxygen and the steam on issuing from the retort pass together into a condenser; the steam is condensed, and the oxygen passes on to a gasholder in which it is collected. When all the utilisable oxygen contained in the binary compound has been disengaged by the action of the steam, the operation of superoxidation by means of air is recommenced, and *vice versâ.* The production of oxygen is continued in this alternate manner as long as may be required.

This patent is said by report to be at work very successfully in France. If the reactions proceed in practice with as great regularity as would appear from the above description, there is no doubt that this is a very valuable invention, and one which will be applied to many metallurgical processes.

97. *Preparing Tetrachloride of Carbon.* Charles Crump, Yealmpton, Devon. Dated January 11, 1866.

The inventor dissolves iodine in bisulphide of carbon, the latter being contained in a retort or other suitable vessel, and the solution being kept in a cool state by being surrounded by water, or by any other suitable means. He then passes dry chlorine gas into the liquid so prepared as long as it is taken up or absorbed thereby, or until crystals of chloride of iodine appear in the retort or other vessel employed. The compound thus formed consists of a mixture of tetrachloride of carbon and chloride of sulphur, which is then digested with excess of sulphur in order to convert the higher chlorides of sulphur which are present into protochloride. The tetrachloride of carbon is afterwards partially separated by distillation, and the distillate purified by treatment with water or milk of lime or potash ley, or in any other suitable manner. In some cases, especially when a sufficient amount of chlorine has not been passed into the solution of iodine in the bisulphide of carbon as before mentioned, it may be necessary after purifying the tetrachloride of carbon to complete the purification by dissolving in it a fresh quantity of iodine, and passing in a small additional quantity of chlorine. A very small quantity of iodine is sufficient to effect the decomposition of an unlimited amount of bisulphide of carbon, but it will be found desirable to proportion the quantity of iodine to the rapidity with which the chlorine is passed into the liquid, so that there shall be enough iodine present to cause the whole of the chlorine to be absorbed with facility. Bromine may be employed instead of iodine for the purposes of this invention.

This process is not only valuable as a patent, but is based upon a new chemical principle, which appears capable of great extension.

169. *Improvements in the Combination of Chemical Matters and Mechanical Apparatus applied therewith for the Prevention or Cure of Contagious and other Diseases to which Human Beings and Animals are Subject.* William Hibbert, Manchester. Dated January 18, 1866.

This invention consists, firstly, of a compound solution to be used internally as a medicine or outwardly as baths, embrocations, or saturated bandages; it also acts as a disinfectant and preventive agent against infectious diseases generally. Secondly, of mechanical apparatus for filtering, purifying, and disinfecting the polluted air or atmosphere in infected situations. It is said to be particularly applicable to preventing and arresting the progress of fermentation and decomposition in the blood of human beings or animals, as in the cases of rinderpest, fevers, scrofula, mortification, glanders, mange, running sores, and other diseases arising from an unhealthy state of the blood.

The said compound consists of chlorides of magnesium, bromine, and zinc, either separately or in any combination. The patentee takes chloride of magnesium in solution at about 40° Twaddell, adds from one to two ounces of bromine to a gallon of the said solution, and in some cases from five to ten per cent of chloride of zinc. For human beings ten to twenty drops in a wineglass of pure water will be a sufficient dose for an adult, to be repeated as the case may require. For cattle one or two ounces of the solution with five to ten per cent. of chloride of zinc added may be given in a pint of water, or as much water as the beast will drink, but these proportions may be varied according to the virulence of the disease.

For outward application, as baths or embrocations, the said solution may be freely applied; also painless bandages, which do not stick to the skin when taken off, are obtained by impregnating cloth with the above solution. By increasing the chloride of zinc to from eleven to twenty per cent., it may also be freely used as a disinfectant for hospitals, barracks, holds of ships, railway trucks, or similar places. He also uses chlorides of magnesium and bromine for preserving animal matter for shipment as food, the strength to be about 16° Twaddell.

The mechanical apparatus consists of an auxiliary lung respirator, which he makes of leather or other suitable material, and of any suitable conformation to suit cattle or human beings.

The improved air-disinfecting filter is attached or not to a reserve chamber from which the respiratory organs are supplied with disinfected air, and consists of a box sufficiently large to supply one or more subjects, in which box are inserted a number of tubes which conduct the air through the disinfecting solution, after which it rises through charcoal, coke, or other material saturated with the same solutions, and through a sieve or perforated plate into the reserve chamber. He also employs, when desired, another filter of similar construction to the above for disinfecting the exhaled air before it passes into the atmosphere.

For feeding, the patentee partitions off the front part of the stall with an opening to admit the head, which opening is enclosed by air-proof or disinfecting cloth surrounding the neck of the animal, the purified air being supplied by a valve connected with the air chamber, and the exhaled air passes through a valve into the above-named disinfecting filter before its arrival into the open air. The above appliances procure isolation of the respiratory organs.

For safe removal or perambulation he couples to the valves short tubes with disinfecting filters inserted therein, one for the prevention of receiving the infected air, and the other to prevent its communicating infection.

The method for preventing contagion being communicated or received through the medium of the skin is by clothing, surrounding, or bandaging the animal with cloth or other suitable material impregnated with the above-named disinfecting solution or solutions, or by impregnating the skin with the same, by which isolation from the infection of the atmosphere by which they are surrounded is obtained. Small doses of the said solution occasionally given to healthy animals will lessen the violence of an attack of rinderpest or other contagious disease, if not throw off the influence altogether without isolation.

This patent is very amusing, and the fact of its having been proceeded with is a strong argument for the appointment of scientific examiners to inquire into the claims of a would-be patentee. We have here a patent for the use of chloride of magnesium, bromine, and chloride of zinc, either separately or in combination, as a medicine for all diseases arising from an unhealthy state of the blood. What on earth is to prevent some one else from taking out another patent to-morrow for the use of sulphate of magnesia as a remedy for another affliction to which the sedentary portion of humanity is supposed to be peculiarly liable? The patentee of the latter would be tolerably certain to meet with infringements, an annoyance to which we can safely promise Mr. Hibbert will not be subject.

Recipes for Copying Ink.—(1.) 3 parts by weight of white glycerine; 3 do. of purified white honey, best quality; 10 do. of violet, black, or other coloured ink. Mix up well, and leave the mixture to settle two or three days before using. (2.) 4 parts by weight of white glycerine; 4 do. of purified white honey, best quality; 10 do. of Robertson's ink; ¼ do. of powdered gum arabic. Add one or two drops of strong solution of bichloride of mercury to prevent deterioration of the ink; stir up well, and leave it to settle for two or three days before using. If it should be found, in taking copies from inks according to Recipe No. 1, that thicker characters are produced than those of the original, the proportions of glycerine and honey may be respectively reduced to 2 parts of each, or another quarter by weight of 1 part powdered gum arabic may be added.—*Chemical Technology.*

CORRESPONDENCE.

Composition of the Solar Spectrum.

To the Editor of the Chemical News.

Sir,—You are probably aware of Sir David Brewster's investigation into the nature of the solar spectrum by examining it through coloured liquids and glasses, and the theory he formed to account for the facts he observed. You are also probably aware of the manner in which these investigations were received in France, more especially by Helmholtz and Bernard—viz., that they were not exact experiments, and that he had diffused and confused light and contrasts of colour that he did not take into account, which vitiated his experiments and consequently his conclusions.

Seeing such an account in some back numbers of the *Photographic Journal*, and being unable to ascertain whether Sir David Brewster has written anything in reply, I shall feel extremely obliged, if you are aware of his having done so, to inform me of the nature of his reply in your valuable paper. It seems most ridiculous to me to insert these experiments in our English scientific text-books as true or legitimate experiments, when they have been successfully confuted by others, according to "Cosmos." I may say they have led me astray considerably in my endeavours to obtain a correct knowledge of the nature of the solar spectrum, if what Helmholtz and Bernard state is true.

I am, &c.

G. Marlow.

MISCELLANEOUS.

On Spontaneous Generation.—The September and October number of the *Journal de l'Anatomie et de la Physiologie* contains the results of some experiments on spontaneous generation, by M. Al. Donné, which appear to the author favourable to this theory, although for a long time he has been one of its opponents. He has examined the result of exposing eggs to spontaneous decomposition during some weeks. He argued that, having thus an organised matter highly complex and naturally free from all floating atmospheric germs—and as this matter contained in itself a certain amount of pure air—it was in the best possible state to give rise, in its alteration, decomposition, and putrefaction, to infusoria, or animalcules, the ordinary result of the putrefaction of animal matter freely exposed to the air. With a substance naturally free from all foreign matter and protected from exterior contact, like the egg in the shell, the conditions of a crucial experience would be realised. Tried in this manner, the results were against the theory of spontaneous generation.

But the small quantity of air enclosed in the egg was not considered sufficient to determine the phenomena, and the experiments were tried again with certain modifications. The eggs were carefully washed, well dried, and then enclosed in a thick coating of cotton wool taken out of a stove at 150° C. A fine sharp rod, previously heated to redness, was then inserted obliquely through the cotton, and the tip of the egg was pierced with a hole. The eggs were then put in a safe place, and covered with a bell-glass. In a few weeks' time the surface of the contents of the egg was covered with velvety-looking mould, white, grey, yellow, or green. Under the microscope, this was seen to consist of organised filaments and beautiful globules of different sizes. There was, however, no trace of living animalcules. Supposing that the presence of water was needed, as the viscosity of the contents of the egg might hinder their development, a little boiling water was put into the egg covered with cotton. In two days, the substance was swarming with vibrios. The same experiments were then tried with hard-boiled eggs. The result, therefore, appears to be, that we can produce at will vegetable or animal beings in pure organic matter, without the intervention of germs from without. Water is necessary to the development of infusoria; and air is indispensable to the development of living beings of either kingdom.

New Works and New Editions.—Amongst the forthcoming literary announcements likely to interest our readers, we find that Messrs. Churchill are about to publish "*Lectures on the Relation of Chemistry and Mechanics to Pathology and Therapeutics.*" By H. Bence Bence Jones, M.D., F.R.S. 8vo. — "*Urine, Urinary Deposits, and Calculi, and on the Treatment of Urinary Diseases.*" By Dr. Lionel S. Beale, F.R.S., Physician to King's College Hospital. With Plates. Third edition, very much enlarged. Crown 8vo.—"*The Microscope in its Application to Practical Medicine.*" By the same Author. With Engravings on Wood. Third edition. 8vo.—"*Chemistry, Inorganic and Organic; with Experiments.*" By Charles L. Bloxam, Professor of Practical Chemistry in King's College, London; Professor of Chemistry in the Department of Artillery Studies, Woolwich. With nearly 300 Wood Engravings. 8vo.—"*The Action of Medicines in the System.*" By Frederick W. Headland, M.D., F.R.C.P. Fourth edition. 8vo.—"*The Elements of Natural Philosophy.*" By Golding Bird, M.A., M.D., F.R.S., and Charles Brooke, M.A., M.B., F.R.S. With more than 600 Engravings on Wood. Sixth edition, thoroughly Revised. Fcap. 8vo.—"*The Pharmacopœias of the Principal Hospitals of London.*" Arranged in Groups for easy Reference and Comparison. By Peter Squire, Chemist in Ordinary to the Queen and the Prince of Wales; Member of the Pharmacopœia Committee of the Medical Council. Second edition. 18mo.—"*Handbook of Local Anæsthesia.*" By Benjamin W. Richardson, M.A., M.D., F.R.C.P. With Engravings. 8vo.—"*The First Step in Chemistry.*" By R. Galloway, F.C.S., Professor of Practical Chemistry in the Museum of Irish Industry. Fourth edition. Fcap. 8vo.—"*The Arrest and Prevention of Cholera:*" being a Guide to the Antiseptic Treatment, with New Observations on Causation. By Arthur Ernest Sansom, M.B. Fcap. 8vo.—"*The Induction Coil:*" being a Popular Explanation of the Electrical Principles on which it is Constructed. With a Series of Beautiful and Instructive Experiments. By Henry M. Noad, Ph.D., F.R.S., F.C.S., Lecturer on Chemistry at St. George's Hospital. With engravings. Fcap. 8vo.

Refracting Powers of Saline Solutions. — Physical processes may in certain cases be advantageously employed to determine the chemical constitution of bodies. Density, boiling point, dilatation by heat, and even the capillarity of liquids, have been suggested as giving useful results. One of the last numbers of Poggendorff's *Annalen* contains a memoir by M. E. Reichert, on the different refracting powers by fluids modified by their chemical composition. This memoir contains the results of experiments on solutions of common salt of different strengths. The proportions of salt shown by optical means and by ordinary analysis agree very closely. The first column of the following table gives the proportions obtained by analysis, and the second the results of the optical method:—

2·26	2·27
7·12	7·13
12·02	12·07
17·25	17·25
23·02	22·89

An equally satisfactory result was obtained with solutions of sugar; but with alcohol and acetic acid the differences in the refractive indices are only half as great, and the indications, consequently, are not so satisfactory.—*Les Mondes.*

The Hardness of Silver.—Goldsmiths often complain of the hardness of silver, which is sometimes very difficult to carve, and presents a dead grey cut. These properties are generally attributed to the presence of a foreign metal; but M. Mathey, assayer at Locle, has shown that in this silver there is neither tin, lead, nor any other injurious metal. He considers this property to be due solely to the high temperature at which silver is cast. By letting the crucible cool till a slight solid crust is formed on the surface of the fused metal, and casting at this moment, a soft silver with a brilliant cut is obtained. —*Dingler's Polytechn. Journal.*

On Candle-light Blue employed in the Dressing of Tissues.—According to M. Kletzinsky, there is employed, to a certain extent, in the dressing of light tissues, crapes, tulles, &c., a particular blue, the tint of which is in no way modified by artificial light. This blue is sulphindigotate of copper. It is prepared by dissolving indigo in Nordhausen sulphuric acid at 20°; after twenty-four hours, dilute with water, filter, saturate the liquid by carbonate of copper, and evaporate the filtered solution.—*Dingler's Polytechn. Journal.*

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. XIII. 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., II., and VII. are out of print. All the others are kept in stock. Vol. XIV. commenced on July 6, and will be complete in 26 numbers.

A. B. C.—The book has been sent by post.

Student.—You cannot have a better guide than Fresenius's "Qualitative Analysis," published by Churchill.

H. M.—Probably you will find bichloride of tin a useful solvent for iodine in your experiments.

Paraffin Wax.—A. B. is requested to send his address to the office, and the required information will be forwarded.

A Constant Reader.—You can probably dispose of amber dust at a photographic varnish-maker's. It is dissolved in chloroform, and used for coating glass negatives.

Mechanic.—Ordinary solder is made by melting together equal weights of lead and tin. If required more fusible, use three equivalents of tin and one of lead. This alloy melts at 367° F.

L——s.—Your article cannot appear. Indeed, no respectable journal would insert it. Apart from the exceeding bad taste of the attack, its publication would be libellous.

Photographic Printer.—Chloride of gold is always acid to test-paper. The pure compound met with in commerce is $AuCl_3,HCl+aq$. When this is heated, even in a water bath, to drive off the last equivalent of hydrochloric acid, some protochloride of gold is produced, which is not soluble.

Theta.—An ammoniacal solution of oxide of chromium is easily prepared by dissolving three grammes of potash chrome-alum in boiling water, then adding 14 c.c. of oil of vitriol and 90 c.c. of ammonia. The resulting liquid will be strongly alkaline and of a beautiful purple colour, and will keep unchanged in stoppered bottles.

John Mayer.—We are not aware when the next edition of Fownes will be issued, nor what views it will take as to the new notation. You may, however, be satisfied that it will be correct, and on a footing with the latest developments of the science.

Immo.—If the article is electro-plated, it will give the same reaction with the tests as if it were pure silver. File or scrape away some of the outer surface from a part where it will cause no disfigurement, and then test the metal beneath with nitrate of silver solution or a piece of moistened lunar caustic. If it be a base metal, it will be blackened.

Isinglass.—F. W.—We cannot understand what is meant by "isinglass" in the paragraph from the *Mechanics' Magazine* which you have sent. Can any of our readers favour us with a solution of the problem? The paragraph says:—"It is somewhat strange that in the course of the long series of explorations and experiments directed to the procuring of some indigenous substance with which to construct smelting furnaces, no effort is made to utilise isinglass. That substance is quite insensible to all influences of heat. Why may it not be ground and made into a plaster, and then worked into the smelting furnaces? The complaint is that nothing can be found to answer in place of the English firebricks, and they are enormously expensive. Perhaps our native isinglass would serve as a substitute."

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On Indium, by M. Winckler,[*] *and MM.* Kachler *and* Schrötter.[†]

M. Wesselky's method of separating indium from its solutions by means of hyposulphite of soda[‡] is not, according to M. Winckler, advisable. By boiling a neutral solution of indium with hyposulphite, a small quantity only of the indium is precipitated, and that not as sulphide, but in the state of basic sulphate; from acid solutions, some sulphide of indium separates, while the greater part of the indium remains in solution. All the indium is only precipitated by hyposulphite of soda, when it is in the state of hydrate; but then it is as subsulphate, and not as sulphide, and this precipitation would have been more easily effected by using simply sulphate of soda.

M. Winckler considers it better, in extracting indium, to treat the roasted blende by hydrochloric acid, to precipitate by an excess of zinc the indium, copper, lead, cadmium, &c., and to separate these metals by sulphuretted hydrogen and carbonate of baryta.

MM. Kachler and Schrötter have ascertained the presence of indium in a blende at Schönfeld, near Schlaggenwalt. M. Schrötter modifies the method of extracting indium by treating the blende after roasting by sulphuric instead of hydrochloric acid, and precipitates the indium directly by zinc, fractioning the precipitates; the purification of indium is then easier in consequence of this division.

In its electric properties indium much resembles cadmium, but is more electro-negative.

The blue ray of indium has no corresponding black ray in the solar spectrum; it corresponds to number 2523 in M. Kirchhoff's scale; the violet ray of indium lies between rays G and H; it answers to number 3265·8. The spectrum of indium presents others besides these two rays, but they may possibly be owing to impurities.

Contributions to the History of Graphitic Acid,[§] *by M.* Gottschalk.

To prepare graphitic acid, the author directs to add nitric acid in small portions to 1 part of purified graphite and 3 parts of chlorate of potash placed in a flask cooled with ice; then heat in a water-bath to about 70°. After decanting, purify the residue by extracting it by nitric acid of density 1·28, expelling any excess of the acid by gentle heat, washing the residue in alcohol, then in ether, and finally heating in a water-bath to expel the alcohol and ether; there thus remains a light pulverulent matter. The author considers that the substance described by Professor Brodie as graphitic acid, with the formula $G_{11}H_4\Theta_5$, is not the last stage of the oxidation of graphite, but that there may be obtained, by prolonging the action of the oxidising mixture, a substance having the composition $C_{11}H_4\Theta_6$, being a yellow, crystalline, homogeneous mass, formed of transparent flakes.

This substance is very hygroscopic, and colours in the light until it becomes nearly black. It reddens tincture of litmus when wet, and is slightly soluble in water. Its solution deposits amorphous yellow flakes under the influence of light or heat, or by the addition of a salt or a diluted acid.

This graphitic acid is also slightly soluble in alcohol, but not at all so in ether, wood spirit, essence of turpentine, benzol, chloroform, and sulphide of carbon. Heat decomposes it, giving water and carbonic acid. Alkaline solutions, lime, and baryta water colour it; when heated, the colour deepens till nearly black.

During the washing of graphitic acid treated by potash, the liquid is at first colourless, but soon becomes brown, and the product remaining on the filter greatly increases in volume. The brown alkaline filtered liquid, if boiled after having been neutralised by acetic acid, deposits brown flakes, and returns to its alkaline state, which proves the presence of an alkaline combination soluble in alkalies and decomposable by boiling.

The brown substance remaining in the filter, after treatment by an alkali, washed with water and dried at 100°, is difficult to pulverise, and becomes very electric by friction. It contains 11·2 to 12·3 per cent. of alkali.

This graphitic acid behaves in the same way in presence of ammonia; only, as ammonia volatilises readily, the precipitate inflates by boiling, and finally redissolves.

The author has verified the reactions of sulphide of ammonium and stannous chloride on graphitic acid, observed by M. Brodie.

Monohydrated sulphuric acid colours graphitic acid grey-green; by the addition of water it returns to yellow, and if boiled decomposes completely.

TECHNICAL CHEMISTRY.

The Manufacture and Properties of Aniline Colours, and the Bodies used in their Preparation,[*] *by MM.* Depoully *Brothers.*

(Continued from page 90.)

III. Aniline.—Nitrobenzol submitted to the action of reducing agents changes into aniline according to the equation—$C_{12}H_5NO_4 + 6H = C_{12}H_7N + 4HO$.

Many trials have been made to effect this change on a large scale; but M. Béchamp's process—that is, the action of iron and acetic acid on nitrobenzol, is generally decided to be the best.

M. Béchamp introduces into a retort 50 gr. of commercial nitrobenzol, the same quantity of acetic acid, and 100 gr. of iron filings. The reaction manifests itself in a strong effervescence; when that ceases he cohobates and then distils to dryness; the aniline passes with the water.

These proportions have been modified in practice; there is no fixed rule, each manufacturer using his own proportions, as well as his particular apparatus and mode of working. Further on we will refer to the necessary proportions, and will first describe two processes as examples, one having its origin in France, the other in England. In the first the reaction is effected without the help of artificial heat; in the second by the aid of steam.

First Process.—The proportions employed are:—100 parts of nitrobenzol, 60 to 65 of commercial acetic acid, and 150 of medium-sized pounded iron turnings.

The iron and nitrobenzol being introduced into a cast-iron boiler, the acetic acid is added, either all at once or in two portions at an interval of twelve hours. About

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[*] *Journal für praktische Chemie*, vol. xciv., p. 414.

[†] *Ibid.*, xcv., 441.

[‡] See *Bulletin de la Société Chimique de Paris*, iv., 194.

[§] *Journal für praktische Chemie*, xcv., 321.

[*] Memoir presented to the *Société Industrielle de Mulhouse* at the meeting of May 31, 1865.

an hour after contact a violent reaction takes place, with a strong effervescence and the production of a considerable amount of heat; then the reaction ceases, and the mass must be stirred with a rake; the action recommences, and the stirring must be continued whilst any reaction takes place. The operation requires thirty-six or forty-eight hours.

The boiler should be closed by a lid which communicates with a worm or ascending refrigerator, so as to condense the vapours produced, and bring them back to the boiler. When this is not attended to, a notable loss occurs.

The mixture is found to be transformed into a thick homogeneous paste, containing excess of iron; all the nitrobenzol is changed into aniline, mixed with acetic acid and oxide of iron. This paste is then placed in semicylindrical boats of thin sheet-iron, and these are introduced into cylindrical horizontal retorts, slightly flattened like gas retorts, but of cast iron and of large dimensions. By the action of heat the aniline is distilled, mixed with water, and is condensed in a cooled worm.

The furnace should be so constructed that the upper part of the retort is not in contact with the flame, for otherwise a portion of the vapour of aniline becomes decomposed. As the vapour of aniline is easily condensible, the escape pipe should be placed as low as possible, and have no ascending inclination.

The use of boats offers great advantages in point of the rapidity with which the cylinders may be discharged and recharged whilst they are hot. When a little common salt and soda are added to the mixture of aniline and water resulting from this distillation, it forms two layers; the aniline, occupying the superior part, is decanted and rectified by distillation.

Second Process.—The proportions are:—100 nitrobenzol, 8 to 10 acetic acid, 200 iron. The operation is conducted in an iron cylinder placed vertically. In the middle of this apparatus is a shaft, made hollow to contain steam, and furnished with arms to agitate the mixture. This shaft communicates by driving wheels with the motive power. A pipe placed in the upper part of the cylinder conducts the vapours to a worm.

The iron and the acetic acid being introduced into the apparatus, add about 20 kilogrammes of nitrobenzol. A violent reaction takes place; when that ceases, set the shaft in motion; let the steam enter, and at the same time introduce, in a continuous stream, the remainder of the nitrobenzol which is in the upper reservoir. The aniline distils with the water condensed from the steam.

The great advantage of this process is the small quantity of acetic acid employed; but we think that when once the transformation of the nitrobenzol into aniline is effected it is better to stop the operation, remove the paste and introduce it into the retorts, and conclude the operation as in the previous process.

More aniline ought to be obtained by this process, but its solubility in water causes loss, and the distillation cannot be so complete as over an open fire; we lose the high anilines, which are the most useful.

In the English process we see that, provided it takes place in presence of iron and water, a given quantity of acetic acid will transform an indefinite amount of nitrobenzol. Experience enlightens us regarding the different phases of the reaction.

Thus, the acetic acid attacks the iron and forms ferrous acetate and hydrogen; the nascent hydrogen changes the nitrobenzol into aniline and water.

The ferrous acetate, in the presence of water and of nitrobenzol, becomes ferric acetate and ferric oxide, and reduces the nitrobenzol to the state of aniline.

The aniline formed decomposes the ferrous and ferric acetate, and precipitates them as oxides and hydrates; the ferrous oxide attains the ferric state at the expense of the nitrobenzol; and, as the acetate of aniline attacks the iron like acetic acid, the reaction continues indefinitely whilst there remain water, iron, and nitrobenzol; the definite products being aniline and ferric oxide.

Commercial anilines are always combinations of various proportions of aniline and toluidine; in consequence of the first bodies employed to make the nitrobenzol never being either pure benzol or pure toluol, aniline distilling at 182° and toluidine distilling at 198° cannot be obtained. Moreover, they contain various secondary products, proceeding from the impurity of the hydrocarbons employed, the manufacture of the nitrobenzol or that of the aniline.

Among these secondary products oftenest met with in commercial anilines are:—The alkaloids distilling above 200° and proceeding from the benzols containing hydrocarbons of a higher equivalent than toluol. Benzol, resulting from incompletely made nitrobenzol. Phenylene and toluene diamines, resulting from the reduction of binitrated bodies contained in the nitrobenzol. The nitrobenzol incompletely attacked in the manufacture of the aniline. Acetic acid and its derivatives, acetanilide and acetoluide. Considerable quantities of these bodies are often found in anilines, but to a less extent since the diminution of the proportions of acetic acid used in the manufacture of aniline. Acetone, which is especially produced in manufactories where lime is added at the moment of distillation in metal retorts.

A good part of these impurities is separable by rectification, but much always remains.

In testing commercial anilines, density must be taken into account. The density of aniline is 1028, that of toluidine is from 1001 to 1002. An aniline of density below 1000 contains acetone or benzol. An aniline of above 1030 contains nitrobenzol or other heavy bodies.

Another essential experiment is that of dissolving aniline in at least half its weight of sulphuric acid diluted with three times its weight of water. It forms a thick paste of sulphate of aniline; and on diluting and dissolving the salt, if there are any tarry bodies, nitrobenzol, &c., they will float on the surface of the liquid.

In submitting aniline to fractional distillation, reject all below 180° and above 200°.

On submitting the same aniline to distillation in the presence of a small quantity of caustic soda, then distilling anew, the product should pass at the same degrees as in the distillation of the aniline itself. If, as often happens, there is a great difference, it is owing to the presence in the aniline of acetic acid and its derivatives.

Many errors are attributable to the presence of these various impurities in anilines. A manufacturer often thinks he possesses a high aniline, when in reality it is a low impure one.

An idea may be gained by fractional distillation of the composition of commercial aniline as to the quantities of aniline and toluidine. We can thus nearly ascertain its composition, but not the mode of separating aniline and toluidine.

When a mixture of these two alkaloids is distilled, it passes continuously from 182°, the boiling point of aniline, to 198°, the boiling point of toluidine. However, it is noticeable that the thermometer remains some time stationary, first between 187° and 188°, and then between 192° and 193°.

The liquids which distil at these points are definite mixtures, the first containing 2 parts of aniline and 1 of toluidine, the second, 1 part of aniline and 2 of toluidine. The first has a density of 1018 and the second 1010. These densities are just the mean densities of mixtures of the two alkaloids in the proportions of 2 to 1 and 1 to 2.

The conclusion to be drawn from these observations is, that it would be far better to manufacture aniline and toluidine each separately and as pure as possible, in the manner already explained in the two preceding chapters on this subject, and this should be the aim of manufacturers of commercial aniline.

PHARMACY, TOXICOLOGY, &c.

*Notes on Plasma,** *by Mr.* G. F. Schacht.

Early in the year 1858 a paper of mine was read before the Pharmaceutical Society, entitled "*Glycerine, a Proposed Substitute for Oils and Fats in Ointments.*"

The discussion which followed the reading of this paper (supposing the report in the *Journal* to have been correct) appeared to me at the time, as it appears to me now, by no means characterised by judgment or candour. It seemed to be assumed that the proposed substitute, "plasma," was identical with a certain something else that had been tried and found wanting, and that therefore there was little hope for plasma. The two things, however, were not alike. Unfortunately, I was unable to be present on the occasion, and, as no defence for the proposition was volunteered by any other person, a verdict, on the whole adverse, was delivered by the learned critics. Notwithstanding this damaging circumstance, certain individuals, both in my own neighbourhood and in other localities, were differently impressed, and, having given the preparation something of a trial, arrived at the conclusion to continue its use. And so, after eight years' experience, I am not a little pleased to find plasma not only talked about, written about, and prescribed, but also that a proposition has been made by no less an authority than Dr. Redwood to introduce it into the next Pharmacopœia.

From the date of my paper (February, 1858) to the present moment I have made no further public allusion to the article; I may, perhaps, then be excused if I now once more obtrude it upon my fellow-pharmaceutists.

It is, perhaps, undesirable that I should follow every one who has expressed himself upon the matter; in referring, however, to the opinions and observations of a few, I trust to be understood to imply no disrespect for the labours of the rest.

I may observe, as a general remark, that those who have written upon the matter express opinions favourable to the preparation; the objections to it have usually been uttered in conversations and discussions upon these more deliberately expressed opinions. The list of tangible objections, however, is not large; it amounts to no more than two. These are serious objections, I admit, if they really exist, but they are not numerous.

The first is, that the preparation becomes softer by exposure to the moisture of the air; and the second, that it is liable to become mouldy by keeping.

With regard to the first, I think we must admit that it is a difficulty. I pointed it out in my original paper, and I do not think there is any prospect of our being able altogether to obviate it. We must accept it as a property of all preparations of glycerine, and avoid exposure to moisture as much as possible. But I have not found this property of much practical inconvenience. I have kept plasma in a common covered pot for a long time without apparent change. Here is a sample kept in this way since December, 1865, and it is still of very good consistence. But if the article be really useful, there would be no more difficulty in preserving it in well-closed vessels than many others about which we have to be specially careful.

The second alleged objection to plasma is, that it becomes mouldy by keeping. This statement is backed by the authority of names that command respect. Mr. Dean and Mr. Squire have both recorded this fact against plasma, and it is difficult to discredit anything advanced by observers of so large experience and of such well-known carefulness. But without intending any contradiction of the observations of others, I am bound to assert that I never saw a particle of mould upon plasma, and that since 1858 I have never been more than a few days at a time without plasma in stock. It is possible the mould to which these gentlemen refer may have appeared upon some of the compound plasmas. I admit I have not kept many of these for any length of time, but such as I have kept—Plasma lini and Plasma petrolei—have remained as free from mould as simple plasma itself. I do not therefore feel disposed, as yet, to admit "a disposition to become mouldy by keeping" as a proved fact against plasma; but, on the other hand, am bold to assert that it has but the one weak point already admitted.

Though I have prepared plasma in batches varying from one ounce to twenty pounds, and have for experimental purposes occasionally modified my formula, I have found no advantage to result from any change, either in the proportions of the ingredients or in the selection of any particular starch granule. Some experimentalists have supposed considerable differences in the results to have attended the employment of different feculas. My own experience goes rather to constrain me to attribute all variations of result to slightly altered manipulation. For instance, if, after heating the mixed ingredients to the required temperature and for the required time, the vessel be removed from the fire and its contents allowed to cool without further stirring, they will become gelatinous and toughly elastic, a consistence very inconvenient for the required purpose, but by a little judicious stirring during the process of cooling this may be entirely obviated, and an excellent ointment-like consistence obtained. Again, I have observed the translucency of the result to depend a good deal upon the time the mixture is exposed to heat, and the amount of stirring during the last part of the process. I find arrowroot, tous-les-mois, and potato starch will all give equally good results under exactly similar circumstances; and, on the other hand, they all, under slightly modified circumstances, will yield inferior results.

My experience, therefore, leads me to suggest but little change in my original instructions, which were as simple as could well be—viz.:—"Take of starch-powder 70 grs., glycerine 1 fl. oz.; mix the ingredients cold, and heat to 240°, constantly stirring." All I would add to that is, if the batch be large, say 10 lb. or 20 lb., it is better to escape the dreary task of constantly stirring so large a mass, whilst it is being gradually heated to 240° (which must be done if the starch be added). This

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* Read before the Pharmaceutical Conference, Nottingham meeting.

can be accomplished by mixing the starch with about one-twelfth of the glycerine, placing the remainder on the fire, and, when this has become heated to 260° (which will involve no special attention), mixing all together and stirring till complete. I venture then to repeat my opinion that plasma, carefully made, is a very elegant and useful material, possessing features of undoubted advantage over the fats commonly employed for ointments, and is not liable to any serious inconveniences.

I wish now more particularly to refer to some of Dr. Redwood's remarks contained in his paper, "*On the Construction of a Pharmacopœia*" (April 5, 1865), and more especially to the nomenclature by which he proposes to designate this solid preparation of mine and certain other classes of fluid compounds of glycerine. He introduces the matter by a kindly and favourable mention of plasma. He says (vol. vi., 2nd series, p. 572):—

"In external applications, also, some improvement has been made. The old form of ointment has often been referred to as one calling for improvement, for what can be more offensive than a rancid unguent smeared over the skin? The so-called 'plasma,' which was introduced by Mr. Schacht, of Clifton, in 1858, is certainly a great improvement in elegance and the absence of repulsiveness upon the forms previously used for similar purposes. This plasma, which is a solution of starch in glycerine, has now been in use for several years, and there appears to be but one objection to it, which is that, if exposed to the air, it absorbs moisture, and is then liable to become mouldy. But it has several recommendations, and it will probably come into more general use as it becomes more extensively known."

He then alludes to a class of preparations in which glycerine acts as a useful solvent, and in which the resulting compounds still retain the fluid form of the solvent. After commending these also as a useful series of applications, he proceeds to criticise the names by which they have hitherto been called. He says:—

"If glycerine is to be thus used, it is desirable that we should have some name that could be conveniently applied in pharmacy as a generic name for solutions where it is employed as the solvent. Some names have been already proposed, but none of them appear to me unobjectionable. Solutions in glycerine have sometimes been called glyceroles, but this name is suggestive of a property the reverse of that which glycerine imparts. Glyceroleum cannot, therefore, be considered a suitable generic name for a class of preparations distinguished from olea and unguenta by the possession of entirely different characters. Then we cannot call them glycerides or glycerates, because these names are already appropriated as chemical names, having different significations from those here intended. I would suggest that the name glycemate might be suitably used for these preparations. This name has not yet been appropriated that I am aware of, and it seems to fulfil what is required. The word glycemate would be glycematum in Latin, and this would apply to solutions of substances such as I have named in glycerine. The solution of starch in glycerine, Mr. Schacht's Plasma, would be Glycematum Amyli, glycemate of starch. Under this name it would be included among other solutions in glycerine; but as this glycemate of starch may itself become the basis of a class of external applications, while others of the glycemates are applicable for different purposes, it would be desirable to have a name that could be used as a generic name for preparations of glycemate of starch with more active ingredients. Thus the glycemate of starch forms a good vehicle for the application of aconitia, atropia, &c., and what name should be applied to such? I would suggest that the name Glycematum Amyli should be abbreviated into Glycemylum, which would be a synonym for glycemate of starch, and a generic name for preparations consisting of what is now called plasma, with the addition of other substances.

We should thus have—

Glycematum Amyli, Glycemate of Starch. Synonyms: *Glycemylum*, glycemyle, Plasma. Solution of starch in glycerine.

Glycematum, Aloës, Glycemate of Aloes. Synonym: Glycerole of Aloes. Solution of Aloes in glycerine.

Glycematum Boracis, Glycemate of Borax. Solution of borax in glycerine.

Glycematum Carbolicum, Carbolic glycemate. Solution of carbolic acid in glycerine.

Glycematum Gallicum, Gallic glycemate. Solution of gallic acid in glycerine.

Glycematum Tannicum, Tannic glycemate. Solution of tannic acid in glycerine.

And then we might have—

Glycemylum, Glycemyle. Synonym: Plasma. Solution of starch in glycerine.

Glycemylum Aconitiæ, Glycemyle of Aconitia. Solution of aconitia in glycemyle.

Glycemylum Atropiæ, Glycemyle of Atropia. Solution of Atropia in glycemyle, &c.

Now, I think the author's strictures upon the names glycerole, glyceride, and glycerate are perfectly fair, and I agree with him in thinking they ought not to be used, but I cannot see that the new ones he suggests are one whit better. In the first place, the words glycematum and glycemylum are very much like each other, the difference not only being slight, but being also one that would by no means easily fix itself in the memory of the prescriber and dispenser. Here are two distinct forms of remedy as different in physical features as an "extract" differs from a "liquor" or an "aqua." Why, then, call them by names which sound and look so much alike? I admit that glycemylum suggests itself as a compound word of glycerinum and amylum, but then that does not necessarily imply that glycemylum is solid, for unless heated the ingredients would remain fluid. But I do not at all see the etymological appropriateness of glycematum. A glycemate might certainly be a correct name for a compound of glycerine acid (did such a thing exist) and a base; but, as this is not intended, I can only suppose the word to be also a compound of glycerinum and pomatum. But that would rather suggest a solid, inasmuch as pomatums usually are solid. But Dr. Redwood applied this term to the fluid class of preparations.

I cannot help thinking that the Doctor has passed over the most simple, the most natural, and the most correct name for these fluid glycerines. When we dissolve small portions of foreign substances in water, we call the resulting fluids waters, aquæ. A little oil of cinnamon dissolved in water constitutes cinnamon water, aqua cinnamomi. A little lime dissolved in water we call lime water, aqua calcis, &c. We do not find it necessary to increase the mystery of the matter by talking of an "aquate of lime," "aquatum calcis," "aquatum cinnamomi;" why not, therefore, call a solution of aloes in glycerine "aloes glycerine,"—Glycerinum Aloës—or a solution of tannin in glycerine Glycerinum Tannicum? Such a nomenclature would be too simple and obvious for confusion, and the whole series of medicated glycerines would lie together with the simple solvent at their head.

And with regard to the solid series—plasma and its compounds—I cannot help thinking they had better continue to be called by the name under which they were introduced. As godfather to the interesting stranger, I may perhaps be somewhat partial; but I think the name both euphonious and descriptive: it implies something to be spread; it is not more arbitrary than others we employ with great convenience, such as "tinctura" and "emplastrum," and it serves to discriminate peremptorily between the solid and the fluid forms of the glycerine applications.

If, then, these preparations are honoured with places in the new Pharmacopœia, I hope they will appear under the easily-recognised names of "glycerina" and "plasmæ."

The Exhibition of the Pharmaceutical Conference, Nottingham.

Press of more important matter has prevented us from noticing this Exhibition before, but we are unwilling to omit all mention of it, as there were many points connected with it which well deserve notice. It was remarkable not only for the variety of the objects exhibited, but likewise for the scientific interest of many of them. Many of the contributions were from considerable distances, and to their American brethren the members of the British Pharmaceutical Conference are under great obligations for a very interesting collection forwarded from the other side of the Atlantic. Many branches of Materia Medica were very fully represented, and in going round the room we were struck with the names of many persons whose names, both as scientific chemists and practical pharmaceutists, are familiar to the readers of the Chemical News.

To give a notice of everything present would fill many more pages than can be spared for the purpose; we must be satisfied with mentioning a few of the more prominent things which attracted our attention, confining ourselves chiefly to those interesting from their novelty or scientific characters.

Amongst the apparatus and novel processes we noticed an ingenious arrangement for the preservation of liquids liable to be injured by exposure to the air, by Mr. Bourne. It consists of a thin membrane, which being attached to the side of the cask or other vessel, divides the interior into two separate chambers of varying capacity. Being formed in size and shape to correspond with one half of the vessel, it lines, or fits tightly to, either the upper or lower portion, according as the vessel is full or empty. When full, the diaphragm, floating on the surface of the fluid, precludes evaporation, and shields it from contact with the air which is freely admitted above. Descending as the fluid is withdrawn, it protects the remainder to the last, and preserves the empty vessel from becoming foul or musty, so that a simple rinsing with warm water is all that is necessary to fit it for fresh use.

Mr. Casella exhibited some of the mural standards of measure, having metrical and English systems side by side.

Messrs. Cliff and Co. exhibited many pieces of apparatus for which their Lambeth Potteries are so justly famous.

Messrs. Johnson and Sons exhibited a series of platinum crucibles, platinum spatula for pocket, platinum-wire net for straining and electroplating operations; platinised copper bowl for counter or laboratory use small and cheap platinum spoons for blowpipe experiments, especially useful for students; various preparations of platinum; silver crucibles, basins, and funnels. We would draw attention especially to the platinised copper bowl as a valuable addition to the dispensing counter or laboratory. Messrs. Johnson and Son contemplate introducing to pharmaceutists dispensing fiscale-pans, made on the same principle as the bowl, which, for their elegance, cleanliness, and convenience, we expect will be generally adopted by dispensers.

Messrs. Krohne and Sesemann exhibited a large series of Dr. Richardson's anæsthetic apparatus, one with reservoir and double tube for major operations, a spray producer, and inhalers for aqueous or other vapours, fitted with a variety of heating contrivances.

Messrs. S. Maw and Sons exhibited a very large collection of medical and surgical instruments and appliances.

Messrs. Murray and Heath sent pocket microscopes, demonstrating class microscopes, and a portable polariscope.

M. L. André Pontier, Boulevart du Temple, Paris, exhibited Kessler's evaporating and distillatory apparatus, called by the inventor by the general name of "erorator." This consists of a series of superposed vessels, each connected with a refrigerator common to all, and so arranged as to economise the whole of the heat employed, and insure the perfect condensation of the vapour raised, whether of water or alcohol, plain or medicated. It is further adapted for the inspissation of all kinds of extracts at a low temperature, for the crystallisation of salts at fixed temperatures, and, when made of platinum, for the distillation of sulphuric acid. The distillatory apparatus for the evaporation or economical concentration of liquids is so constructed that vapour formed during the evaporation of a liquid can be collected, and hence distillation may be effected, as it is but a condensation of a vapour. From this it will be understood that whenever it is desired to distil or evaporate a liquid in order to concentrate it, the erorator may be used with most advantage, as it serves the double purpose. Before describing in detail the component parts of the erorator, it may be considered as a pan with a lid. Every one has noticed that when a pan containing water has a lid larger than itself, and is placed on the fire, little drops come together at the lower part of the lid, and fall spontaneously around and outside the pan on the stove-plate. This was the true and original idea from which the present perfect erorator was formed. These drops come from vapour which is condensed at the lower portion of the lid; these are collected in the erorator as distilled water, by means of a channel placed under the sides of the lid. Lastly, to increase the condensation of vapour in proportion as it is formed, a current of cold water is made to play on the lid.

From Mr. Robbins we noticed some of his registered inhalers in porcelain, and anæsthetic ether specially prepared.

Mr. Squire sent a set of imperial weights with metrical equivalents engraved thereon.

Mr. E. C. C. Stanford illustrated his patent process of treating seaweed by destructive distillation. The specimens illustrated the method of distilling seaweed, and substituting for a fused ash, called kelp, a highly porous charcoal, the former being a vitreous mass, prepared in contact with air at a high temperature, from which most of the iodine has been dissipated; the latter carbonised at a low red-heat, in closed iron retorts, retains the whole of the iodine existing in the seaweed. This process is carried out by the British Seaweed Company (Limited), in works in the outer Hebrides; one in the Island of Tyree, and another in the Island of N. Uist. The charcoal prepared here is shipped to other works on the Bowling Canal, near Glasgow, and there lixiviated. The specimens illustrate the original sea tangle, which is thrown up in the winter in large stems, about 8 feet long and 1½ inch in diameter; these, when dried, shrink to about ½ inch diameter, and closely resemble horn; after carbonisation, these expand to about ¾ inch diameter, forming a highly porous charcoal, containing about 40 per cent. salts. Through the lixiviation of this charcoal, fine colourless specimens of salts are obtained. Those exhibited are all commercial specimens, and consist of muriate of potash, 97 per cent.; sulphate of potash salt, containing 17 per cent. alkali; iodine, bromine, iodide of potassium, and bromide of potassium. The commercial specimens of iodine and bromine are very pure; the latter, the manufacture of which, from this source, was introduced into this country by Mr. Stanford, is now made on a large scale in Scotland. The muriate is obtained unusually pure by this process, 80 per cent. being the usual standard. The salt also contains a large proportion of alkali, 8 per cent. being not uncommon. The products of distillation exhibited are—muriate and sulphate of ammonia, tar, oils, and pitch from the tar, and acetone naphtha. Gas is also produced and used to light the factories in the outer Hebrides. The charcoal, from its high porosity, is introduced as a deodoriser; its chemical composition resembles that of animal charcoal rather than that of vegetable charcoal, and the products of distillation are closely analogous to those of bone. This is especially interesting, as tangle, being a pure alga, is close to the border line separating the animal from the vegetable kingdom. For the filtration of water and disinfection of sewage, this charcoal affords a convenient substitute for animal charcoal at one-fourth the price.

Mr. F. Sutton, Norwich, who has made volumetric analysis his speciality, and has written perhaps the best book on the subject, exhibited twelve Mohr's burettes, graduated in cubic centimetres and decems, with Erdmann's floats; two revolving stands of new and convenient shape, to carry six burettes each; stoppered graduated flasks and test mixers; standard volumetric solutions of the British Pharmacopœia; new blowing burette for solutions which are affected by the india-rubber in the usual Mohr's burette, such as permanganate of potash, &c. The graduation of these instruments is guaranteed to be very correct.

Dr. J. Attfield, the hon. secretary, exhibited a set of metric decimal weights in brass, as used by chemists and druggists in France and other countries. Ditto in iron, as used by grocers and others. Ditto in brass, aluminium, and platinum, as used by analytical chemists in all civilised countries. A specimen of the wooden metre used by drapers. A jointed metre, used by carpenters. A decametre tape. A set of pewter measures, from double litre to centilitre. Glass metric decimal measures in various forms. A set of dry measures, from decalitre to decilitre, as used by seedsmen, &c. A set of the decimal coins used in France, Italy, and elsewhere, their weights, diameters, &c., being on the metric system. An American coin, 5 cents in value, 5 grammes in weight, and 2 centimetres in diameter. In a paper read before the Conference, "On Weights, Measures, Coins, and Numbers," the exhibitor stated that his object in showing the articles enumerated above was to aid in familiarising chemists and druggists with a system of weights and measures already noticed in the British Pharmacopœia, and destined, sooner or later, to be universally adopted.

Mr. James Yates, F.R.S., exhibited diagrams and models intended to aid in teaching the metric decimal system of weights and measures in schools.

Messrs. Heaton and Sons showed specimens of decimal coins in accordance with the metric system, now being manufactured for the Italian Government.

Amongst medicines, drugs, and chemicals, several were from the United States. Thus, Prof. E. Parrish, of Philadelphia, exhibited one half gallon metallic pharmaceutical still; a patent gas furnace for pharmaceutical purposes; sundry interesting pharmaceutical preparations and specimens of dispensing bottles and boxes, with illustrations of the mode in which medicines are sent out by pharmaceutists in America;

Messrs. Squire and Co., of Cincinnati, a variety of pharmaceutical preparations;

Mr. Frederick Stearns, Detroit, a variety of pharmaceutical preparations;

William R. Warner and Co., Philadelphia, a handsome case containing ninety varieties of pills, prepared according to the Pharmacopœia of the United States and other recognised formulæ. The peculiarity which these pills present is, that they are all sugar-coated. This plan shows some important advantages, viz., an attractive taste and clean exterior; but it is chiefly to be recommended as an effective mode for the preservation of the pill from the variable effects of atmospheric change.

Mr. Baker, of Philadelphia, sent a volume of American labels, comprising dispensing and other trade labels, together with a great variety used for pharmaceutical preparations.

From Beaufoy and Company, of Lambeth, we noticed *acetate of lime*; pure *acetate of soda*, from which their acetic acid is made; *acetic acid*, British Pharmacopœia; *glacial acetic acid*; *malt*, from which their vinegar is made; *pale vinegar* of normal colour, and *coloured vinegar*, as the public in general will have it.

Mr. Davis, of Harrowgate, sent a case containing tubes, exhibiting at a glance the relative *saline residues* of a pint of each of the Harrogate waters. This case has subsequently been presented to the Museum at Bloomsbury Square.

(To be continued.)

On the Estimation of Morphia in Opium: Improvements on M. Guillermond's Process, *by M.* ROUSSILLE.

M. GUILLERMOND's process, which consists in macerating the opium in cold alcohol of 72 per cent., is very accurate, but it possesses the inconvenience of being long. I propose to introduce some modifications. 15 grammes of opium are treated with 25 grammes of boiling water till complete disaggregation; then add 60 grammes of boiling alcohol at 40°; digest for an hour, and filter through linen; then treat the residue again with 10 grammes of water and 60 grammes of alcohol as before. Now extract the residue with 50 grammes of boiling absolute alcohol. All the liquids collected together and cooled are to be carefully filtered, evaporated to one-third, and filtered again after cooling. Then precipitate the morphia with 10 grammes of ammonia, and evaporate over sulphuric acid. At the end of three days collect the deposited crystals, and wash them with ether and with water.

Six successive trials have given the same results as by Guillermond's process, which takes more than five days, whilst this only requires three.

PHYSICAL SCIENCE.

On the Spectrum of Aqueous Vapour, by M. J. JANSSEN.

I HAVE the honour of acquainting the Academy with the discovery of a new optical property of steam, which, it appears, must lead to important results in celestial physics and meteorology. The optical study of this vapour has just brought to light the fact that it possesses a power of elective absorption on light, or, in other words, that it gives rise to dark lines and bands in the spectrum of a luminous beam which has traversed a sufficient thickness. But before entering into a detail of experiments, I shall ask permission to recall briefly the researches on spectrum analysis which first led me to this inquiry.

It is known that the illustrious Brewster discovered, about 1833, what are called the atmospheric bands of the solar spectrum. Brewster perceived that when the sun was near the horizon its spectrum was enriched with new dark lines. This fact, compared with others of the same kind—viz., the action of nitrous gas—led the English physicist to the just idea that our atmosphere might act in the same manner, and thus become the cause of the dark lines observed when the sun was near the horizon; he even thought that all the solar lines might be accounted for in this way. Unfortunately this fine conception could not be demonstrated in a complete manner. Indeed, these dark bands generally faded away as the sun rose, and no perceptible traces of them remained as it passed the meridian.

Later, a direct experiment, in which Drs. Brewster and Gladstone tried to reproduce the gaps in the solar spectrum by examining an artificial light at a great distance, did not give a satisfactory result. The question of the origin of the dark lines and bands was not therefore determined, but some important ideas and facts have been gained, which may serve as a groundwork for further research.

A short time after the publication of the large memoir of Drs. Brewster and Gladstone, which sums up the labours of these gentlemen on this question, M. Kirchhoff made known his studies on the solar spectrum. The result of these is well known; the origin of the lines was carried back to an atmosphere surrounding the sun, and on studying them, the chemical composition of this atmosphere was disclosed. Between the ideas of Dr. Brewster, seeking to explain the solar spectrum by the action of the atmosphere of the earth, and those of M. Kirchhoff, assigning its origin in a solar atmosphere, there was room for a less exclusive and more complete theory, which would include both causes, and point out the double origin of the lines which Wollaston and Fraünhofer discovered in the prismatic image of the sun. The solar origin of a portion of the lines being pointed out, the action of our atmosphere remained to be proved. This is the object of the studies which I have undertaken since 1862.

By some new optical arrangements I first showed that the bands of Dr. Brewster were formed of a multitude of fine lines, comparable, strictly speaking, to those of the sun.

Further, the study of these lines has proved to me that they are permanent in the spectrum, although incessantly variable in their intensity, according to the height of the sun—that is to say, according to the density of the atmosphere traversed by the rays of that luminary. These results proved that our atmosphere exercised some action. To corroborate them, I studied the spectrum on a high mountain, the Faulhorn (September, 1864), and there I saw the rays of terrestrial origin weaken in proportion as I went higher, and as the solar rays traversed a lesser density of terrestrial atmosphere.

Subsequently, in an experiment made on the Lake of Geneva (October, 1864), I was able to reproduce the same lines artificially. The flame of a large pile of fire-wood, which, when close, gave no line, except that of sodium, at 21 kilometres' distance showed the atmospheric lines of the solar spectrum. This harmony of proofs showed, then, the evident action of our atmosphere, and the double origin of the lines of the solar spectrum. I may add that the atmosphere, notwithstanding its small height and the low temperature of the gases which form it, acts on the light as powerfully as the atmosphere of the sun, although in a very different manner. In the red, orange, and yellow of the spectrum, a system of lines ten times more numerous than the solar lines of these regions is produced by the atmosphere of the earth. On the contrary, it is the lines of solar origin which prevail in the green, blue, and violet. Thus, these two atmospheres, so different in their actual temperatures, are not less distinguished by their actions on the light. They divide the spectrum in a manner; the atmosphere of the earth, which is of low temperature, acts specifically on the rays having long wave length; the solar atmosphere, which is of high temperature, exerts its elective action on the rays having short wave length.

Let us now inquire briefly to what elements of the atmosphere this action must be attributed.

Now, the attentive study of the solar spectrum led me, two years ago, to assign a very important place in the production of the telluric lines to the aqueous vapour dissolved in our atmosphere. Indeed, comparisons carried out for a long time at different seasons of the year, showed very clearly that, for the same heights of the sun, certain lines of the spectrum of this luminary were the more definite as the dew point rose higher. The observations made on the Faulhorn again confirmed these indications. I was able, during some very dry days, to see the lines in question fade entirely from the spectrum. Again, in the experiment made on the Lake of Geneva, I was led to choose the lake from the consideration that the luminous beam, in glancing on the surface of the water, must traverse some strata of damper air, which added to the chance of success, and the result confirmed this foresight.

There then remained little doubt of the action of aqueous vapour. However, it was necessary, in proportion to the importance of the result, to submit this theory to a direct proof by studying the changes which a ray of light would experience in passing through a tube, of sufficient length, containing nothing but steam. Unfortunately, this experiment presented great practical difficulties. Our atmosphere contains so much aqueous vapour that, to realise artificially the effects which it produces on the solar light, it was necessary to use apparatus of such increased dimensions that the results were difficult to realise.

A first attempt took place at the central manufactory of lighthouses. M. Allard, head engineer in this establishment, wished to assist me, but the tube which we set up was not long enough to show the phenomenon sufficiently; but I have since been more fortunate. M. Goschler, superintendent of the studies at the Central School of Architecture, referred me to the superintendent of the Parisian Gas Company, and to the head engineer. These gentlemen put at my disposal the large resources which this establishment possessed.

A tube of iron of 37 metres was set up; it was put into a wooden case of the same length containing some very dry sawdust—an arrangement which prevented any sensible loss of heat. The steam was furnished by an engine of six-horse power, and the light by sixteen jets of gas adjusted in a line with the axis of the tube.

This light, which it is well known gives a continuous spectrum, allows the production of the faintest dark bands to be perceived.

The experiments are being carried on at this time, and I now acquaint the Academy with only the first results, which, however, confirm, in the most complete manner, what the study of the solar spectrum before indicated to me.

In an experiment (August 3, 1866) where the tube, quite free from air, was full of steam at a pressure of seven atmospheres, the spectrum appeared with five dark bands, two of which, well defined, were in the portion from D to A (Fraunhofer) calling to mind the solar spectrum seen in the same instrument towards the setting of the sun.

From the first comparisons made between the spectrum of steam and that of solar light, Fraunhofer's group A, B (in greater or less part), the group C, and two groups between C and D, are owing to the action of the aqueous vapour of the atmosphere.

Moreover, this experiment has given another interesting result. The spectrum of the transmitted light appeared very dark in the most refrangible part, whilst it was brilliant in the regions of the red and yellow. Thus, although aqueous vapour absorbs certain red and yellow rays powerfully, it is mostly very transparent in these rays, while it acts in a general manner on those which are most refrangible. It follows from this that steam would be of an orange-red colour by transmission, and redder in proportion as it acts under a greater density.

This result will require to be verified and established with the greatest care, and I do not present it here without reservation. If it be definitively proved, we shall find in it the explanation of the variable red colour which is always observed at the rising and setting of the sun. The consequences of this discovery will doubtless be obvious to all. We have at length arrived at the origin of a considerable portion of the lines of the solar spectrum, and the acquaintance with these will permit us to study the most elevated strata of our atmosphere, till now inaccessible to our means of investigation. But it is especially in astronomy that the unfolding of these results will be so interesting.

Relying upon the precise knowledge of the spectrum of aqueous vapour, I anticipate being able very soon to ascertain distinctly the presence of this important element of organic life in the atmospheres of the planets and other stars. Even now I am able to announce that this vapour does not form part of the solar atmosphere.

Electric Buoys.—The experiments made at Cherbourg, by order of the Minister of the Marine, on the electric buoys of M. Emile Duchemin, have succeeded perfectly. It appears certain that henceforth the current from these very simple batteries can be economically and efficiently employed for the preservation of the iron hulls and armour plates of vessels. We understand that the zinc carbon and salt-water battery of M. Duchemin is used very advantageously in almost all the telegraphic stations of Switzerland.—*Les Mondes.* [In what does the novelty of this form of battery consist?—Ed. C. N.]

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION.—*Friday, June 8, 1866.*

On the Source of Muscular Power, by Edward Frankland, *Ph.D., F.R.S., Professor of Chemistry, R.I.*

(Concluded from page 152.)

Playfair's Determinations.

Actual Energy developed by One Gram of various Articles of Food when oxidised in the Body.

Name of food.	Metrekilograms of force. Dry.	Natural condition.
Cheshire cheese	2429	1846
Potatoes	1563	422
Apples	1516	273
Oatmeal	...	1665
Flour	...	1627
Pea-meal	...	1598
Ground rice	...	1591
Arrowroot	...	1657
Bread crumb	1625	910
Lean of beef	2047	604
Ditto veal	1704	496
Ditto ham, boiled . .	1559	711
Mackerel	2315	683
Whiting	1675	335
White of egg	1781	244
Hard-boiled egg . . .	2562	966
Yolk of egg	2641	1400
Gelatin	1550	...
Milk	2046	266
Carrots	1574	220
Cabbage	1543	178
Cocoa nibs	...	2902
Butter	...	3077
Beef fat	3841	...
Cod liver oil	3857	...
Lump sugar	...	1418
Commercial grape sugar . .	...	1388
Bass's ale, bottled . . .	1559	328
Guinness's stout . . .	2688	455

Weight and Cost of various Articles of Food required to be oxidised in the Body in order to raise 140 lbs. to the height of 10,000 ft.

External work = $\frac{1}{5}$th actual energy.

Name of Food.	Weight in lbs. required.	Price per lb. s.	d.	Cost. s.	d.
Cheshire cheese . .	1·156	0	10	0	11½
Potatoes . . .	5·068	0	1	0	5¼
Apples	7·815	0	1½	0	11¾
Oatmeal . . .	1·281	0	2¾	0	3½
Flour	1·311	0	2¾	0	3¾
Pea-meal . . .	1·335	0	3¼	0	4¼
Ground rice . . .	1·341	0	4	0	5½
Arrowroot . . .	1·287	1	0	1	3½
Bread	2·345	0	2	0	4¾
Lean beef . . .	3·532	1	0	3	6½
,, veal . . .	4·300	1	0	4	3½
,, ham boiled . .	3·001	1	6	4	6
Mackerel . . .	3·124	0	8	2	1
Whiting . . .	6·369	1	4	9	4
White of egg . .	8·745	0	6	4	4½
Hard-boiled egg . .	2·209	0	6½	1	2½
Isinglass . . .	1·377	16	0	22	0½
Milk	8·021	5d. per quart		1	3½
Carrots . . .	9·685	0	1½	1	2½
Cabbage . . .	12·020	0	1	1	0½
Cocoa-nibs . . .	0·735	1	6	1	1¼
Butter	0·693	1	6	1	0½
Beef fat . . .	0·555	0	10	0	5½
Cod-liver oil . . .	0·553	3	6	1	11¼
Lump sugar . . .	1·505	0	6	1	3
Commercial grape sugar	1·537	0	3½	0	5½
Bass's pale ale (bottled)	9 bottles	0	10	7	6
Guinness's stout . .	6¼ ,,	0	10	5	7½

Weight of various Articles of Food required to sustain Respiration and Circulation in the Body of an average Man during 24 hours.

Name of Food.	Weight in oz.	Name of Food.	Weight in oz.
Cheshire cheese	3·0	Whiting	16·8
Potatoes	13·4	White of egg	23·1
Apples	20·7	Hard-boiled egg	5·8
Oatmeal	3·4	Gelatine	3·6
Flour	3·5	Milk	21·2
Pea-meal	3·5	Carrots	25·6
Ground rice	3·6	Cabbage	31·8
Arrowroot	3·4	Cocoa-nibs	1·9
Bread	6·4	Butter	1·8
Lean beef	9·3	Cod-liver oil	1·5
,, veal	11·4	Lump sugar	3·9
,, ham, boiled	7·9	Commercial grape sugar	4·0
Mackerel	8·3		

These results are in many instances fully borne out by experience. The food of the agricultural labourers in Lancashire contains a large proportion of fat. Besides the very fat bacon which constitutes their animal food proper, they consume large quantities of so-called apple dumplings, the chief portion of which consists of paste in which dripping and suet are large ingredients—in fact, these dumplings frequently contain no fruit at all. Egg and bacon pies and potato pies are also very common *pièces de résistance* during harvest-time, and whenever very hard work is required from the men. The speaker well remembers being profoundly impressed with the dinners of the navigators employed in the construction of the Lancaster and Preston Railway: they consisted of thick slices of bread surmounted with massive blocks of bacon, in which mere streaks of lean were visible. Dr. Piccard states that the chamois hunters of Western Switzerland are accustomed, when starting on long and fatiguing expeditions, to take with them, as provisions, nothing but bacon-fat and sugar, because, as they say, these substances are more nourishing than meat. They doubtless find that in fat and sugar they can most conveniently carry with them a store of force-producing matter. The above tables affirm the same thing. They show that ·55 lb. of fat will perform the work of 1·15 lb. cheese, 5 lbs. potatoes, 1· lb. of flour or peameal, or of 3½ lbs. of lean beef. Donders, in his admirable pamphlet "On the Constituents of Food and their Relation to Muscular Work and Animal Heat," mentions the observations of Dr. M. C. Verloren on the food of insects. The latter remarks, "Many insects use, during a period in which very little muscular work is performed, food containing chiefly albuminous matter; on the contrary, at a time when the muscular work is very considerable, they live exclusively, or almost exclusively, on food free from nitrogen." He also mentions bees and butterflies as instances of insects performing enormous muscular work, and subsisting upon a diet containing but the merest traces of nitrogen.

We thus arrive at the following conclusions:—

1. The muscle is a machine for the conversion of potential energy into mechanical force.

2. The mechanical force of the muscles is derived chiefly, if not entirely, from the oxidation of matters contained in the blood, and not from the oxidation of the muscles themselves.

3. In man the chief materials used for the production of muscular power are non-nitrogenous; but nitrogenous matters can also be employed for the same purpose, and hence the greatly increased evolution of nitrogen under the influence of a flesh diet, even with no greater muscular exertion.

4. Like every other part of the body, the muscles are constantly being renewed; but this renewal is not perceptibly more rapid during great muscular activity than during comparative quiescence.

5. After the supply of sufficient albuminised matters in the food of man to provide for the necessary renewal of the tissues, the best materials for the production, both of internal and external work, are non-nitrogenous matters, such as oil, fat, sugar, starch, gum, &c.

6. The non-nitrogenous matters of food, which find their way into the blood, yield up all their potential energy as actual energy; the nitrogenous matters, on the other hand, leave the body with a portion (one-seventh) of their potential energy unexpended.

7. The transformation of potential energy into muscular power is necessarily accompanied by the production of heat within the body, even when the muscular power is exerted externally. This is, doubtless, the chief, and probably the only, source of animal heat.

ACADEMY OF SCIENCES.

September 24.

The sitting this day was a very short one, but several papers of interest were brought forward. The first was

"*On Wine: its Maladies and their Causes; New Methods of Preserving and Aging it,*" by M. Pasteur. The above is the title of a book which the author presented to the Academy, accompanying it with some remarks. The first part of the work contains a description of the maladies of wine, and the ferments which occasion them. The second part treats of the influence of oxygen in vinification. The third part explains an industrial process of preserving wines, which it is expected will produce considerable profit. The process has been tried by a great number of persons, and the results are said to be very favourable to the new process. The criterion to which final appeal was always made was tasting by a commission composed of experienced persons, and details are given of the results of experiments on twenty-one samples of wine.

"*Note on Galvanic Piles with Two Liquids,*" by M. Zaliwski-Mikorski. . The author has introduced an improvement in the method of filling and emptying the trough. The permanent part consists of an alternate succession of porous diaphragms and isolated carbons. By means of tubes in the lower part, a liquid poured into one compartment immediately flows into all the analogous compartments; the whole of them can likewise be emptied simultaneously with a siphon. The trough therefore need not be moved when it has to be filled or emptied. The zincs, which are loose, rest on the carbon, which projects for this purpose at its base, and the effect of removing one or more is not to stop, but only to diminish the intensity of, the current. The cement consists essentially of sulphur rendered less brittle by admixture with tar and lamp black.

"*New Considerations on the Movements of Subterranean Materials in Fusion,*" by M. A. de Caligny.

"*On the Polymeres of Acetylene, Second Part,*" by M. Berthelot. This is a continuation of the paper given by the same author last week, and will be laid before our readers in full. In the condensed liquid obtained by passing acetylene through a red-hot tube, he finds diacetylene,

$$C_8H_4 = 2C_4H_2,$$

triacetylene or benzol,

$$C_{12}H_6 = 3C_4H_2,$$

and tetracetylene or styrolene,

$$C_{16}H_8 = 4C_4H_2.$$

In the higher boiling portions he finds naphthaline, derived from five molecules of acetylene and the loss of hydrogen,

$$C_{20}H_8 = 5C_4H_2 - H_2,$$

pentacetylene,

$$C_{20}H_{10} = 5C_4H_2,$$

and towards the boiling point of mercury he obtains enneacetylene or retene,

$$C_{36}H_{18} = 9C_4H_2.$$

"*On the Isomeric States of Styrolene,*" by M. Berthelot. The formula $C_{16}H_8$ represents two hydrocarbons obtained by different ways—one from extract of storax, in which it pre-exists; the other from the decomposition of cinnamates. By some chemists these have been considered different bodies, and by others identical. M. Berthelot has examined them, and found decisive differences between them. The carbide from cinnamates has no rotatory power, whilst that from storax deviates the plane of polarisation −3 degrees. The two carbides, mixed with concentrated sulphuric acid, disengage unequal quantities of heat, the proportion being three to four, the greatest quantity corresponding to the carbide from storax.

"*On Hydrated Peroxide of Copper,*" by M. C. Weltzien. When peroxide of hydrogen is added to a solution of ammonio-sulphate of copper, there is a lively disengagement of oxygen, and an olive-green precipitate is produced, which is doubtless identical with the peroxide of copper obtained by Thenard and Boettger. The formula appears to be H_2CuO_3. The author gives several reactions of peroxide of hydrogen, and some theoretical considerations.

"*On the Silkworm Disease,*" by MM. Joly and M. F. Achard. These are two separate papers on a subject which is attracting great attention in France.

NOTICES OF BOOKS.

A Dictionary of Chemistry. By H. Watts, B.A., F.R.S. Part XXXVI.

This standard work is rapidly approaching completion. The October part embraces from *Saccharum* to *Silica*, and includes salicine; the salicylic compounds; an excellent memoir on *salt*, by Professor Foster, in which he defines the modern idea of a salt as implying "the capability of readily undergoing double decomposition;" a good article on secondary alcohols; and a full account of selenium and its manifold combinations.

Zeitschrift für analytische Chemie. Edited by Dr. C. Remigius Fresenius. First Part. 1866.

As we before had occasion to remark, this very valuable contribution to analytical and abstract chemistry does not make its appearance with any regularity, for we have only just received the first part of the volume for 1866. We hasten to lay before our readers a list of its contents, and will lose no time in translating and printing, either in full or in abstract, those papers which are likely to be of more particular interest. The number consists of 140 well-printed pages, and contains:—

"*On the Detection and Estimation of Tannic Acid,*" by P. Wagner.

"*On the Estimation of Mixtures of Organic and Inorganic Substances in River, Spring, and Mineral Waters,*" by W. Heintz.

"*On the Separation and Isolation of Organic Matter in Spring and Potable Waters,*" by J. Löwe.

"*On the Elementary Analysis of Hygroscopic Substances,*" by W. Stein.

"*On the Detection of Free Acid in Alum,*" by M. Derselbe.

"*On a Process of Gas Volumetric Analysis,*" by E. Dietrich.

"*On the Action of Reagents on Diabetic Urine,*" by G. Bizio.

"*On the Quantitative Determination of the Nitrogen and Oxygen dissolved in Water,*" by O. Helm.

"*On the Estimation and Separation of Protoxide of Manganese from Proto- and Per-oxide of Iron,*" by E. Reichardt.

"*On Gas Analysis,*" by M. Derselbe.

"*On the Estimation of Bromine in Organic Bodies,*" by R. L. Maly.

"*On Filtration,*" by V. Prittmitz.

"*On the Presence of Magnesia in Commercial Baryta Salts,*" by W. Reuling.

The following are communications from Professor Fresenius's laboratory at Wiesbaden:—

"*On the Separation of Cobalt and Nickel,*" by F. Gauhe.

"*On the Behaviour of Soda, Lime, Caustic Potash Solution, Hydrate of Potash, and Potash Pumice Stone, towards Gases containing Carbonic Acid,*" by R. Fresenius.

"*On the Application of Dialysis to the Detection of Poisonous Alkaloids,*" by A. Cossa.

The remainder of the part is occupied with extracts from English and foreign journals, most of which have already been noticed in these pages.

Chemisches Central Blatt, Nos. 41 and 42.

The former of these two numbers contains the following articles extracted from the *Annalen der Chemie und Pharmacie* for June and July:—

"*On the Action of Nitric Acid on Glycolamidic Acid,*" by W. Heintz.

"*On the Action of Nitrate of Potash on Salts of Triethylamine, and on the Separation of Diethylamine from Triethylamine,*" by W. Heintz.

"*On Crotonic Acid,*" by C. Bulk.

"*On the Periodides of Organic Bases,*" by W. A. Tilden (from the *Journal of the Chemical Society*).

No. 42 contains articles "*On the Tar Dyes,*" and on "*Chemical Researches on the Influence which a Variation of the Quality of the Food of Sheep exerts on their Excreta,*" by Dr. E. Reichardt.

The usual short notices of papers are given in each number.

Journal für praktische Chemie. No. 13. August, 1866.

The present part of this journal contains the following papers:—

"*On the Formation of Peroxide of Hydrogen by the gradual Oxidation of Organic Matter in Towns.*" By C. F. Schönbein.

"*On the Formation of Active Oxygen by the Gradual Oxidation of Volatile Organic Substances.*" By C. F. Schönbein.

"*On Bromide of Benzylidene, and Two Derived Hydrocarbons.*" By C. A. Michaelson and E. Lippmann.

"*On the Salts of Thialdine.*" By E. Brusewitz and M. Calhander.

"*On Pyromucic Acid.*" By MM. Schmelz and Beilstein.

The number contains several other papers; but as they are extracted from the *Comptes Rendus*, or from English journals, and have already been noticed in our columns, it is not necessary to refer to them a second time.

Blue Ink from Prussian Blue.—By the following process M. Vogel has always obtained a good solid blue ink with Prussian blue and oxalic acid:—Dissolve in a matrass, in a large quantity of water, ten grammes of sulphate of protoxide of iron; boil, and then add sufficient nitric acid to sesquioxide all the iron. Then add a solution of yellow prussiate of potash, containing ten grammes of this salt, and leave the precipitate to deposit. After decanting the supernatant liquid, throw the deposit on a filter, wash it with cold water, and leave it to drain until it can be easily raised from the filter with a knife. Then, without further drying, mix it in a porcelain mortar with two grammes of oxalic acid in crystals. Let the reaction continue for an hour, then gradually add 400 cubic centimetres of water. This produces a dark blue solution, which, even after long standing, does not precipitate.—*Moniteur Scientifique.*

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

2236. J. M. Mellor, Broadway, New York, U.S.A., "Softening, disintegrating, and bleaching vegetable fibres."—Petition recorded August 30, 1866.

2252. A. Lebandy, Spring Gardens, Westminster, "An improved solder or composition for joining certain metals, or uniting fractures in certain metals, and for similar uses." A communication from C. Halot, Brussels.—September 1, 1866.

2255. S. Vickess, Liverpool, "An improved method of and apparatus for facilitating the moving of moulds and the draining of syrup from the sugar solutions and sugar in the said moulds in the manufacture of sugar."

2266. C. E. Brooman, Fleet Street, "A new method of bleaching fibres and fabrics of vegetable origin." A communication from C. M. T. du Motay and C. R. Maréchal, Metz, France.—September 3, 1866.

2273. A. Paraf, Manchester, and J. A. Wanklyn, London, "Improvements in the extraction of iodine and bromine from kelp."—September 4, 1866.

2278. T. G. Webb, Manchester, "Improvements in furnaces for the manufacture of glass, commonly called melting furnaces."—September 5, 1866.

2323. W. E. Gedge, Wellington Street, Strand, "Improvements in the manufacture of calcareous bricks or artificial stones." A communication from A. F. Osselin, Faubourg St. Martin, Paris.—September 10, 1866.

2331. W. Olley, Enfield, Middlesex, "Improvements in apparatus for separating animal and vegetable matters from water and other liquids."—September 11, 1866.

Invention Protected by the Deposit of a Complete Specification.

2415. A. B. Berard, Avenue Montaigne, Paris, "Improvements in the manufacture of steel, and in the apparatus employed therefor, parts of which improvements and apparatus are also applicable to the production of gas for heating purposes."—Petition recorded September 20, 1866.

CORRESPONDENCE.

"*Isinglass*" *for Smelting Furnaces.*

To the Editor of the Chemical News.

Sir,—Referring to the question at the end of your last number as to the meaning of the word "isinglass" in a paragraph from the *Mechanics' Magazine*, I beg to offer the following attempt of an explanation:—When I read the same paragraph a few weeks ago, I was naturally struck with its apparent absurdity; but I soon consoled myself with the assumption that the writer might have somehow confounded "isinglass" with "marienglass," the German name for the highly transparent variety of gypsum. If this were the case, there would be no flagrant nonsense in the proposal of using the substance in question in constructing smelting furnaces; but I am very far from committing myself to any approval of that scheme.

I am, &c., G. L.

South Shields, September 30.

To the Editor of the Chemical News.

Sir,—According to Dr. Dana's "Manual of Mineralogy," p. 33, under head "Cleavage," "mica" is often improperly called "isinglass." Perhaps this substance is meant in the paragraph of the *Mechanics' Magazine* alluded to in your notice to "J. W." last week. Let us hope that such improper use of terms may for the future be banished this country at least, even if tolerated in America.

I am, &c., J. O.

On the Results of the Micro-Chemical Examination of Extract of Flesh.

To the Editor of the Chemical News.

Sir,—In the Chemical News of September 14, appears a verbatim report of a paper read by Messrs. Deane and Brady before the British Pharmaceutical Conference on the examination of *extractum carnis* by the microscope, in which, after detailing their experiments, the authors state that they have arrived at the following conclusions:—"That the microscope does afford a ready means of ascertaining proximately the value of this article;" and 2nd. "That the value of a sample is in direct relationship to its crystalloid, and inversely to its colloid, constituents"—a result so much at variance with that arrived at by Baron Liebig, the learned demonstrator of the process for making this article, that I venture to trouble you with a quotation from his "Letters on Chemistry," p. 420, where, speaking of the crystalline constituents of the extract of flesh, the learned chemist says: "All these substances constitute but a small part of the extract of flesh. By far the greater part of it consists of uncrystallisable (colloid) compounds, the properties of which have not yet been sufficiently studied. To these substances belong the savoury constituents of the juice of flesh, and those among them which become so easily brown when gently heated." So much difference is apparent in these opinions, that it is absolutely necessary to have further proofs of the constituents of extractum carnis before expressing an opinion as to the quality of any particular make.—I am, &c.

F. D.

MISCELLANEOUS.

Eclipse of the Sun.—On Monday next, October 8, there will be a partial eclipse of the sun. It will begin in London at 26 m. past 4 p.m., and will be at its maximum at 26 m. past 5; but the sun will set at 21 m. past 5, when something less than half the sun's diameter will be eclipsed. Observers situated in other parts of the kingdom will be able to observe the greatest obscuration before sunset. Thus:—

	Eclipse begins.	Maximum obscuration.	Sun sets.
London (Greenwich time)	4·26	5·26	5·21
Oxford (local time) . .	4·20	5·20	·20
Liverpool „ . .	4·8	5·10	5·19
Edinburgh „ . .		5·5	5·16
Dublin „ . .	3·52	4·56	5·19

The Sodium Amalgamation Process.—From an article in our excellent contemporary, the *American Artisan*, we learn that a paper was read before the American Association for the Advancement of Science at its recent session in Buffalo, N. Y., by Professor Wurtz. From it we make the following extracts:—"Some objections to the use of sodium for silver ores, on the part of a Californian metallurgist named Kustel, were briefly discussed. Kustel has erred mainly in supposing that the purpose of the sodium-amalgam was to *decompose* silver ores by extracting their sulphur by sheer force of chemical affinity. The rapid and perfect collection and separation from a slime or pulp of contained and diffused silver-amalgam by the use of sodium-amalgam would alone give it an obvious importance; but it has other values when properly understood. Kustel's experiments, having been based upon an incorrect idea of the mode of action, have but little applicability *pro* or *con*, and inconsistencies were pointed out in his conclusions. Kustel's conclusion, that iron pans cannot be used with sodium, for instance, is shown to be fallacious by very numerous working results now on record. Mr. Kustel, however, admits the value of sodium for gold ores, and others in California experienced in amalgamation do not concur with Mr. Kustel in his opinion with regard to silver ores. . . . The most surprising articles elicited by this discovery in Transatlantic journals have emanated from certain persons who have denied the authenticity of the discovery altogether, and claimed that the use of sodium in amalgamation of ores has already actually been a matter of publicity for centuries. Mr. John Calvert and another writer (anonymous) have put forth the astounding assertion that extracts can be given from more than one hundred works in various languages, showing that not only sodium, but magnesium, has been used in this way from time inmemorial. Three very ancient works are referred to by name—Schwartz's 'Alchymia de Salabus,' Albaro Alonso Barba's 'Art of Metals,' and Roger Bacon's 'Ars Omnia.' Professor Wurtz has examined the work of Barba, written in 1640, and finds nothing in it indicating in the remotest degree any knowledge of sodium, much less of its use in amalgamation; and has examined Mr. Calvert's translated extracts from the Latin manuscript of Bacon, which it appears was never published, and finds in them only some obscure allusions as to what wondrous magic might be worked by a pinch of salt in transmuting a mass of worthless stuff into gold. Schwartz's still older work Professor Wurtz has been unable to find in this country, but thinks it may be said with reason that a person of lively imagination could find plainly set forth in the jargon of the alchemists every one of the discoveries of the nineteenth century, besides a multitude of other discoveries either yet to be made or never to be made. Respecting the recent and wonderful announcement from an unknown source, so widely and persistently paraded in the public press, of the amazing *explosiveness* of an amalgam of sodium, it appears that this was simply an ingenious but futile *commercial trick*—the motive for it having been the hope of embarrassing the transportation and introduction of the amalgams of sodium into the mining regions, by those legitimately entitled to introduce it, until the completion of certain arrangements for infringing upon the patent rights.

Solubility of Paraffin.—Aug. Vogel has determined the solubility of paraffin in benzol, chloroform, and sulphide of carbon. The paraffin experimented with melted at 48° C., and congealed at 45°. The benzol had the sp. gr. 0·887. One part of benzol

at 46° C.	dissolved	7·7	parts paraffin.
43°	„	5·0	„
39°	„	4·0	„
23°	„	0·7	„
20°	„	0·3	„

Solubility in chloroform: One part of chloroform at 23° dissolved 0·22 parts paraffin; one part of chloroform at 20° dissolved 0·16. Solubility in sulphide of carbon: One part of the sulphide of carbon at 23° dissolved an equal weight of paraffin. Comparative experiments with stearic acid showed that one part of benzol at 23° C. dissolved 0·22 parts of stearic acid, and one part of sulphide of carbon at 23° dissolved 0·3 of stearic acid. This acid is consequently less soluble in the above menstrua than paraffin. A mixture of stearic acid and paraffin fused together did not separate from these solutions in a homogeneous mass, but in two layers, the stearic acid appearing in distinct crystals. This may suggest a method of recognising the presence of stearic acid in a mixture with paraffin.—*Am. Drug. Circ.*

Cement for Rooms.—An invention by M. Sarel, of Paris, is stated to be superior to plaster of Paris for coating the walls of rooms. It is used as follows:—A coat of oxide of zinc, mixed with size, made up like a wash, is first laid on the wall, ceiling, or wainscot, and over that a coat of chloride of zinc applied, being prepared in the same way as the first wash. The oxide and chloride effect an immediate combination, and form a kind of cement, smooth and polished as glass, and possessing the advantages of oil paint without its disadvantages of smell.—*Dublin Med. Press.*

Creosote.—Dr. A. E. Hoffmann* purified creosote, which he had obtained warranted from beechwood tar, according to Von Gorup-Besanez's method by distillation, and only used such as began to boil at nearly 203°. The boiling point rose to 208°. This distillate agrees in all physical attributes with that described by Von Gorup-Besanez; only the specific gravity was greater, 1·075 (1·040 according to Gorup-Besanez). From an examination of the chemical behaviour, the inference drawn is, that creosote is only imperfectly pure carbolic acid. Hexachlorxylon is identical with chloranil. Von Gorup-Besanez† contradicts this, and dismisses Hoffmann's supposition that he was working with beechwood tar creosote as untenable, as it has entirely disappeared from German commerce. Accordingly, Hoffmann's research would merely amount to a statement of the long-known fact that carbolic acid may be bought for creosote—not, however, that true creosote does not exist.

Chloride of Barium.—According to Godin, a process lately patented in Belgium for preparing this salt consists in melting together a mixture of sulphate of baryta, charcoal, limestone, and chloride of calcium. During the operation, the charcoal reduces the sulphate of baryta to sulphide of barium, and this forms, with chloride of calcium by double decomposition, chloride of barium and sulphide of calcium; this latter again combines with the lime produced by the decomposition of some of the limestone, forming an insoluble oxysulphuret of calcium. The chloride of barium is now separated from the calcined mass by lixiviation and evaporation. The proportions used are 100 parts native sulphate of baryta, 35 to 50 parts charcoal, 15 to 25 parts limestone, and 40 to 60 parts chloride of calcium.—*Dingl. Polyt. Journ.*

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. XIII. 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., II., and VII. are out of print. All the others are kept in stock. Vol. XIV. commenced on July 6, and will be complete in 26 numbers.

F. T.—We must decline to write trade puffs.

Owen.—Chloroform will remove the stains of dry paint much better than turpentine, and will leave no unpleasant odour behind.

Pharmaceutist.—The presence of nitric acid will prevent the precipitation of bismuth salts by water. This fact has been made use of for some time in the preparation of Liquor Bismuthi.

W. M. M.—The Hindustani name for indigo is *Nil*, or the blue dye. The word aniline is derived from this.

Cantor Lectures.—We have received the copy for these valuable lectures, lately delivered by Dr. F. Crace Calvert before the Society of Arts. Their publication will commence almost immediately.

Distiller.—The fœtid smell of your carbolic acid is due to the presence of sulphur compounds of some of the higher acids. It can be removed by rectification from oxide of lead.

X. Y. Z.—To purify the nitrate of baryta, dissolve in hot water and add strong nitric acid. This will precipitate the nitrate of baryta in the form of a snow-white crystalline powder. Collect on a funnel partially closed with a glass rod, wash once with nitric acid, and dry at 212°.

B. M. Nash.—We shall be pleased to hear further particulars, as the subject is one of some importance. Respecting the Paris Exhibition, your best plan will be to apply to the Secretary of the Exhibition Committee, South Kensington Museum. But we think you are too late to obtain space.

Books Received.—Dictionary of Chemistry, by Henry Watts, B.A., F.C.S., &c. (Part XXXVI.); Technologist for October; Antiseptic Treatment of Cholera, by Dr. A. E. Sansom.

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* *Journ. f. prakt. Chem.*, Bd. xcvii., S. 225.

† *Ibid.*, Bd. xcvii., S. 63.

DISINFECTION AND THE CHOLERA.

A STARTLING assertion has been made by a Dr. Saunders, to the effect that carbolic acid is of no special value in preventing the spread of infectious disease, and that, in fact, its very general employment during the recent visitation of cholera has been productive of more harm than good. In a report which he has just issued to the guardians of the City of London Union, he winds up an intemperate attack on the City Commissioners of Sewers in the following terms:—

> "During the last few weeks the streets of the City have been abundantly supplied with a solution of carbolic acid, and its nauseous and suffocating odour has polluted the atmosphere night and day, ostentatiously appealing to the olfactories of the million, in proof of the vigilant care of the Commissioners of Sewers. It has been sought to justify this process upon the purely hypothetical grounds that the air we breathe contains floating animal or vegetable organisms supposed to be the germs or nidus of cholera, and that these are rendered harmless by the action of this disgusting agent. I need not say that modern scientific investigation fails to justify any such proposition; far better would it have been for the general well-being of the community if the energies of the Commissioners had been directed into the more practical operation of searching out the causes of disease in the courts and alleys of the poor."

Now, such statements as these, emanating as they do from a Medical man occupying, we believe, a responsible position in the City of London, and who may therefore be supposed to know something of the history and literature of the modern doctrines of disinfection, must not be passed over without notice. The subject is one which is interesting to all chemists, as it is mainly through the researches and exertions of some of our fraternity that the antiseptic treatment of zymotic diseases has so widely prevailed; it especially affects ourselves, inasmuch as from the first we have consistently and emphatically urged the extension to cholera, of those chemical processes of disinfection and prevention, which proved so efficacious in arresting the cattle plague; and it is mainly through our exertions that carbolic acid has met with such extended application in London. It certainly cannot be denied that, simultaneously with this wholesale employment of the most powerful antiseptic known, the cholera has, contrary to all previous experience and present anticipation, not only ceased to spread, but appears to be steadily on the decline.

It is a notorious fact that the odour of carbolic acid, especially when diluted, is rather pleasant than otherwise; yet Dr. Saunders has the hardihood to speak of polluting the atmosphere by its nauseous, suffocating, and disgusting odour. Medical and scientific journals for months past have been filled with experimental researches and theoretical arguments, which have placed in the strongest light the two facts that carbolic acid is, perhaps, the most energetic known destroyer of animal ferments and poisons, and that the cholera is propagated by the diffusion of an animal ferment or poison. Carbolic acid and the cholera poison thus appear to be placed by modern scientific research in the natural relationship of poison and antidote, acid and alkali; and yet Dr. Saunders, with the researches of Dr. Lionel Beale, Dr. Angus Smith, and other well-known experimentalists staring him in the face, by a strange perversion of language, attempts to bias the minds of those who naturally look to him for correct information, by the specious phrase—"I need not say that modern scientific investigation fails to justify" this employment of carbolic acid. It is to be hoped that those to whom this report is addressed will know what value to place on opinions expressed with such temerity.

It will be remembered that, in some remarks which we made on the subject of disinfection a few weeks ago, we called attention to the fact that in the parish of St. Pancras the sewers were being disinfected on alternate days with oxidising and deoxidising agents. This was mentioned quite incidentally, and with no particular desire to cast any blame on the parish authorities, but merely as an illustration of the waste of material occasioned by the want of accurate knowledge of the laws of disinfection, and the absence of combined action among the local self-governing authorities. To this statement Mr. Worrell, Chief Clerk of the St. Pancras Department of Works, has written a reply, in which, after first denying the facts mentioned by us, he says:—"During the autumn of last year, and since the spring of this year, the district sewers of St. Pancras have been deluged only with carbolic acid, principally of MacDougall's manufacture. . . . . We also put chloride of lime into the gullies discharging into main line sewers, so that there might be no neutralising effects. Chloride of lime was also used dry for gullies having catch pits. . . . This course was approved by Dr. Hillier, the Medical Officer of Health, whose abilities as a chemist are a sufficient warranty for the correctness of the course adopted."

This statement is almost sufficient in itself to justify the remarks which we felt it our duty to make, but the facts, as observed by us, are even stronger than those mentioned by Mr. Worrell. In three, and doubtless more, streets in the immediate neighbourhood of Mr. Worrell's office, on one morning in the early part of August, the passer-by was assailed by the powerful odour of chloride of lime, and on every grating leading into the drains an abundance of this powder was seen to be strewed. Two days after, this was replaced by another powder of a slightly yellowish cast, and the prevailing odour now was that of carbolic acid. Suspecting that this might be MacDougall's powder, some of it was collected and submitted to analysis. This confirmed our suspicions, and proved that carbolic acid and sulphite of lime and magnesia—powerful *deoxidising* agents—were being added to the sewers. The next day chloride of lime had resumed its sway, and, to complete the evidence, some of this was collected and examined; this, we need scarcely add, is a powerful *oxidising* agent. Mr. Worrell further says that "the use of chloride of lime has not taken place for many weeks past, it having been found more expensive and less effective and lasting than carbolic acid, which is now employed freely both in powder and solution in all parts of the parish." So we are justified in concluding that the changes have again been rung on oxidisers and deoxidisers.

The above observations and analyses were made personally by the Editor of this Journal, and the arguments based upon them cannot therefore be considered either out of place or unjust to those responsible for this scientific incongruity.

TECHNICAL CHEMISTRY.

On Sodium Amalgamation, with Special Reference to saving the Precious Metals, and especially Gold, by Professor E. SILLIMAN. (*Abstract.*)

SAMPLES of waste or "tailings" collected by myself at various amalgamation works in Grass-valley, California, a place noted above most others for the great success which has attended amalgamation of gold, proved on assay to contain in the quartz waste over 30 dollars to the ton, and in the sulphides over 50 dollars to the ton, showing a loss nearly equal to the average amount saved in that district. One of the most cautious and experienced metallurgists of California, at one time connected with the geological commission of that State, informed me that by his own determinations the saving in a large number of cases was barely 30 per cent. of the gross contents of the ore, as shown by careful assays both of the ore and the waste. The causes of this large loss are various, amongst which may be mentioned imperfect processes, insufficient comminution of the ore, and the difficulty of bringing the gold into contact with the mercury. In an ore containing one ounce of gold to the ton of quartz or waste, the ratio is as 1 to 32,000, or less than one-fourth of one grain in one pound of stuff. It is, however, well known to all who are conversant with gold amalgamation that the mercury often appears perfectly indifferent to the gold, even when brought in contact with it, failing to amalgamate with it. This indifference may sometimes be traced to a minute portion of grease, which effectually checks amalgamation, but it is quite as often due to some other and less obvious cause, baffling often the skill of the best amalgamators, and resulting often in a ruinous loss of the precious metal. Numerous inventions have been devised to save this loss and avoid the causes which involve it, but until lately with very indifferent success. One of the most promising—viz., the use of mercurial vapour—has proved itself, on trial in the large way, a failure, and the problem has remained in a great measure unsolved. It was communicated to me, as the result of preliminary experiments, that the use of a minute portion of the metal sodium would impart to mercury the power of amalgamating with gold readily under any of the adverse conditions which had thus far proved so serious a drawback to the practice of this art. I have the honour to place before the Academy two of the alloys thus formed. The one contains about 2 per cent. of sodium, crystallised in beautiful prismatic crystals and needles, as may be observed, and melts below 212° Fahr. The other contains about 4 per cent., commonly rather more, of sodium, and is a hard brittle solid, remarkably infusible, and requiring a temperature nearly as high as the fusing point of type metal to melt it, and which may be cast into ingots, and packed either under petroleum or in air-tight iron cans, filled with dry lime. This harder alloy may be fused in free mercury at a temperature below its point of vaporation. But for practical use it will doubtless be found more convenient to employ one of the more fusible alloys of sodium. This amalgam may be most conveniently transported by employing the common iron quicksilver bottles, which, being filled with the alloy and tightly closed, will need no other protection from the air, and by setting the flask in boiling water a short time the alloy becomes liquid, and may then be used to charge the ordinary quicksilver for use.

Experiments upon Gold Ores.—Having at my disposal a considerable quantity of California quartz from a mine in Calaveras county, I proposed subjecting these ores to amalgamation, under conditions subject to control, both as expressing the actual value of the material experimented on, as well as giving the value of the results and the loss in the process. For this purpose recourse was had to the crushing and grinding apparatus of Mr. M. B. Dodge, in New York city, which, doing its work dry, gives unusual facilities for exactness. The details obtained in these experiments as to the degree of comminution reached by this apparatus have been very carefully worked out, but are reserved for a future communication, having no bearing on the subject now before us, although believed to be of value to the art of ore dressing. Suffice it to say, we were able by this means to obtain a fair average sample of the entire amount of the ores treated—a thing of the greatest practical difficulty, as every assayer well knows.

First Series of Experiments.—One lot of very poor ores, being quartz, showing no gold, but some iron pyrites and much ochery matter, being crushed and ground, gave of fine dry powder 525 lbs. Several assays of this lot gave an average value to the ore on the ton of 2000 lbs.—

Gold.	$13·56
Silver	1·33
	$14·89

The whole of this lot of 525 lbs., or rather more than a quarter of a ton pulverised ore, was then treated in a Freiberg amalgamating pan, provided with sixteen mullers, and driven by steam power. In this apparatus the mass was first made into a thin paste with water, and then treated for one hour with 20 lbs. of mercury, to which 4 oz. of 4 per cent. sodium amalgam were added in four successive doses, applied at about equal intervals during the time of the process, the alloy being dissolved in a small part of the mercury. On cleaning up the results of the experiment and obtaining as nearly as possible average samples of the waste, the entire amount of mercury used in the experiment was recovered with a loss of less than $\frac{1}{320}$th of the original quantity. On careful distillation (retorting) the button of bullion melted at the United States Assay-office gave 1·925 of one ounce troy of a fineness of 827-thousandths, and a value of 3·295 dol., or calculated upon the ton of 2000 lbs., giving a value per ton of 14 dol. 3 c. of precious metal. The tailings from this experiment yielded to assay a mere trace of gold, too small to be weighed. The concentrated sulphides washed from the tailings, and representing a very small fraction of the whole original mass, gave as the result of two assays—1183 dol. 73 c., and 1140 dol. 63 c.; average 1162 dol. 18 c. per ton of 2000 lbs. On calculating the ratio of these concentrated tailings to the whole mass, it was found to be as 1 to 1700, giving about 70 cents as the bullion value additional to the bullion obtained by amalgamation, giving a total of 14 dol. 73 c., and differing by only 16 cents from the entire chemical contents, as shown by the average of several assays—in other words, the sodium amalgamation had in this experiment saved, practically speaking, all the gold in an ore containing less than 15 dols. to the ton.

Second Series of Experiments.—Another lot of ores from the same mine, known to be much richer than the first, was in like manner ground to a fine powder, and very carefully sampled in a manner to secure a fair average.

Repeated assays, at the United States Assay Office and elsewhere, fixed the value of this sample of about 80 lbs. of powdered ore at 320 dol. per ton, the range of difference being moderate.

The assay gave respectively 293 dol. 63 c., 332 dol. 78 c., 296 dol. 37 c., 368 dol. 22 c., 306 dol. 20 c., 320 dol. 36 c. The average result of the value of the whole quantity being very closely 320 dol. per ton of 2000 lbs. of ore. In treating this sample, a different mode of experimenting was adopted. A small rotating cask, capable of treating 10 lbs. or 15 lbs. of ore, was arranged in imitation of the usual Freiberg barrel. In operating on small quantities of ore (10 lbs. or 15 lbs. for example), the ratio of loss and error is much higher than in treating larger quantities, as in the great processes of the arts. We did not expect, therefore, to obtain in this series of experiments results so closely approximating the assay as in the first experiment, which was made upon a scale equal to that of the quartz mill.

Experiments.—I. To make a comparative experiment, showing the relative saving power of common quicksilver and of the sodium amalgam, 5 lbs. of the ore were treated for thirty minutes with 2 lbs. of common mercury, which gave—

	Per cent.
Per ton of 2000 lbs. . . .	$118 80 c. or 37·12
The tailing of this experiment, panned by hand with one ounce of magnetic mercury, yielded an additional quantity . .	$67 20 c. or 21·00
	$186 00 c. or 58·00

II. 10 lbs. of the ore were next treated in the same manner with 1 lb. of common mercury thirty minutes, and the tailings panned in like manner with 1 oz. of magnetic quicksilver, giving in all, per ton, 182 dol. 60 c., or 57·1 per cent.

III. 10 lbs. of the ore, with 1 lb. of common quicksilver, for thirty minutes—

Yielded	$191 80 c., or 60 p. c.
Tailings treated for thirty minutes with 1 lb. of magnetic quicksilver (quarter of an ounce of No. 2 amalgam) gave in addition . . .	$63 60 c., or 20 p. c.
	$255 40 c., or 80 p. c.

No appreciable loss of mercury.

IV. 10 lbs. of the ore treated for thirty minutes with 1 lb. of magnetic quicksilver (one quarter of an ounce of No. 2 amalgam), and the tailings, as in No. II., treated in a pan with one ounce magnetic quicksilver, yielded in all 266 dol. 40 c., or 83·3 per cent.

No appreciable loss of mercury.

General Results.—These experiments are still in progress, but the results show that with unaided mercury the gold saved is less than 60 per cent. of the whole quantity of gold known to be present. In one experiment less than 40 per cent. was saved, while by the aid of the amalgam of sodium the saving is increased to 80 or 83·3 per cent., or an increase of more than 20 per cent.; leading to the reasonable expectation that in the large way at least 80 per cent. of the gold present in a given case may be saved, and in many cases, where the gold is coarse and free, that even better results than this may be attained. The first experiment detailed, in which a different amalgamating apparatus was used, gave results surprisingly close. I do not think the barrel as good a form of apparatus for this description of amalgamation as some one of the numerous forms of pan now in use. It was employed in these experiments simply because it was a convenient means of treating small quantities of ore in making comparative experiments. Experiments in California, under my direction, have been set on foot upon a scale of magnitude adequate to test the value of the discovery in the metallurgy of gold in a satisfactory manner, the results of which may be looked for at no distant day.

The action of the sodium in this case appears to be in a manner electrical, by placing the mercury in a highly electro-positive condition towards the electro-negative gold. The quantity of sodium is too small to allow the supposition that it acts by its chemical affinities. It is well known to chemists that the metallic sulphides are decomposed by amalgam of sodium, but no one supposes that an inventor could be found so Quixotic in his chemical notions as to seriously propose the use of sodium amalgam as a means of effecting the reduction of the sulphides of silver, &c., since not less than one equivalent of sodium would be required to set at liberty one equivalent of silver. The use of sodium amalgam for silver amalgamation must depend upon a like power of electrical action to that seen in its action on gold, and also to the well-known power of preventing the granulation (flouring) of mercury, or of saving the mercury when thus changed. Indeed, there is good reason for believing that a most important part is played by the sodium amalgam in this last particular. The amalgam of gold or silver is very liable, as every millman knows to his loss, to granulate and disappear from the plates of the battery, or from the ripples, after it has once been formed. If this granulation takes place, it is almost impossible, by the existing modes of amalgamation, to recover the minute particles which float off with the currents of water, and are lost. The action of the sodium in recovering mercury which has passed into this condition is perhaps its most remarkable property.

Alta California, March 13.

On Resins,* *by M.* H. VIOLETTE.

CALCUTTA COPAL resins, which form the basis of varnish, are not naturally soluble in ether, essence of turpentine, benzol, petroleum, and other hydrocarbons, nor in vegetable oils.

These resins become soluble, cold or hot, when, by previous distillation, they have lost 25 per cent. of their weight.

The present memoir comprises some new researches which may be summed up as follows:—

1. The above-mentioned resins being heated in a closed vessel, at a temperature between 350 and 400°, acquire after cooling, without losing any of their weight, the property of dissolving, hot or cold, in the above-named liquids, and forming excellent varnishes, without any loss of substance.

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* *Comptes Rendus*, lxiii., 461.

2. Calcutta copal resin, heated as above with one-third of drying linseed oil and one-third of essence of turpentine, gives directly, without any loss, a rich, clear, limpid varnish, of a beautiful slightly lemon colour, perfectly adapted for carriages, and for the inside as well as outside of rooms, where delicate painting is required.

Under the double influence of heat and pressure, resins then acquire new properties; this, measured by the manometer, amounts to twenty atmospheres. It must be left to manufacturers to overcome the difficulty of transferring this new method from the laboratory to the factory.

PHARMACY, TOXICOLOGY, &c.

The Exhibition of the Pharmaceutical Conference, Nottingham.

(*Continued from page 162.*)

From Messrs. Davy, Yates, and Routledge, there were forwarded a large series of metallic and other preparations. Among them we noticed:—*Ferri et quiniæ citras*, in scales of a fine greenish golden-yellow colour, freely soluble in water, and yielding a clear, bright solution. It contains 16 per cent. of pure quinia, which is equivalent to 25 per cent. of citrate. The process of the B. P., when strictly adhered to, produces scales of somewhat duller colour than those in the sample above referred to. *Ferri et ammoniæ citras*, made by saturating citric acid with metallic iron, adding liq. ammoniæ until the white proto-citrate is dissolved, and exposing the solution to atmospheric air until oxidised. The liquor is then evaporated to a syrupy consistence, and scaled by exposing to a temperature of 80° to 100° Fahr. in thin layers on glass or earthenware plates. The scales thus produced are of a garnet-red colour, are readily soluble in water, and have a slightly ferruginous taste. *Ferri percitras*, in fine garnet-coloured scales, prepared by dissolving freshly-precipitated hydrated sesquioxide of iron in citric acid, and scaling as described in the remarks respecting ferri et ammon. cit. It has an acid and slightly styptic taste. *Ferri pyrophosphas*, in beautiful golden green scales. Its chemical composition is not, however, accurately represented by the name it bears, it being prepared by dissolving pyrophosphate of iron in a mixture of the citrates of soda and ammonia; the solution is then evaporated to a syrupy consistence, and scaled in a similar way to the ferri et ammoniæ citras. *Iodo-cyanide of potassium and mercury*, prepared by mixing strong solutions of bicyanide of mercury and iodide of potassium in equivalent proportions. The salt is deposited in white, pearly, crystalline plates. Its chief use is to detect the presence of small quantities of the mineral acids in hydrocyanic acid. *Benzoic acid*, made from gum benzoin, in soft, feathery, pearly crystals. When thus made it is much preferred to that obtained from the urine of some graminivorous animals, as it then cannot altogether be deprived of a disagreeable odour by repeated sublimation. *Potass. permanganas*, in fine iridescent needles. *Iodide and bromide of cadmium. Bromide of ammonium, and chloride of gold*, principally used for photographic purposes. Bromide of ammonium was lately in considerable demand as a remedy for whooping-cough. The iodide of cadmium exhibited is in fine crystals. *Valerianate of iron*, made according to the process of the Dublin Pharmacopœia. It is almost entirely soluble in spirit, but not perfectly so, which is seldom practically the case when the salt is thus prepared, owing to a slight decomposition which takes place while drying. *Naphthaline.* When purified by sublimation, it forms, as in the specimen shown, large brilliant crystalline plates of a pearly lustre. *Bismuth. et ammon. citras*, only lately introduced into pharmacy. The specimen exhibited is in minute scales, containing 60 per cent. of oxide of bismuth, and is readily soluble in water, differing in this respect from other salts of bismuth, which are decomposed and precipitated by water. It is prepared by precipitating a solution of nitrate of bismuth with an alkaline citrate, collecting and washing the precipitate with water, dissolving it in liq. ammoniæ, and drying on glass plates at a temperature of between 90 and 100° Fahr. If too great a heat be employed, it is liable to be rendered insoluble. *Potassæ borotartras* (soluble cream of tartar) may be prepared in the form of scales, as exhibited, by dissolving together boracic acid and cream of tartar in water, evaporating to a syrupy consistence, and scaling on glass plates. Thus prepared, it presents an appearance far superior to the amorphous powder which is more often sold as soluble cream of tartar, and which is made from cream of tartar and borax. *Acetate of amyl* (essence of pear), *valerianate of amyl* (oil of apple), and *butyrate of ethyl* (essence of pineapple), the principal ingredients used in the manufacture of the fruit essences, which are now made in such considerable quantities. By judicious admixture, artificial essences may be obtained, resembling very closely the flavour of almost every kind of fruit. *Podophyllin*, a resinous substance obtained from the root, or rather rhizome, of the *Podophyllum peltatum*, now an article of the British Pharmacopœia, sometimes called vegetable calomel. It varies much in colour, from a dark brown to a greenish or yellowish tint, is practically insoluble in water, and soluble in alcohol and ether. It is prepared by exhausting the crushed rhizome with spirit, the greater portion of which is afterwards distilled off, and pouring the concentrated solution into water previously acidulated with hydrochloric acid; the precipitated resin is then collected, washed, and dried at a low temperature.

Mr. Daniel Hanbury forwarded a large case of medicinal fruits derived from the order Scitamineæ.

Messrs. Hearon, M'Culloch, and Co., sent a series of the leading drugs, selected from a number of samples forwarded to them by a merchant in China, for the purpose of ascertaining their market value in this country. They have been examined both by Dr. Lockhart and Daniel Hanbury, Esq., who state that, although they meet with a ready sale in China, and are considered useful remedies, they possess few properties sufficiently prominent to render them important as medicinal agents amongst ourselves—none to qualify them to displace those we are accustomed to see prescribed in this country—and must therefore be regarded as mere curiosities. They are mostly infused, and taken in combination in considerable quantities, and possess in some slight degree either tonic, stomachic, or demulcent properties. The essential oils (otto ?) of roses and elder flowers are curious by reason of their scarcity and costliness, the product of either being so small that if the flowers were distilled for the purpose of obtaining these alone, and not as by-products, their respective values would amount to about 20*l.* per oz. The quantity of otto of roses exhibited is the result of the distillation of about 300 bushels of flowers. Elder flowers do not yield nearly so much in proportion, and therefore it would not have been commercially practicable to prepare the water as recommended by the London College in their Pharmacopœia of 1836—viz., by using 2 drachms of the essential oil as a substitute for 10 lbs. of the flowers, for this would be equivalent to a very much larger quantity. The concentrated infusions, preserved juices, liquid and solid extracts, comprise the leading preparations of both the London and British Pharmacopœias, placed side by side for the purpose of contrast.

The well-known firm of Morson and Son forwarded a few specimens for exhibition, comprising globules containing pepsine, pancreatine, and charcoal. These globules are a convenient form for administering these and other medicines. They also exhibited specimens of pancreatine or pancreatic oil in both an acid and alkaline state, with an emulsion formed from the latter, which has the advantage of greater stability and can be kept without change or putrefactive fermentation. Specimens of *meconine* and *narceine*, two of the least abundant alkaloids of opium, the latter body having recently obtained considerable reputation in France and Germany as a most valuable sedative, applicable in cases in which morphia and other preparations of opium cannot safely be administered. The small quantity of this alkaloid present in opium, and its consequent high price, will of necessity limit its use to cases in which other narcotics are inadmissible. A specimen of pepsine prepared by a modification of the process of Dr. Pavy, by which, if carefully followed out, the greatest digestive activity of this body appears to be obtained. A preparation of the cuticle of wheat, to which the name of saccharative wheat phosphates has been given; this preparation has been used and recommended for some years by Dr. Tilbury Fox. The peculiar digestive principle of bran will not, like pepsine, digest animal matter, but seems peculiarly suited for the digestion of farina.

(To be continued.)

On the Purification of Quinoidine, by M. de* VRY.

COMMERCIAL quinoidine is never pure; M. de Vry has proved it to contain sometimes as much as 30 per cent. of foreign matters. His purifying process is founded on M. Pasteur's observation that nine parts of quinoidine triturated, and kneaded a long time in a mortar with a diluted solution of two parts of neutral oxalate of ammonia, end by entirely dissolving, while disengaging ammonia, and abandoning the foreign matters. But while M. Pasteur operated at the ordinary temperature, M. de Vry advises the use of heat.

The following is the process by which he proposes to purify quinoidine, and consequently to render it fit for medicinal purposes. Boil, in an iron vessel, nine parts of quinoidine, with a diluted solution of two parts of neutral oxalate of ammonia, until ammonia ceases to be disengaged. As part of the insoluble matter will attach itself to the sides of the vessel while boiling, add distilled water from time to time, so that this part may be covered during the boiling, and thus be continually in contact with the ammoniacal solution. As soon as ammonia ceases to be disengaged, let the liquid get quite cold, and if the addition of water does not cause it to become turbid, dilute it with that liquid. Then filter the liquid, and precipitate it in a capsule by means of an excess of caustic soda solution.

Collect, by means of gentle heat, the glutinous precipitate at the bottom of the capsule, then decant the clear alkaline liquid, and wash the precipitate of quinoidine several times in distilled water. Then expose the still glutinous quinoidine thus purified for some time to a temperature of 100° to 110° C., which will thus lose the little water it retained, and finally become, when cold, hard and friable. Oxalate of ammonia is used for the purpose of getting rid of the lime usually contained in commercial quinoidine.

PROCEEDINGS OF SOCIETIES.

BRITISH ASSOCIATION, NOTTINGHAM MEETING.

Friday, August 24.

A Lecture "On the Results of Spectrum Analysis, as applied to the Heavenly Bodies," by WILLIAM HUGGINS, *F.R.S.*

AN important invention or discovery seldom, if ever, remains sterile and alone. It gives birth to other discoveries. The telescope and the microscope have led to remarkable discoveries in astronomy and in minute anatomy and physiology, which would not have been possible without those instruments. The observation that a magnetic body, free to move, arranges itself nearly north and south, has not only contributed immensely to the extension of commerce and of geographical discovery, but also has founded the important science of terrestrial magnetism.

This evening I have to bring before you some additions to our knowledge in the department of astronomy, which have followed from a comparatively recent discovery. The researches of Kirchhoff have placed in the hands of the astronomer a method of analysis which is specially suitable for the examination of the heavenly bodies. So unexpected and important are the results of the application of spectrum analysis to the objects in the heavens, that this method of observation may be said to have created a new and distinct branch of astronomical science.

Physical astronomy, the imperishable and ever-growing monument to the memory of Newton, may be described as the extension of terrestrial dynamics to the heavens. It seeks to explain the movements of the celestial bodies on the supposition of the universality of an attractive force similar to that which exists upon the earth.

The new branch of astronomical science which spectrum analysis may be said to have founded, has for its object to extend the laws of terrestrial physics to the other phenomena of the heavenly bodies, and it rests upon the now established fact that matter of a nature common to that of the earth, and subject to laws similar to those which prevail upon the earth, exists throughout the stellar universe.

The peculiar importance of Kirchhoff's discovery to astronomy becomes obvious, if we consider the position in which we stand to the heavenly bodies. Gravitation and the laws of our being do not permit us to leave the earth; it is, therefore, by means of light alone that we can obtain any knowledge of the grand array of worlds which surround us in cosmical space. The star-lit heaven is the only chart of the universe we have, and in it each twinkling point is the sign of an immensely vast, though distant, region of activity.

Hitherto, the light from the heavenly bodies, even when collected by the largest telescopes, has conveyed to us but very meagre information, and in some cases only of their form, their size, and their colour. The discovery of Kirchhoff enables us to interpret symbols and indications hidden within the light itself, which furnish trustworthy information of the chemical, and also, to some extent, of the physical, condition of the excessively remote bodies from which the light has emanated.

We are indebted to Newton for the knowledge that the beautiful tints of the rainbow are the common and necessary ingredients of ordinary light. He found that when white light is made to pass through a prism of glass it is

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* *Journal de Pharmacie et de Chimie*, iv., 50.

decomposed into the beautiful colours which are seen in the rainbow. These colours, when in this way separated from each other, form the spectrum of the light. Let this white disc represent the transverse section of a beam of white light travelling towards you. Let now a prism be interposed in its path. The beam of white light is not turned aside as a whole, but the coloured lights composing it are deflected differently, each in proportion to the rapidity of its vibrations. An obvious consequence will be, that, on emerging from the prism, the coloured lights which formed the white light will separate from each other, and in place of the white light which entered the prism we shall have its spectrum—that is, the coloured lights which composed it—in a state of separation from each other. Wollaston and Fraünhofer discovered that when the light of the sun is decomposed by a prism, the rainbow colours which form its spectrum are not continuous, but are interrupted by a large number of dark lines. These lines of darkness are the symbols which indicate the chemical constitution of the sun. It was not until recently, in the year 1859, that Kirchhoff taught us the true nature of these lines. He himself immediately applied his method of interpretation to the dark lines of the solar spectrum, and was rewarded by the discovery that several of the chemical elements which exist upon the earth are present in the solar atmosphere.

It is my intention to bring before you this evening the results of the extension of this method of analysis to the heavenly bodies other than the sun. These researches have been carried on in my observatory during the last four years. In respect of a large part of these investigations—viz., those of the moon, the planets, and fixed stars—I have had the great pleasure of working conjointly with the very distinguished chemist and philosopher, Dr. Wm. Allen Miller. Before I describe the results of our observations, I will state, in a few words, the principles of spectrum analysis upon which our interpretation of the phenomena we have observed has been based, and also the method of observing which we have employed.

When light which has emanated from different sources is decomposed by a prism, the spectra which are obtained may differ in several important respects from each other. All the spectra which may present themselves can be conveniently arranged in three general groups. A spectrum illustrating each of these three orders is placed upon the diagram.

1. The special character which distinguishes spectra of the first order consists in that the continuity of the coloured band is unbroken either by dark or bright lines. By means of the electric lamp, Mr. Ladd will throw a spectrum of this order upon the screen. We learn from such a spectrum that the light has been emitted by an opaque body, and almost certainly by matter in the solid or liquid state. A spectrum of this order gives to us no knowledge of the chemical nature of the incandescent body from which light comes. In the present case, the light is emitted by the white-hot carbon points of the electric lamp. A spectrum in all respects similar would be formed by the light from incandescent iron, or lime, or magnesia.

2. Spectra of the second order are very different. These consist of coloured lines of light separated from each other. From such a spectrum we may learn much. It informs us that the luminous matter from which the light has come is in the state of gas. It is only when a luminous body is free from the molecular trammels of solidity and liquidity that it can exhibit its own peculiar power of radiating some coloured rays alone. Hence substances, when in a state of gas, may be distinguished from each other by their spectra. Each element, and every compound body that can become luminous in the gaseous state without suffering decomposition, is distinguished by a group of lines peculiar to itself. These green lines are produced by silver in a state of gas, and only by silver gas. It is obvious that if the groups of lines characterising the different terrestrial substances be known, a comparison of these as standard spectra, with the spectrum of light from an unknown source, will show whether any of these terrestrial substances exist in the source of the light.

3. The third order consists of the spectra of incandescent solid or liquid bodies, in which the continuity of the coloured light is broken by dark lines. These dark spaces are not produced by the source of the light. They tell us of vapours through which the light has passed on its way, and which have robbed the light by absorption of certain definite colours or rates of vibration; such spectra are formed by the light of the sun and stars.

Kirchhoff has shown that if vapours of terrestrial substances come between the eye and an incandescent body, they cause groups of dark lines; and further, that the group of dark lines produced by each vapour is identical in number and in position in the spectrum with the group of bright lines of which its light consists when the vapour is luminous.

Mr. Ladd will throw upon the screen the spectrum of incandescent carbon points which contain sodium. Observe in addition to the continuous spectrum of the incandescent carbon, a bright yellow band, which indicates the presence of sodium. Now a piece of metallic sodium will be introduced into the lamp. The sodium will be vaporised by the heat, and will fill the lamp with its vapour. This vapour absorbs, quenches the light that it emits when luminous. There will thus be produced a black line exactly in the place where the bright yellow line was.

It is evident that Kirchhoff, by this discovery, has furnished us with the means of interpreting the dark lines of the solar spectrum. For this purpose it is necessary to compare the bright lines in the spectra of this light of terrestrial substances when in the state of gas, with the dark lines in the solar spectrum. When a group of bright lines coincides with a similar group of dark lines, then we know that the terrestrial substance producing the bright lines is present in the atmosphere of the sun. For it is this substance, and this substance alone, which, by its own peculiar power of absorption, can produce that particular group of dark lines. In this way, Kirchhoff discovered the presence of several terrestrial elements in the solar atmosphere.

METHODS OF OBSERVATION.

I now pass to the special methods of observation by which, in our investigations, we have applied these principles of spectrum analysis to the light of the heavenly bodies. I may here state that several circumstances unite to make these observations very difficult and very irksome. In our climate, on few only even of those nights in which the stars shine brilliantly to the naked eye, is the air sufficiently steady for these extremely delicate observations. Further, the light of the stars is feeble. This difficulty has been met, in some measure, by the employment of a large telescope. The light of a star falling upon the surface of its object-glass of eight inches aperture is gathered up and concentrated at the focus into a minute and brilliant point of light.

Another inconvenience arises from the apparent movement of the stars, caused by the rotation of the earth, which carries the astronomer and his instruments with it. This movement was counteracted by a movement given by clockwork to the telescope in the opposite direction. In practice, however, it is not easy to retain the image of a star for any length of time exactly within the jaws of a slit only the 1-300th inch apart. By patient perseverance these difficulties have been overcome, and satisfactory results obtained. We considered that the trustworthiness of our results must rest chiefly upon direct and simultaneous comparison of terrestrial spectra with those of celestial objects. For this purpose we contrived the apparatus which is represented in the diagram.

By an outer tube the instrument is adapted to the eye-end of the telescope, and is carried round with it by the clock motion. Within this outer tube a second tube slides, carrying a cylindrical lens. This lens is for the purpose of elongating the round point-like image of the star into a short line of light, which is made to fall exactly within the jaws of a nearly-closed slit. Behind the slit, an achromatic lens (and at the distance of its own focal length) causes the pencils to emerge parallel. They then pass into two prisms of dense flint glass. The spectrum which results from the decomposition of the light by the prisms is viewed through a small achromatic telescope. This telescope is provided with a micrometer screw, by which the lines of the spectra may be measured.

The light of the terrestrial substances which are to be compared with the stellar spectra is admitted into the instrument in the following manner:—

Over one-half of the slit is fixed a small prism, which receives the light reflected into it by the moveable mirror placed above the tube. The mirror faces a clamp of ebonite, provided with forceps to contain fragments of the metals employed. These metals are rendered luminous in the state of gas by the intense heat of the sparks from a powerful induction coil. The light from the spark reflected into the instrument by means of the mirror and the little prism passes on to the prisms in company with that from the star. In the small telescope the two spectra are viewed in juxtaposition, so that the coincidence and relative positions of the bright lines in the spectrum of the spark, with dark lines in the spectrum of star can be accurately determined.

(To be continued.)

ACADEMY OF SCIENCES.

October 1.

The first article read at this meeting was, "*On the Porosity of Caoutchouc relative to the Dialysis of Gases*," by M. Payen. The author refers to the important discovery of Professor Graham, who considers it demonstrated that a thin film of caoutchouc has no porosity because it is absolutely impervious to gaseous air. M. Payen asserts that ordinary caoutchouc contains true pores, and under the microscope they are readily visible, especially when in contact with a liquid. When immersed in water, caoutchouc absorbs 18 or 20 per cent., and becomes white and opaque, the opacity being evidently due to the introduction of water by capillarity into the porous substance. This is different from the penetration of water into a homogenous mass, such as gelatine (among colloids) which will absorb fifty times its weight of water, and pectic acid, and gelose, which will take up more than double this quantity. The porosity of caoutchouc is not only rendered evident in the presence of water; cold or warm alcohol will show it, as also will fused sulphur, which, at the temperature of 115° or 120°, will penetrate without sensibly exerting chemical action. These phenomena of capillarity must not be confounded with the effects produced by liquids which have a solvent action—such as sulphide of carbon, ether, benzol, and many hydrocarbons, which, partly dissolving the substance, cause it to swell up and lose its pores. The author has also shown that water, by opening the pores of the caoutchouc, can pass through a film of it and evaporate on the opposite side. Gutta percha in the form of thin sheets, as left when a solution in sulphide of carbon is allowed to evaporate on a glass plate, also contains pores which can be detected under the microsope. By strong traction this porosity becomes transformed into a fibrous texture.

"*On the Application of the Silvering Process to an Object-glass 25 Centimetres in Diameter*," by M. Leverrier. At the sitting on September 3, M. Foucault brought forward a process for weakening the solar radiation by covering the object-glass with a film of silver. Since then, M. Secretan has allowed the experiment to be tried on a large object-glass of the above diameter, and the result has satisfactorily proved that the anticipations which a trial on a small glass led the inventor to entertain were fully justified. The image of the sun is freed from almost all the heat and excess of light which render observation difficult and dangerous; the interposition of the film of silver appears in no way to alter the optical properties of the lens; it only diminishes the intensity of the transmitted light without affecting the path of the rays and without producing sensible diffusion. Under favourable atmospheric conditions a power of 300 diameters could be applied, and the entire surface of the sun was observed to be covered with those numerous details which have been described by the most experienced observers. At times it was seen that advantage would have been derived from the application of a much higher power. The transmitted light is bluish, but the eye soon gets accustomed to it; the spectroscope shows that all the rays of the spectrum are present, except the extreme red—the orange, yellow, and green undergoing partial extinction.

"*Note on the Tendency of any Material System to a State of Absolute or Relative Repose*," by M. A. Dupré. The author proves that every material system has a tendency to assume a state of relative or absolute repose; without being able to point out the time which will elapse before it attains its ultimate state. Also, every material system in which we observe actual relative movements, and consequently gradual declension, has had a commencement; for, if we suppose the contrary, we shall at last arrive at a time when the sum of the losses of *distance* will surpass the equivalent of the heat contained in the system when arrived at its final condition—which is absurd. Applying these conclusions to the material world considered as a whole, we see that the existence of the movements which produce those harmonies which we admire in the works of the Creator, is sufficient to prove that they have have had a supernatural commencement, whilst they tend towards a natural termination.

"*On M. Cavana's Hydraulic Motor*," by M. Muller' M. Cavana has constructed a machine of 450-horse power' which is worked by the motive force of sea or river water.

"*Application of the Principle of the Transparency of Metals*," by M. Melsens. The author has applied M. Foucault's principle to darkening spectacle glasses used in cases of injury to the eye. He covers the pale blue glasses with a leaf of gold or silver applied mechanically. He finds that the light transmitted under these conditions is of particular softness, and suggests that gilded or silvered glasses might be useful in many cases of photophobia.

"*On the Action of Nitrate of Silver and Protonitrate of Mercury on Bichloride of Platinum*," by M. A. Commaille. In Dumas' "*Traité de Chimie*," and Cahours' "*Traité de Chimie*," the action of nitrate of silver on bichloride of platinum is stated to be entirely different. The author has consequently re-examined the question, and finds that on mixing these two salts together an abundant yellow precipitate is produced, and the liquid becomes decolorised on standing or when heated; this precipitate does not blacken in sunlight. Ammonia, after prolonged contact, removes all the chloride of silver, leaving protochloride of platinum, whilst warm hydrochloric acid changes all this chloride of platinum into bichloride, with a residue of chloride of silver; thus confirming Dumas' statement. Analysis of the yellow precipitate gave the formula—

$$AgCl + 2\,(PtCl).$$

When protonitrate of mercury is mixed with chloride of platinum, a somewhat complicated reaction takes place, the result depending upon the temperature, the bulk of the liquids, and the order of their addition.

NOTICES OF BOOKS.

The Elements of Chemistry, Inorganic and Organic. By J. C. Buckmaster. Third edition. London: Longman and Co.

This work is divided into two parts, the former of which treats of inorganic chemistry (184 pp.), and the latter of organic chemistry (96 pp.). The organic portion has been prepared by Mr. Rowden. At the end of the book there is an appendix containing questions on chemistry "given at the examination of science schools and classes," and at an "examination for science certificates," both examinations being those held under the science and art department. Some of these questions are followed by answers, and the book terminates with an "explanation of some of the terms used in chemistry," and a short index.

The ultimate object of this treatise (we learn from the preface) is to promote "the scientific education of the senior classes in middle-class schools;" but "pupil-teachers, schoolmasters, and the students of classes in mechanics' institutions" are expected to find the work to be "not without its value." An advertisement sheet enclosed in the volume contains several testimonials to the effect that these objects have been pretty well realised. So serious a mistake, however, must not be allowed to pass unnoticed. The manual itself is obviously the production of persons having very little practical acquaintance with the subjects of which they treat. It abounds with loose statements, inaccuracies as to fact, and very important omissions. An endeavour is made to shield these by a seductive appearance of clearness and compression. We will substantiate these charges by adducing a few out of many particular instances which the book presents to us.

At page 1 we are told that "chemistry investigates the relationship between the different kinds of atoms or particles of which these materials (constituting the earth) are composed." What is a student to make of this loose definition? As to the vague "relationship," on the understanding of which the whole definition turns, he will find no further allusion; but at page 49, a chemical reference is made to the atmosphere, though in an underhand sort of way, as if it were rather an intruder into the subject. The atoms themselves, so far as we can learn, are mainly considered as undergoing analysis or synthesis—the author's two leading ideas with regard to chemical phenomena. Again, we are told at page 6, "If nitrogen and hydrogen be mixed in the same vessel, combination does not take place; but when these gases are set free at the same time, as in the case of manure-heaps, ammonia is formed." Now, the author evidently does not mean to say that these gases are set free at all in the latter case; for, if they were once set free, he would assert that they would not combine. Why should a "manure-heap" induce combination any more than a "vessel?"

The following are a few examples of inaccuracy as to fact. In the preface to this edition it is stated that Gerhardt's notation is to be used. Here are some examples:—

$$Ba = 137, Ca = 40, Cu = 63{\cdot}4, Pb = 207{\cdot}4.$$

At page 35 we have another blunder, which any well-trained beginner would never have made—

$$\text{" (Steam), } H_2O + Fe = FeO + H_2 \text{ free."}$$

At page 44 we read: "From the chlorate of potassium chloric anhydride is obtained by boiling with a solution of hydrofluosilicic acid. The process is tedious and requires care." So tedious indeed that the operator would have to wait till the Greek kalends. A wrong account, also, is given (page 50) of what takes place when binoxide of manganese is heated to redness. "Two atoms of the oxide of manganese yield up an atom of oxygen, forming the [illegible]." The same is repeated at page 12[illegible]lix, however (page 288), the right account of the reaction is given. But what would a student make of the three statements? Oxygen appears to have undergone a change in one important property: "it is not combustible—that is, it will not burn" (page 52). At page 55 we read that "there are seven oxygen compounds of sulphur." Five, however, of the bodies he mentions are perfectly unknown.

Neither under the head of "sulphuric acid," nor when treating of the *tests* for barium, is there the slightest mention of the precaution (which every teacher knows it is so absolutely necessary to enforce) to dilute the solutions. The term "molecular weight" does not occur. No account is given of the *laboratory* process for preparing hydrochloric acid. A figure of a Pepys' gasholder is left entirely without a description. Such are some of the omissions. Yet the author can find time to tell us about the preparation of red and green fire, and to give us particulars about the "washerwomen of Holland and Belgium."

The organic part has been written with more care, but with very little improvement in accuracy or precision. Here, for example, is a piece of confusion. At page 186 it is said—"Ferrocyanide of potassium may be regarded as the double cyanide of K and Fe;" but at page 190—"Such, however, is not the case." It appears from an equation at page 186 that when "dilute sulphuric acid" is boiled with "ferrocyanide of potassium" all the cyanogen is eliminated as hydrocyanic acid, which is certainly not the case. The practice of constructing equations from the imagination (of which there are plenty of instances in the volume) is much to be deplored; it renders the student's path easier, in most cases at the expense of truth. Cellulose, starch, and dextrine are represented (with a C_{12} formula) as isomeric bodies. Chloride of ethyl "is *usually* prepared by the action of terchloride of phosphorus on alcohol." Methyl "has not been isolated" (page 221). The formulæ of the alcohol radicals (page 226) have only half their proper value. "Benzol is *usually* prepared by distilling benzoic acid, &c., &c." (page 247). What has become of coal tar? *All* the initial equations given at pages 256-7 for the preparation of the ethylamines are practically false. Tannic acid is dismissed, in general terms, with four lines and a half; "Pharaoh's serpent" is described with detail in eight lines and a quarter. So closely do these two authors resemble each other!

We should not have reviewed this book at such length had we not deemed it a duty to warn students of the dangers into which they may fall by reading such productions. Bad grammar, confused statements, bad chemistry, and false chemistry are dear at any price; yet such a vicious collocation is the natural result of a system of examination which is contented with a very superficial general training, and does not require practical acquaintance with what is a pre-eminently practical subject. We are far from impugning the educational status of "certificated teachers" individually; but it is too much that the mere certificate as now granted should be taken as proving competence to *teach*. Can we be surprised that it should lead the less informed to write books?

We commend to the consideration of Mr. Buckmaster, his coadjutor, *and* the public one remarkable sentence which occurs in this manual at page 33, a sentence quite unexceptionable in every respect, and worth the whole cost of the treatise. It is this—"Nothing short of actually *doing* the thing will give the proper knowledge."

Journal de Pharmacie et de Chimie. September, 1866.

The first article in the present number is

"*On Medical Tinctures,*" by M. Vuaflart. This article is written in consequence of a note published by M. Filhol in the July number of the *Journal de Pharmacie.* It discusses the relative values of tinctures made by displacement and by maceration.

"*On the Blue and Red Colouring Matters of Urine, Urocyanose, and Uroerythric Acid*," by M. Fordos. The author believes that the blue colouring matter is due to the transformation or doubling, under the influence of acids, of an organic matter which is not precipitated by subacetate of lead, but which he has not yet succeeded in isolating. This blue matter is ordinarily accompanied by a red colouring matter, which it is easy to separate by means of solvents—the red colouring matter being more soluble in alcohol, chloroform, and benzol, than the blue colouring matter.

The blue matter may easily be obtained pure and crystalline; it appears under the microscope in the form of right-angled prisms of a magnificent blue colour. It differs by its crystallisation from indigo, which, however, it resembles in chemical properties. To detect traces of urocyanose in urine, mix in a test-tube one volume of urine with at least half a volume of hydrochloric acid, and in twenty or thirty minutes agitate with ether, which dissolves the urocyanose, and floats on the top with a blue colour. Chloroform may be used instead of ether, in which case the blue liquid sinks to the bottom of the liquid.

"*On the Carbonisation of Seaweeds, and the Extraction of Bromine and Iodine from them: Estimation of Iodine with Alkaline Hyposulphites*," by M. E. Moride. This is a paper which we have already noticed, having been presented to the Academy of Sciences April 30. It contains nothing novel, and our only reason for again alluding to it is to correct a misstatement which the author again repeats —viz., that "Mr. Edward *Strandfort's* process for extracting bromine and iodine from seaweed has been abandoned." If by the above name Mr. E. C. C. Stanford's process is meant, we must inform M. Moride that it is at the present time being energetically and very successfully carried on in the Hebrides.

"*On the Niauli of New Caledonia*," by MM. Gervais and Chatin. This medicinal plant appears to be the *Melaleuca viridiflora* of botanists. Its leaves are used for flavouring and for adulterating tea with.

"*On the Propagation of Electricity in a Solution containing several Salts*," by M. E. Bouchette. He finds that the electric conductivity of a mixture of solutions of salts is sometimes above and sometimes below the mean of the constituent solutions.

"*Report on a Formula for Ferruginous Syrup of Quinquina*," by MM. Shaeuffèle, Goblez, and Baudrimont. This is on the subject of a letter addressed by M. E. V. Garnier to the Pharmaceutical Society of Paris. Our readers can judge of the tenor of this report by the following quotation:—"It appears to us that such discussions are always hurtful, especially for science, which ought only to inhabit those calm and serene regions in which the sterile noise of human passions should be allayed." Would that our Continental neighbours always bore in mind this necessity of scientific discussion!

"*Report on the Swiss Pharmacopœia*," by M. Mayet.

"*On Alkaline Injections in the Veins during the Last Stage of Cholera*," by Dr. Colson, of Beauvais.

"*Precautions to be taken during a Thunderstorm*," by Dr. Sestier.

"*On the Therapeutic Applications of Donovan's Iodo-arsenical-Mercurial Liquid*," by Dr. Pedrilli. The author says that this has been successfully employed in cases of syphilis.

"*On a New Glycerole: Glyconine*," by M. E. Sichel. The author mixes four parts of yolk of egg and five parts of pure glycerine in a mortar. This forms a mass of the consistency of honey, and unctuous, like fat bodies. It is unalterable, having been left exposed to the air without injury for three years. Applied to the skin, it forms a varnish impervious to the air.

The remainder of the articles, which are very numerous, consist of quotations from the *Comptes Rendus* and various other journals, which have been already noticed in our columns.

Zeitschrift für Chemie. Nos. 15 and 16. 1866.

We give below the titles of the papers which appear in these numbers; translations or abstracts of the more important ones are in preparation.

"*Theoretical and Empirical Remarks on the Constitution of Glycol, and of the Acids derived from it.*" By L. Dossios.

"*On Drying Oil.*" By G. J. Mulder.

"*On Acetic Acid.*" By Dr. R. Brandes.

"*On Formic and Valerianic Acids.*" By Dr. E. Greiner.

"*On the Action of Nitric Acid on Glycolamidic Acid.*" By W. Heintz.

"*On the Action of Nitrate of Potash on Salts of Triethylamine, and on the Separation of Diethylamine from Triethylamine.*" By the same author.

"*On the Constitution of Anethol.*" By E. Erlenmeyer.

"*On the Constitution of Eugenol.*" By the same author.

"*On the Detection of Alkaloids.*" By M. Dragendorff.

"*On the Principal Archil Lichens, and their Colouring Matters.*" By O. Hesse.

"*On Isobutyric Acid and Pseudo-Propylethyl-Ether.*" By W. Markownikoff.

"*On the Isomorphism of Lithium Salts with Potassium and Sodium Salts.*" By C. Rammelsberg.

"*On Bromide of Selenium.*" By R. Schneider.

"*On Xylol Compounds.*" By A. Vollrath.

"*On the Reaction between Monacetic Glycol Ether and Mono-natrio-Glycolate.*" By Dr. R. Mohs.

"*On the Reaction between Alcoholate of Sodium and Iodide of Tetrethyl-Ammonium.*" By Dr. R. Mohs.

"*On Sulphobenzol.*" By M. Fleischer.

"*On Œnanthylidene and Caprylidene.*" By H. Limpricht.

"*Researches on Isomerism in the Fatty Acid Series.*" By W. Markownikoff.

"*On the Products of the Oxidation of Coal Tar Cumol (Trimethyl-Benzol).*" By G. Herzel and F. Bielstein.

"*On Crotonic Acid.*" By C. Bulk.

The few other papers which are contained in these numbers have already been noticed in the Chemical News.

NOTICES OF PATENTS.

101. *Treating Sewage and Urine.* Francis Sutton, Norwich. Dated January 12. (This invention received Provisional Protection only.)

The sewage, in order to be treated by this process, is run into tanks, and the precipitation of the solid matter takes place there. The patentee adds sulphate of alumina, which may vary in proportion from three to ten grains per gallon of sewage, either used alone or in conjunction with common clay, fullers' earth, burnt clay, bog ochre, sulphate of magnesia, or peroxide of iron, these substances being used in proportion according to the state of concentration in which the sewage exists. The settlement of all solid matters from the liquid takes place very rapidly, when the clear fluid can be run or pumped off for further treatment or for irrigation. In order to extract the ammonia, this liquid or urine, as the case may be, is now run into large tanks or pits having covers or other means of being closed tolerably tight, and fresh caustic lime added either in a slaked or unslaked condition in the proportion of about one pound to every hundred gallons of diluted sewage, and in larger proportion if the sewage or urine is in a concentrated state. Shallow trays of wood, porcelain, earthenware, or slate, containing sulphuric acid or hydrochloric acid either alone or mixed with sawdust, spent bark, tan, animal charcoal, wood charcoal, superphosphate of lime, earth, gypsum or peat, or with the manure produced from sewage by the precipitation process, are then suspended immediately over the surface of the mixed sewage and lime. Fermentation is set up in a short time by the action of the lime upon the nitrogenous matters in the sewage, and ammonia evolved, which is immediately absorbed by the acid or acid mixture in the trays. When sufficiently saturated with ammonia, the contents of the trays may be mixed with ordinary artificial manures or with sewage manure, and fresh acid material placed above the liquor till it is exhausted, when it may be turned into rivers as harmless, and the precipitate used as manure.

The former portion of this patent appears of great value. We are, however, not aware whether it is prior to Mr. Bird's patented process for the use of sulphate of alumina for a similar purpose. The latter part of the patent, though ingenious, is, we fear, impracticable on a large scale.

No. 301. *Improvements in the Manufacture of Saltpetre and White Lead.* CLARENCE DELAFIELD, of Staten Island, United States of America. Dated January 31, 1866.

THE patentee commences by stating that the white lead of commerce, as manufactured after the old or what is known as the Dutch process, consists of the carbonate of lead united with the hydrated oxide of lead in about the proportion of two chemical equivalents of the carbonate of lead to one equivalent of the hydrated oxide of lead. The mechanical means and the chemical agencies employed in the manufacture of the white lead of commerce after the old process are familiar to every one skilled in the arts to which this invention appertains; but the formation and chemical union of the carbonate of lead and the hydrated oxide of lead which takes place in and forms a part of that process, is not so well understood. It is believed, however, that the acetic acid driven off from the vinegar by the heat induced by the fermentation of the tan bark or horse manure against metallic lead surrounded by an atmosphere of water vapour and carbonic acid gas forms oxide of lead, and these three chemical equivalents of the oxide of lead in process of formation take from this atmosphere one equivalent of water and two equivalents of carbonic acid gas, yielding as the result of the chemical action carbonate of lead united with the hydrated oxide of lead in about the proportion above stated. The patentee says that he has discovered that the white lead of commerce, instead of being made by the slow Dutch process, can be made very much quicker, and equally good or better, by making, manipulating, and uniting a solution of the nitrate of lead and a solution of the carbonate of potash in such a manner as to yield a precipitate of the carbonate of lead united with the hydrated oxide of lead, which is the white lead of commerce. The manner of making, manipulating, and uniting these solutions so as to obtain the above-mentioned result is as follows:—

First take from 112 to 124 parts of the nitric acid of commerce of about 36° Baumé; to this add 112 parts of the oxide of lead and sufficient water to make a saturated solution of the nitrate of lead; and in order to convert quickly the mixture of the nitric acid and the oxide of lead and water into a solution of the nitrate of lead, make the mixture hot. Then take about 70 parts of the purified carbonate of potash and dissolve it in its weight of water, forming a solution of the carbonate of potash and water, which also make hot. In making the solution of the nitrate of lead, use hot water, and raise the temperature of the mixture to about 200° of Fahrenheit. And in making the solution of the carbonate of potash use boiling water, the temperature of which is lowered by mixing in the patash, and which afterwards raise to about 200° of Fahrenheit. Having thus made and heated these solutions, throw the hot solution of the carbonate of potash into the hot solution of the nitrate of lead, by which the carbonate of lead at once precipitates and leaves the nitrate of potash in solut[illegible] the same time the precipitate carbonate of lead from crystallising is prevented, and a small proportion of the hydrated oxide of lead also gets in combination with the carbonate of lead. The result of this process is an approximation of what is sought for, but it does not yield so large a proportion of the hydrated oxide of lead in chemical combination with the carbonate of lead as is contained in the white lead of commerce. Now, in throwing the hot solution of the carbonate of potash into the hot solution of the nitrate of lead, there seems to be a complete chemical union between the carbonate of lead and the hydrated oxide of lead until about two-thirds of the alkaline solution has been added to the nitrate of lead solution, when the formation of the hydrated oxide of lead seems to stop, so that in adding the other third of the alkaline solution pure carbonate of lead is formed. It is, therefore, necessary to change the molecular formation of this remaining carbonate of lead by adding the necessary proportion of hydrated oxide of lead, for which purpose the patentee introduces into the tank containing the united solutions a jet of hot steam through metallic or flexible pipes, and continues the application until the whole solution or mass is thoroughly pervaded or heated by the steam, when it will be found that hydrate oxide of lead has been formed and united to the carbonate of lead in about the proportion above stated. The apparatus or means of applying the steam to the solution or precipitated salts may be varied to suit the circumstances or taste of the manufacturer, but it should be applied through pipes or orifices, and with sufficient force to diffuse it well through the solution or mass in case it be applied to the salt after precipitation. It what way the jet of steam operates upon the solution, salt, or mass, is difficult to affirm. The beneficial effect may be owing to the increase of temperature resulting from the introduction of the steam, or it may be owing to the electricity generated by the passage of the steam through the pipes, the electricity enlarging and accelerating the chemical combination that takes place between the elements present, be they what they may. The patentee inclines to the belief, however, that the same result will be obtained by raising the temperature of the combined solutions by the application of heat thereto, whether in the form of steam or in any other suitable form. But whatever may be the true theory in regard to the chemical action, the fact is, that by the introduction of the steam as above stated he gets the result sought for—that is, the white lead of commerce, quicker, whiter, and purer than can be obtained by the old or Dutch process. In stating the improvements in the manufacture of white lead, he has described his improvements in the manufacture of saltpetre also, for in the use of this process, after the salts of lead have been precipitated, he gets as a residue a hot solution of the nitrate of potash, which may be drawn off, evaporated, and rapidly crystallised into a very fine saltpetre of commerce.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W. C.

1859. L. Mignot, Faubourg St. Denis, Paris, "Improvements in the preparation of soluble alkaline silicates, to render them suitable for being used for preserving stone, wood, and other materials, and for manufacturing artificial stone, and for other purposes."—Petition recorded July 16, 1866.

2245. A. de la Gautraye, Belvedere Road, Lambeth, "An improved method for the preservation of wood." A communication from M. Manne, Rue des Saints-Pères, Paris.—August 31, 1866.

2362. G. Robinson, Welbeck Street, Middlesex, "Improvements in the manufacture or production of ammonia, baryta, and strontia."—September 14, 1866.

CORRESPONDENCE.

The Source of Muscular Power.

To the Editor of the CHEMICAL NEWS.

SIR,—In your last number the concluding portion of my lecture on this subject is headed "Playfair's Determinations." As the determinations which immediately follow constitute the real hard work of my portion of the investigation, and as they were all made in the chemical laboratory of the Royal Institution, I cannot, in justice to this institution, allow the error to remain uncorrected.

I am, &c. E. FRANKLAND.

Royal Institution, October 6.

Patent for Preparing Tetrachloride of Carbon.

To the Editor of the CHEMICAL NEWS.

SIR,—In the notices of patents published in No. 356 of the CHEMICAL NEWS, there is a description given of a process for "preparing tetrachloride of carbon," patented by Charles Crump, Yealmpton, Devon, Jan. 11, 1866. Allow me to ask Mr. Charles Crump, through the medium of your journal, whether he is aware that the process of producing chloride of carbon from bisulphide of carbon by means of iodine and chlorine has been described by me in the *Chemical Society's Journal* for 1862, p. 42, when I first published a short notice of a new method of effecting the substitution of chlorine for hydrogen in organic compounds.

In the meantime, this method for producing chlorinated compounds has received numerous applications, and has been frequently alluded to in the chemical journals. It will therefore be seen that the process patented by Mr. Charles Crump is not based upon a new chemical principle.

I am, &c. HUGO MÜLLER.

Spurious Sulphate of Copper.

To the Editor of the CHEMICAL NEWS.

SIR,—I send you the analysis of a spurious sample of sulphate of copper which has lately made its appearance in commerce, and is said to be of continental manufacture. Its colour is much paler than usual, the tint being pure light azure without a shade of green:—

Sulphate of copper	21·7
Sulphate of iron	29·2
Sulphate of manganese	trace
Sulphate of zinc	47·9
Extraneous water and loss	1·2
	100·0

The salt consists, therefore, of a definitely crystallised mixture of the three vitriols, assumed to contain respectively the usual amounts of combined water.

I am, &c.,
JOHN SPILLER.

October 6.

MISCELLANEOUS.

The Sanitary Condition of the City of London—Extracts from the report of Dr. Letheby:—During the six weeks ending September 8, the common lodging-houses and nearly all the poorer classes of houses in the City, amounting to about 3000 in number, have been disinfected with chloride of lime, each from three to seven times; and in the performance of this work as much as seven tons of chloride of lime and half a ton of carbolate of lime have been used. And with the view of destroying the filth upon the surface walls which form the entrances to the courts and alleys of the City, a staff of from 12 to 50 workmen have been daily occupied in lime-whiting 147 of the public courts, which are all that required it. Besides which, a staff of men has been engaged every night in cleansing, and flushing, and disinfecting 184 courts, which required it. The streets, also, have been constantly watered with a solution of carbolic acid. In the performance of these cleansing and disinfecting operations, a staff of from 44 to 90 men have been daily engaged, in addition to the regular staff of inspectors; and besides the 7½ tons of disinfecting powder already alluded to, there have been used about 1000 gallons of carbolic acid.

Composition and Quality of the Metropolitan Waters in September, 1866.—The following are the Returns of the Metropolitan Association of Medical Officers of Health:—

Names of Water Companies.	Total solid matter per gallon.	Loss by ignition.*	Oxidisable organic matter.†	Hardness.	
				Before boiling.	After boiling
Thames Water Companies.	Grains.	Grns.	Grains.	Degs.	Degs.
Grand Junction	19·33	0·76	0·68	13·0	4·5
West Middlesex	15·89	0·84	0·80	14·5	4·5
Southwark & Vauxhall	17·83	0·91	0·72	13·0	4·0
Chelsea	19·00	0·85	0·56	13·0	4·5
Lambeth	18·54	1·00	0·79	13·5	4·0
Other Companies.					
Kent	25·89	1·01	0·28	18·0	7·5
New River	16·38	0·98	0·21	13·5	3·5
East London	18·52	1·00	0·39	14·0	5·0

* The loss by ignition represents a variety of volatile matters, as well as organic matter, as ammoniacal salts, moisture, and the volatile constituents of nitrates and nitrites.

† The oxidisable organic matter is determined by a standard solution of permanganate of potash, the available oxygen of which is to the organic matter as 1 : 8; and the results are controlled by the examination of the colour of the water when seen through a glass tube two feet in length and two inches in diameter.

H. LETHEBY.

The quality of the water supplied to the metropolis during the month of September has not differed very materially from that of the preceding month, the quantity of organic matter in the water derived from the Thames having been from 0·56 of a grain per imperial gallon to 0·80; while that in the East London, the Kent, and the New River supplies, which are obtained from other sources than the Thames, has ranged from 0·21 to 0·39 of a grain per gallon. In all cases the water has been perfectly bright and free from sedimentary matter.

Platinum Apparatus.—In our last number, mention was made of a platinised copper apparatus, which it was expected would prove serviceable in the laboratory. It may be of service if we mention that Messrs. Johnson and Matthey, the well-known platinum smiths of Hatton-garden, have been for the last twenty years in the habit of making and supplying vessels of platinised copper. They are certainly cleaner and less destructible than copper, but we understand they are not so economical as platinum vessels, as they quickly get injured by acid fumes and splashes, and then wear out. This firm exhibited platinised copper in the Exhibition of 1851, and at Paris in 1855. A large platinised copper bowl was likewise exhibited by them at the *soirées* of the Nottingham Meeting of the British Association. Messrs. Johnson and Matthey also contributed to this meeting other metallic specimens of great interest and value, the platinum alone being worth about 4000*l*. Amongst other things, one ingot of platinum attracted great attention; it was a thick slab of the metal made in one forging, and weighing more than 1000 ounces. It created some little amusement by the discrepancy which appeared to exist between its size and weight. Towering above this was a platinum boiler for sulphuric acid, weighing nearly 2000 ounces, in which many improvements were introduced, especially in the siphon arrangements. A very beautiful and complete series of preparations of the rarer platinum metals also deserved attention. These included melted ingots of pure iridium, pure rhodium, alloy of platinum and iridium, and melted ingots of platinum. We must also draw attention to one novelty of especial interest, which this firm has lately brought out—that is, the patent gun vents of platinum. One of these, exhibited at Nottingham, had fired 2500 rounds without being in any way injured or affected.

The Gun-Cotton Explosion at Woolwich.—We lately devoted some space to the consideration of the gun-cotton question, the aspect of which seemed to justify hopeful anticipations of its satisfactory and not very remote solution. It may therefore be well that we should say a few words as to the bearing of the recent explosion at Woolwich upon the prospects of gun-cotton. This is important, because if gun-cotton be really liable, as might appear from the accounts of the occurrence, to explode spontaneously when carefully stored away in a magazine, it is evidently utterly worthless for practical purposes. But if it be not so liable—if it can be shown that the explosion was the direct result of artificial and abnormal conditions of storage experimentally applied—then the occurrence cannot really or permanently discredit gun-cotton, however it may temporarily prejudice the minds of those who do not care to inquire into the circumstances. In concluding our article on gun-cotton, and after enumerating the advantages which it presents, we said: "Against these advantages are to be urged only, that gun-cotton explodes at a very much lower temperature than gunpowder, and that it undergoes chemical change at an even lower temperature. These objections, which, if the difficulty of regulating the explosions be necessarily overcome, will alone remain, are fairly met by the arguments that the temperature requisite to explode gun-cotton (about 270°) is as purely artificial as that at which gunpowder explodes, and that as the substance will not decompose unless it is exposed to a temperature of about 130° continuously for a lengthened period, such a condition is practically artificial also, and could always be avoided." Now, the gun-cotton which exploded recently at Woolwich was the subject of an experiment at the hands of the Gun-cotton Committee, to determine for how long a period the substance would stand a high temperature without undergoing chemical change. For this purpose it was placed, not, as has been represented, in a bombproof store, but in a brick chamber specially constructed for the experiment, and provided with suitable apparatus for raising the temperature. For three months this chamber was heated daily for twelve hours to 120° Fahrenheit, and for seven months the temperature had been similarly raised to 130°. The gun-cotton was packed in large cases, to which registering thermometers were attached, with a view to noting any rise in the temperature of the cotton such as previous laboratory experiments had shown invariably precedes the decomposition of the cotton. A man was employed to register the periodical readings of the thermometer. Without going into the minuter details of the experiment, it may be stated that none of the cotton, although in each case was purposely deposited a less perfectly prepared sample, showed any signs of yielding to this artificial temperature for the first six months, when indications of incipient decomposition appeared in one case, which was promptly removed. Subsequently, from time to time, the thermometers of other cases rose, pointing to the commencement of chemical change in their contents, and necessitating, of course, the removal of the cases. If decomposition was thus invariably preceded by a rise in the temperature of the cotton, and if this rise were carefully noted, thus rendering it practicable to arrest any chemical disturbance by the immediate removal of the cotton, the experiment, it was argued, might safely be continued until the maximum period for which good gun-cotton would endure great heat had been satisfactorily established. The experiment was accordingly pursued until abruptly brought to a close by the [illegible] the remaining gun-cotton after ten month[illegible] chamber. Four possible explanations of the explosion suggest themselves:—1st. That the man whose duty it was to examine the thermometers, and who performed that duty only fifteen minutes before the explosion, failed to note the readings of *all* the thermometers; 2nd. That he noted one of the readings incorrectly; 3rd. That heat had been locally developed in the interior of a mass of cotton at such a distance from the thermometer as not to be sensible in a general rise of temperature; 4th. That, contrary to all precedent, a violent action suddenly occurred, without any previous rise of temperature. Whichever of these explanations be adopted, it is evident that no discredit is thrown upon the cotton itself, which has been placed under conditions specially contrived with a view to its destruction, though fenced about with such precautions as there were good grounds for supposing might be depended upon to insure the destructive action being noticed at its outset and stopped short of an explosion. On the other hand, the experiment had proceeded long enough to demonstrate that gun-cotton will sustain a more than tropical temperature for a much greater length of time than would occur in actual practice.—*Pall-mall Gazette.*

[We understand that between 140 and 150 lbs. of gun-cotton were being heated when the explosion took place.]

A Hint to London Shopkeepers.—A Paris tradesman announces that a five franc gold piece is secreted in one of every hundred sausages exposed for sale in his shop. The demand for sausages is something extraordinary. A perfumer having adopted a similar mode of increasing the sale of soap, was threatened by the sausage maker with legal proceedings for imitating his invention, but he soon ascertained that he had no ground of action. —*Building News.*

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. XIII. 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., II., and VII. are out of print. All the others are kept in stock. Vol. XIV. commenced on July 6, and will be complete in 26 numbers.

W. S.—The compressed gun-cotton is not prepared as an article of commerce.

A. F. W.—The use of perchloride of iron to deodorise the London sewage was proposed in 1860, but is attended with serious objections.

W. Johnstone.—Böttger has recommended gun cotton as a filter for strong acids and other liquids decomposable by organic matter. Filter your permanganate through a tuft of it.

F. M.—We have heard of oxygen being used for the purpose of more rapidly awakening patients from the influence of chloroform, but cannot say with what success.

J. Sutherland.—Received with thanks. The article shall appear next week.

F. S. Johnstone.—Dr. Hassall has written a very good treatise on the adulterations of food. We believe a new edition is in preparation. You will find a good account of the method of detecting the organic impurity in water by means of a permanganate in the Chemical News for December 6, 1862.

A Subscriber.—We are sorry we are unable to inform our correspondent where he can obtain a mixture of carbonate of soda and cocoa-nut oil. Neither do we knew how it is manufactured, except by the simple process of mixing the ingredients together.

Clericus.—It is impossible to say, with any approach to accuracy, how much ammonia or tar products can be yielded by the distillation of a given weight of coal. A ton of coal is generally considered to yield about 20 gallons of tar, of which 1 gallon will be naphtha and 1 pint benzol.

A Forger.—We understand from a correspondent of the *Scientific American* that chilled iron can be softened by heating the iron red-hot, and exposing it for a few minutes to the flame of burning sulphur. If the iron has a flat surface, the sulphur can be placed upon it, when it will burn itself out, leaving the iron as soft as ordinary cast iron.

Books Received.—"Lecture Notes for Chemical Students," by Dr. E. Frankland, F.R.S.

THE CHEMICAL LABORATORIES OF THE UNIVERSITIES OF BONN AND BERLIN.

Our readers must be well aware that chemical laboratories of almost palatial grandeur have for some time been in course of erection for the two important Prussian Universities of Bonn and Berlin. The design of the buildings, and the details of their arrangement, have been very wisely entrusted to Dr. Hofmann, and as a sum of money commensurate with the grandeur of the conception has been set apart for this purpose by the Prussian Government, there is little doubt that, as regards extent and completeness, these laboratories will be appointed in a manner unprecedented in the history of chemical education.

Early in January, a request was made by Her Majesty's Government to the Prussian Minister of Foreign Affairs for information on the general scope of the institutions, and on the objects contemplated; and an intimation of this wish of our Government to become more intimately acquainted with these great educational undertakings was accordingly conveyed to Dr. Hofmann.

We believe the information was principally required by the Science and Art Department, and almost at the same time that the diplomatic correspondence was going forward, Mr. Cole wrote to Dr. Hofmann, requesting that he would not only furnish full details of construction and arrangement of these laboratories, but would give information generally of the circumstances under which they were commenced, and the precise objects aimed at. We do not think it is premature to state that the noble precedent set by Prussia is likely to be followed by the establishment of a great chemical institution in our own metropolis; at all events, some such idea as this suggests itself in perusing the Report which Dr. Hofmann has drawn up at the request of the Committee of Council on Education. This comprehensive Report has been placed freely at our disposal by the author; we are also indebted to the great kindness of Henry Cole, Esq., C.B., for casts of all the elaborate wood engravings which contribute so materially to the clearness and completeness of this Report; and we shall accordingly place before our readers, with as little delay as possible, a full description of the chemical institution which is now fast approaching completion at the University of Bonn; and at a future time we hope to be enabled, through the courtesy of Dr. Hofmann, to furnish additional particulars respecting the interior fittings and working conveniences with which these palaces for chemical research will be so richly provided.

Gold Test.—A good test for gold or silver is a piece of lunar caustic, fixed with a pointed piece of wood. Slightly wet the metal to be tested, and rub it gently with the caustic. If gold or silver, the mark will be faint; but if an inferior metal, it will be quite black. Jewellers who purchase old gold often use this test.—*Am. Drug. Circ.*

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

*On the Part played by Chalk in Butyric and Lactic Fermentation, and the Living Organisms it contains,** *by M.* A. Bechamp.

During my study of fermentation, it occurred to me to inquire whether the only part played by chalk in the phenomena called butyric or lactic fermentation, is that of maintaining the neutrality of the medium—that is to say, of acting exclusively as carbonate of lime.

White chalk, which belongs to the upper part of the cretaceous stratum, seems to be formed, for the most part, from an extinct microscopic world. According to M. Ehrenberg, these fossil remains are of small organised beings of two families, which he names *Polythalamies* and *Nautilites*. These creatures, formerly organised, are so small and so numerous that a morsel weighing 100 grammes may contain 2,000,000 of them.

But independently of these extinct creatures, white chalk still contains a generation of organisms much more minute than any hitherto known, more minute than any of the infusoria or microphytes of fermentations; and they are not only present, but they are living and adult, though no doubt very old. They act with great energy as ferments (I purposely use this common phrase), and, in the present state of our knowledge, they are the most powerful I know, inasmuch as they are nourished on the most varied organic substances, as I will endeavour to show in a future memoir.

Take from the centre of a block of chalk, either recently taken from the quarry, or after it has been for some time extracted, a portion of the substance, no matter of what size (so that the results may not be supposed to be affected by atmospheric dusts); crush this, mix it with pure distilled water, and put under the microscope with the magnifying power of Nachet's No. 7 eyepiece No. 2 object-glass, and the field will be covered with brilliant points, often very numerous, shaken by a quick trembling movement.

It is generally said that they are animated by a *Brownian* movement. Not believing that this movement belonged to the molecules, and regarding them as living organisms, the smallest I had ever observed, I had recourse to two kinds of proofs to resolve the problem involved in this hypothesis. The first consists in showing these molecules to be ferments, the second in isolating and analysing them—that is to say, showing them to contain carbon, hydrogen, and nitrogen in the organic state.

I. Chalk without the addition of albuminoid matter acts as ferment. For all these experiments chalk from the centre of the block is used.

a. The Action of Chalk on Starch.—Mix thoroughly 420 grammes of starch paste containing 20 grammes of starch, 30 grammes of chalk from the centre of the block, and 4 drops of creosote. Prepare at the same time a similar mixture in which pure carbonate of lime, recently prepared and exposed for forty-eight hours to the action of the air, is substituted for chalk. The next day the two mixtures will appear to be in the same state. The day after, the mixture containing the chalk will begin to liquefy, and the following day will become perfectly liquid, whilst the other containing the carbonate of lime will not have changed. The soluble

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* *Comptes Rendus*, lxiii., 451.

portions of the liquefied starch contain soluble fecula and traces of dextrine.

On November 14, 1864, 100 grammes of starch in the form of paste were placed in 1500 cubic centimetres of water, 100 grammes of Sens chalk, and 10 drops of creosote. The starch was found to liquefy as above, and soon carbonic acid and hydrogen were disengaged. On March 30, 1866, the product of the reaction was analysed, the result being—

Absolute alcohol . . .	4 c.c.
Butyric acid	8·0 gr.
Crystallised acetate of soda .	5·2 ,,

In another experiment, besides these products, a notable quantity of lactate of lime was obtained.

b. The Action of Chalk on Cane-sugar.—On April 25, 1865, 80 grammes of very white cane-sugar, 1400 grammes of chalk, and 1500 cubic centimetres of creosoted water were placed together. On June 14 the product was analysed with the following result—

Absolute alcohol . . .	2·6 c.c.
Butyric acid	4·5 gr.
Crystallised acetate of soda .	6·8 ,,
Crystallised lactate of lime .	9·0 ,,

I have verified these results, and found them always the same. I must add that, under the same conditions, pure carbonate of lime has no action, provided all contact with air be avoided; but there are cases in which creosote does not prevent these mixtures fermenting, which would make it appear that there are in the air adult organisms capable of existing in a creosotic medium containing lime.

I will add two observations: the first is, that, to prevent chalk from acting either on cane-sugar or starch, it should be moistened and heated to about 300°; the second is, that, if sufficient precautions be taken, there will be found, after fermentation, no other ferment than that observed in the chalk, though this will have augmented.

II. Chalk contains carbon, hydrogen, and nitrogen in the state of organic matter.—If the preceding experiments be really conclusive, organic matter ought to be found in chalk. To demonstrate this, I have submitted to organic analysis the insoluble part left by chalk when treated by dilute acids.

Dissolve an unpulverised block of chalk in weak hydrochloric acid. Collect the undissolved portions on strong and smooth paper, and wash them in acidulated water until no lime is detected in the filtrate. Then remove the moist residue with a card, without injuring the filter; spread it thinly on a sheet of glass, and let it dry screened from dust.

100 grammes of chalk will thus give 1·15 gr. of insoluble portions dried at 100°. By then drying at about 160°, and incinerating, it will be found that 100 parts of residue dried at 100° are formed of

	Per cent.
Water (lost at 100° to 160°) . .	2·47
Organic matter (lost by incineration).	7·17
Mineral matter (residue). . .	90·36
	100·00

Submitted to organic analysis, the residue dried at 100° furnished the following results:—

Carbon.	1·053
Hydrogen	0·740
Nitrogen	0·128

The nitrogen was estimated by Will and Varren[illegible]'s process. It was ascertained by a trial experi[illegible] that the sugar and soda lime employed produced [illegible]able quantity of ammonia,

Is white chalk the only form of carbonate of lime which contains actually developed ferments? To resolve this question, I had recourse to M. Michel, who supplied me with a block of limestone of Pountil. This limestone behaved in exactly the same way as white chalk —in short, with chalk only (without any other albuminoid matter than that contained in the starch granules and the trace which may be supposed to exist in cane-sugar), cane-sugar and fecula starch may be fermented, and produce, besides alcohol, the characteristic limits of alcoholic fermentation, acetic, lactic, and butyric acids, the characteristic limits of lactic and butyric fermentations.

The name I propose for the small chalk ferments is "Microzyma cretæ." I believe this to be the first example of a class of organisms which I shall have the honour of laying before the Academy. The microzyma are to be found in many directions; they accompany various other ferments, they exist in certain mineral waters, in cultivated earth, where they no doubt play an important part, and I believe that a great number of molecules, considered as mineral, and animated by a Brownian movement, are no other than microzyma. Such are the deposits of old wines, of which I have treated in a former paper, and the deposits already described by Cagniard-Latour, and which he finally considered as inert matter.

TECHNICAL CHEMISTRY.

*The Smoke Question,** *by Dr.* R. Angus Smith, *F.R.S.*

Warm interest has compelled me for many years to attend to the condition of the air of towns. Habit has no power of rendering smoke pleasant. Few men living in a smoky town require to be convinced that they are in the daily endurance of a monstrous evil. You do not require details, but it is well to remind you of some points, as possibly some present might have long ago given up all consideration of a sight which during all their lives had taken the appearance of an unavoidable misfortune. Many substances make their appearance as smoke from chimneys; that kind to be now considered is coal smoke; all other kinds are comparatively rare; and with us here smoke means generally coal smoke. There are various colours characteristic of smoke—from pale blue to grey, brown, and intense black. The first comes chiefly from domestic fires, when the heat is considerable, but the combustion slight. A dark grey or a deep brown smoke is a product of the distillation of coal. When the dense hydrocarbons have been heated highly, but with insufficient air, we have them decomposed, and carbon of a pure black is thrown out. The coloured substances in smoke are tar and carbon chiefly; the compounds vary with the heat, and may be numerous. Some time ago I calculated that 60 tons of carbonaceous matter were sent off in a day into the atmosphere in Manchester. A very small amount affects the atmosphere; a grain in 18 cubic feet is sufficient to convert good air into Manchester air, so far as carbon is concerned. About one half the colour is due to tarry matter, and the other half to black carbon only. This black matter is the colouring material of all our smoky towns, and, to a great extent, of the

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* Read before the Social Science Congress, Manchester meeting, on the occasion of the discussion—"How far are smoke and the products of combustion arising from various manufacturing processes injurious to health?" "What measures ought to be taken to prevent the contamination of the atmosphere from such causes?"

clothes, as well as of the persons, of the inhabitants. We live in houses coloured by it, and we walk on roads coloured by it, and we can see the sun, the moon, and the heavens only after they have been, to our eyes, coloured by this universal tincture.

These are calamities of themselves; but, although some men would look on such a view of the case as mere sentiment, not one amongst us can fail to have his spirits tinged with the darkness of the sky. I found this strangely corroborated lately. One of the best men of business in Manchester informed me that, on an atmospherically dull day, no one would give a high price for goods, no one had the courage to give it, but on the other hand they could buy goods at a lower price—the seller had not the courage to hope for better.

These dull days are caused in part by the climate, but their remarkable oppressiveness is unquestionably due in great part to the smoke. We do not consider that by the smoke we make we are affecting our own spirits and clouding our own judgment. It is my belief that this effect on the spirits is the most powerful of all objections to smoke even in the minds of those who believe themselves above such feelings. There is, however, no denying the next great fact, that everything coming in contact with a smoky atmosphere is so blackened that cleaning becomes difficult or impossible. Smoke gives to every household it visits either a greater amount of labour or a lower social appearance. Let us suppose a housewife only strong enough to do all the work of her house so as to keep it comfortable when there is no smoke plague, she will break down before attaining the same results in a smoky town. We may, however, fairly doubt if it is possible by any means to attain the same results, and in reality they are not attained. We are apt to call the people who suffer most by it indolent, and they sometimes believe themselves so, but the cause is rather despair at the amount of work demanded of them. Even the higher wages in towns fail to make them reconciled to curtains blackening in a few days, when in country places these would have kept their windows neat for many months. Nor can the higher wages of town reconcile them to having their clothes blackened as soon as washed, instead of being dried when they are hung out for that purpose. The poor pay directly for the smoke, living where it prevails, and the middle classes and the wealthy suffer proportionately in being compelled to live out of the town, and to spend time in going to and fro. It is quite true that carbon, tar and sulphurous acids are disinfectants; but we do not wish to breathe them constantly—we cannot live on medicines. The disinfecting powers of smoke have not rid us of disease, nor does it prevent occasional pestilences. If it does good it does more evil, and much of the mortality of Manchester must be attributed to smoke. It has been said that if the carbon was thoroughly burned the amount of sulphurous acid would be so great as to be intolerable; but when the blackness is removed the sulphuric acid seems to escape more easily. We can imagine the carbon soaked with the acid, falling down with double effect upon the town.

One product of the combustion of any carbonaceous substance is carbonic acid; this is inevitable, and must be endured. Another product is carbonic oxide, which has a deadly character, is invisible, and is not sent out by the domestic fire, and only to a small extent by high chimneys. From a sanitary and economical, and an æsthetic point of view, we shall gain much by the removal of the carbon, and an additional gain will be obtained by removing the carbonic oxide. We are not, however, to suppose that all is then gained; we are not entirely safe until we have removed the sulphurous acid. To effect this is not a problem which we can expect to solve rapidly. The sulphur gases collect wherever there is any obstruction to ventilation. Sometimes the smoke is retained in the town as certainly as if a firmament were put over it of impenetrative material. On a still day, with a clear sky and considerable cold, the smoke lies on Manchester until the streets become dark at midday. It is then that the acids are found painful to the eyes, bad to the taste, dangerous to the breathing. The blackness might be removed; what shall we do with the sulphur?

It is the sulphur acids which render the air and rain of Manchester so destructive to metals. Iron roofs will not remain there; even houses cease rapidly to exist, and become old at an early period. The lime of the mortar becomes sulphate of lime, and the rain washes it away. The very stones decay under the constant action of acid, and the bricks crumble more rapidly. Even in places less troubled with smoke, we see the decay. The Parliament Houses, built to remain for ages, are rapidly, before our eyes, turning into plaster of Paris and Epsom salts. Probably some of the evil might be avoided. The finest buildings in London appear less handsome than flimsy structures in many Continental cities. With us, the peculiarity of the climate is a great enemy. On certain days, the acids rise rapidly; but, as a rule, they fall. Great extremes of dryness and of rain are the best protectives, and, during heavy showers, the air of Manchester is not unpleasant to breathe, because the sulphur is carried down in the rain. The coal used here contains not less than one per cent. of sulphur, and one of sulphur makes three of vitriol. Some coals contain more. The amount of sulphurous acid sent out is enormous—it cannot be less than 180 tons per day. The rain is acid. It falls on the living grass, and puts it out. Young plants struggle against it, but they cannot do so long. We scarcely know how much of the beautiful and useful is destroyed by this acid. The fine arts could scarcely flourish in an atmosphere which attacks without fear a great building which ought to remain sound for centuries.

One of the foremost printers of Lancashire told me that there were some colours which he found almost instantly to fade. They were frequently sent back upon his hands. He was annoyed to find that the French sent the same colours to the same markets without the risk of having them returned, and it was only after much time and loss that he found that the goods must not be allowed to pass through Manchester. One day was enough, but in some weather two hours were sufficient for their deterioration. The colours imbibed a poison and went off to die of it. He now sends such goods from his works without coming here, and he is as successful as his rivals in France.

It must be remembered that even if we burn smoke colourless, this sulphurous acid will remain. The rain will be equally acid, but if we burn the smoke no particles of carbon filled with vitriol will fall upon us. It will more readily diffuse. This seems to be the experience, but it is matter for open discussion. We are told on one side that the sulphurous acid is decomposed by the carbon, and that the sulphur falls down with it in a solid state. I do not know if this is a fact, but if it be, the result will be that the sulphur will be very finely divided, and in that state be oxidised by the air and water, forming oil of vitriol where it lies. It will not be less innocent, although it may change the sphere of its iniquities. This may explain why the black vegetation is so frequently very acid, as it most surely is often or always found to be.

The only sure mode we know of diminishing the amount of acid given out by chimneys is by burning less sulphur. This can be done perhaps, to some extent, by burning less coal, and burning it more economically; next by not allowing the most sulphurous of the coals to be burnt in large towns. This latter is a simple mode of doing some good, and cannot in all cases be considered too great a demand on manufacturers. I inquired of engineers the amount of coal burnt per horse power per hour in the best and the most careless establishments, and was told that it varied from three pounds to fifteen pounds. I obtained other answers, which went lower and higher, but enough if we know that coal is, in many places, burnt at a wasteful rate. This is a department concerning which I am not called on to speak, but it comes as a part of my subject. If we examine this carefully, we shall find, in all probability, that the amount of heat we really use is trifling, whilst the coal is in amount enormous.

A wasteful management of coal is the perpetration of a nuisance not justified by the exigencies of manufactures, and the agents can scarcely plead that they are following a legitimate occupation. I shall say little of this; probably the change in this branch will be more gradual than the destruction of the blackness, but we must not forget it. A great thinker of the time said to me once, the nation reminds me of a man who was left a great barrel of wine for long use; he pulled out the bung to fill his little glass, and had not sense to see that the most of the liquid ran off on the floor. The diminution of the amount of coal burnt without giving out its equivalent of power, will be a benefit sanitary as well as economical. How far we have this in our hands, it is not easy to say; but it is so to some extent, and it would be well if the subject were kept before us permanently. People inform us that the selfishness and self-interest of manufacturers is sufficient for this. That is a theory which I never have found reason to believe in fully. The manufacturers are not more selfish than other men; and if they were, the most selfish man is often blind to his own interest.

One of the effects of the combustion of coal is to remove from the air a certain amount of oxygen, putting in its place the gases and carbonaceous substances spoken of along with coal ashes, which are in part carried upwards. The removal of the oxygen occurs only to a small extent, but it is perceptible, and in some cases considerable. This deterioration of the air occurs most in places where there is most carbon floating, and where it is therefore least pleasant to open our windows. Now, if there is less oxygen, we require the air to be renewed more frequently, and this we cannot permit because of the blackness. The smoke acts like a prison wall, and we shut windows and cease to ventilate. Bad as the air may be, it is better than that which we manufacture for ourselves by shutting our rooms, which remain closed until the bedrooms even in the large hotels of all our towns become unpleasant to the senses. It is the custom to ventilate by the doors from corridors only, in London and elsewhere, in hotels, lest the blacks should enter by the window, from which the freshest air comes. Private houses suffer equally. The weavers of Spitalfields were glad to be able to open their windows when the establishments near began to burn their black smoke, and this is a powerful argument against the opinion of those who would attempt to show that the sulphur is the only thing to be feared. Bad the sulphur gases unquestionably are, but it is the carbon which causes the alarm of housewives and housemaids, and which prevents the needful change of air in our town houses. The oxygen which is removed from the air is the whole of the most active portion. It has long been called ozone and peroxide of hydrogen; but, by whatever name, it is a something always found in agreeable air. This is never found in Manchester.

It is for medical men to consider what class of diseases may arise from this diminution of oxygen. Children suffer most in smoky towns, we are told. They have rapid circulation, they require much oxygen, and are instinctively fond of fresh air. It seems to me that the analyses of the air, showing a diminution of oxygen, even forgetting the sulphurous acid, explains why children should suffer so much, and helps, along with other causes, to explain what Mr. Leigh has called "the massacre of the innocents." The deficiency of active oxidation is equal to a deficiency of power and of healthy stimulus. If so, we need not wonder that some persons should seek artificial means of stimulus, nor why others should rather seek the less vigorous oxidation of a town. I cannot doubt that we have here some of the reasons for a deterioration of race spoken of by Dr. Morgan as visible amongst us. Our strength must be proportionate to the amount of healthy oxidation. If by any method we reduce the amount of floating blackness, we shall increase the purity of the air of the town, increase the beauty of its buildings, and improve the appearance of the inhabitants. We shall enable the houses to be ventilated more thoroughly, and we shall diminish the intensity of those days of darkness that sometimes paralyse the whole community. Every day will be brighter and, I think, happier to every inhabitant. If we diminish the sulphur by burning less coal, we shall diminish the amount of coal dust also, and these two points are not to be forgotten, although the full combustion requires first to be settled.

I will not speak of the means of burning smoke, which some years ago numbered twelve dozen. Amid the many conflicting opinions that are entertained, we cannot do better than trust to the great laws of nature we have learnt, which teach that smoke can be made colourless, and that the escaping of unburnt matter is a loss to the community. I do not entertain the extravagant hope that we may suddenly remove all the smoke of the country. We shall not succeed in our efforts if all our sympathy is on the side of the non-manufacturing public. Manufacturers often make efforts for the purification of the atmosphere greater than even the public have thought proper to require. It cannot be to the advantage of the country to oppress them; but it will be a great boon if they are compelled to work to a standard. It is felt to be an oppression when different rules are enforced in different places. The standard might probably begin low, and rise from year to year. It would be a cause of great gratification if the movement began with an association of manufacturers. If they have no inclination, they may perhaps seek the aid of the authorities, or if this is not done the authorities would no doubt receive from them assistance if it was required. At any rate, it would be well to see the manufacturers, the chief agents in making the reform. Municipal bodies have failed to produce any important reform. We must remember that we cannot live without rendering the air impure, and rich as the country may be, we cannot afford to destroy our manufactures in order to preserve the beauty of a few fields. In most cases there must be compromise. We should oftener arrive at the truth if these questions were considered from wider points of view than are permitted in courts of law.

Process for the Estimation of Resin in Soaps,

by J. SUTHERLAND.

HAVING often had occasion to analyse samples of soap, the author has found the great want of a process for the correct estimation of the resinous acids contained in admixture with the fatty acids. A process has been given in which spirit of turpentine is recommended for this purpose, but resin being so soluble in that menstruum, it is at once apparent that a correct result cannot be obtained. The following process depends on the fact that resin, when subjected to the action of nitric acid at 212°, is converted into a soluble substance known as terebic acid ($\text{Ɵ}_7H_{10}\text{Ɵ}_4$) with liberation of nitrous acid; while fatty acids are unacted upon, or at least inappreciably so. Of course, the oleic acid present is converted into elaidic acid; but, as these acids are isomeric, the reaction does not interfere with the accuracy of the result obtained.

300 grains of the soap cut into small pieces are placed in a capsule and covered with strong hydrochloric acid, the capsule being covered with a piece of glass, and the contents kept gently boiling till the soap is dissolved and thoroughly decomposed. Three or four ounces of hot water are then added, and the capsule is set aside to cool.

When cold, the cake of fatty and resinous acids is carefully removed and re-melted on pure water to remove any acid solution adhering. After cooling it is dried on bibulous paper, and again very gently re-melted and carefully brought to the boiling point for a minute or two to expel the last traces of moisture.

This cake containing the fatty and resinous acids must now be weighed, and the weight carefully noted.

100 grains of the mixed acids are placed in a six or eight ounce capsule. It is covered with strong nitric acid, and the temperature gradually raised to the boiling point, when a powerful action takes place with violent evolution of nitrous acid fumes. The heat is withdrawn till the violence of the action subsides, and is then again applied to maintain gentle ebullition for some minutes, with frequent stirring.

Small portions of nitric acid are successively added till no further distinctly appreciable quantity of nitrous acid is given off. The fatty acids are now allowed to cool, and are carefully removed from the strongly acid and richly coloured solution of terebic acid. The cake is then washed by melting in a further quantity of nitric acid. When cold, it is dried and re-melted at a gentle heat till acid fumes cease to be given off.

The resulting cake is the pure fatty acid freed from resin, the latter being, of course, indicated by the loss. The author has found the above process to give most perfect results by subjecting soaps of known composition to its action.

It will be observed that a correction must be made to obtain the exact relative proportions of fat and resin originally put into the soap pan, as fats on being decomposed lose about 4½ per cent. of their original weight—*i.e.*, 100 parts tallow − glycerine = 95½ parts fatty acid. Hence, in making our calculation, a proportionate addition must be made to the fatty acid before dividing its weight by that of the resin indicated. This process is also applicable to the estimation of resin as an adulterant of beeswax.

Soap Works, Sydney Street, Glasgow.

PHARMACY, TOXICOLOGY, &c.

The Exhibition of the Pharmaceutical Conference, Nottingham.

(Concluded from page 173.)

AMONGST the remaining articles which deserve special attention we must mention those exhibited by Messrs. Savory and Moore, which included specimens of cigars, cigarettes, and cut *Datura Tatura;* medicated gelatine discs, narcotine, Ellis's anæsthetic fluids, Liebig's food for infants, and various pancreatic preparations. The latter deserve a more detailed notice. Their pancreatic emulsion is now an article of large consumption; it is a preparation beautiful to look at, and pleasant to eat, and seems to keep good for any length of time. The fat is first of all treated with the fresh pancreas, and is then extracted with ether. On distilling the ether off, the fat is left behind to all appearance unchanged. But it now possesses the power of mixing with water by means of a spoon, as easily as cream. What the change is that the pancreatic secretion produces in fat is not yet known; it is not saponification, for the fat globules in the emulsion, though very minute, are clearly distinguishable. There appears to be no doubt of the great efficacy of pancreatic emulsion in consumption and cases of extreme weakness of the digestive organs.

Messrs. T. and H. Smith exhibited thebolactate of morphia; gallic acid, nearly colourless; tannin, readily and perfectly soluble; aloin, crystalline tuft of the cathartic principle of aloes; and aconite sugar or mannite.

Messrs. Southall, Son, and Dymond, of Birmingham, forwarded two cases containing sixteen samples of opium and nine samples of scammony, with the following analysis of their most important constituents:—These specimens were selected as ordinary commercial samples such as are commonly met with in the English market. The object in making the analysis was to ascertain the relation which the market prices usually bear to the real values of opium and scammony as shown by the proportions of morphia, etc., and pure resin. The result shows that pharmaceutical preparations, made from these important drugs, are liable to serious variations of strength, unless the drugs employed are uniform in their important constituents, and that the market prices are no guide to the real value of these articles.

Analysis of Samples of Opium.

No.	Crude Morphia.	Dry Extractive.	Moisture.	Market Price.
1	7·5 p. c.	60 p. c.	14 p. c.	12/6
2	6·6	50	20	12/9
3	4	41	20	13/
4	8	30	24	13/
5	5	47	16	13/6
6	7·6	48	21	13/6
7	5·2	44	14	13/9
8	none	34	14	14/
9	11·5	48	18	14/6
10	11	44	18	15/
11	13·3	46	15	15/
12	10·5	50	18	15/
13	10·6	46	23	15/6
14	8·5	48	16	15/6
15	9·7	46	24	15/6
16	7	52	18	16

Analysis of Samples of Scammony.

No.	Pure Resin.	Market Price.	No.	Pure Resin.	Market Price.
1	18 p. c.	8/	†6	100	26/
2	14	12/	7	68	31/
3	29	15/	8	80	37/
4	36	18/	9	76	48/
*5	100	26/			

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* M'Andrew's patent. † Made according to the British Pharmacopœia.

This firm also exhibited specimens of some of their iodine and bromine preparations—viz., iodide of ammonium, iodide of potassium, both crude, fused, and crystallised, bromide of ammonium and bromide of potassium.

From Mr. John Tuck was contributed a highly interesting series, consisting of samples of adulteration, &c., placed at his service by the Hon. Board of Inland Revenue. 1. "*Original Indian Essence,*" consisting of methylated spirit of a strength of 70·1 under proof and treacle. 2. "*Indian Tincture,*" consisting of methylated sweet nitre and treacle. 3. "The only original highly medicated and cordialised *Indian Brandee,*" consisting of treacle and methylated spirit of a strength of 47·3 under proof. 4. "*Indian Brandee,*" consisting of methylated spirit, hyponitrous ether, and treacle. These four samples were sold as medicines under the quoted names, but such compounds are in reality manufactured to be sold for beverages, and extensively used for this purpose in Lancashire and Yorkshire. The presence of methylated spirit in these compounds is clearly shown both by the iodo-hydrargyride of potassium and oxidation tests, as detailed in a paper read at the Birmingham meeting of the British Pharmaceutical Conference. 5. "*Whiskee,*" containing methylated spirit of a strength of 60·0 under proof. 6. "*Essence of Ginger,*" containing methylated spirit. These two samples were taken from a large quantity of spirits sold by public auction in Dublin, and when found to contain methylated spirit were seized by the Inland Revenue authorities. 7 and 21. *Glucose,* consisting of starch, sugar, and gum, and extensively employed in the manufacture of confectionery, and for the adulteration of jams and marmalade. It comes chiefly from France, and is made from potato- or wheat-starch. 8 and 9. *Concentrated ale and porter wort,* manufactured by the Concentrated Wort Company of Margate, to which has been given the name of "Grainstone." This concentrated wort is made of malt and hops in the ordinary way, and reduced by a patent process to a solid hard substance. To convert this substance into beer, porter, ale, or stout, more or less water has to be added, according to the strength required, and, when thus liquefied, it is fermented and racked off into casks in exactly the same way as ordinary beer is brewed. The "grainstone" is exported in the solid state in square tin cases, so that the heavy cost of the carriage of the water in ordinary beer is thus avoided; and, being hermetically sealed up, it will keep good without deteriorating or losing any of its qualities for years. Two pounds of this grainstone to every gallon of water makes a good beer. 10. *Adulterant for porter,* consisting of treacle extracted from sugar-bags and refuse of sugar refineries. There is reason to believe that this species of adulteration is practised a good deal both in London and in the country. 11. *Beer adulterant,* consisting of spent hops, which contain a large proportion of grains of Paradise. 12. *Beer adulterant,* consisting of ground capsicum, starch, and sugar. This was discovered at Stockton-on-Tees. 13. *Cavendish tobacco* of foreign manufacture, adulterated with liquorice. This is found chiefly in seaport towns, and consumed principally by sailors. 14. *Roll tobacco,* adulterated with cabbage leaf. This sample was purchased in Glasgow. 15. *Tobacco leaf* in process of manufacture, adulterated with 19 per cent. of sugar. This was seized in a manufactory at Newcastle-on-Tyne. 16. *High-dried or Irish Snuff,* containing upwards of 20 per cent. of caustic lime. This was obtained from Belfast. 17. "*Snuff,*" [illegible] ground, containing 2 per cent. of rhubarb leaf. The bulk of this snuff weighed several tons. Snuff is most extensively adulterated, and the following are some of the vegetable materials that have been used for this vile purpose, and seized by the Excise authorities:—Rhubarb leaves in several cases, acorns, dock leaves, sawdust, spent dyewoods, rhubarb, and coltsfoot leaves, the "combings" of malt, rhubarb, and potato leaves, coltsfoot and other plants, British tea leaves, &c. These adulterants are principally detected by the microscope. Amongst the mineral adulterants, the most injurious to health are the salts of lead, and if some of the others, such as salt, red ochre, chalk, lime, silica, &c., are not so injurious, they nevertheless defraud the revenue of considerable sums annually. 18. *Hamburg wine,* a sophisticated wine made to imitate sherry, and at one time extensively imported from Hamburg and other German ports. This fraudulent practice is now, however, much checked. 19. *Cadiz sherry wine* of low quality, containing 50 per cent. of proof spirit, used for the fortification of wine to suit the English markets. 20. *Methylated spirit* purified from oil by a process patented by Mr. J. Watson Burton, of Leeds.

Dr. Wagner, Pest, Hungary, forwarded for exhibition a very interesting series, amongst which we noticed chemical works for pharmaceutico- and technico-chemical preparations, simple and compound medicines, essential oils and essences for the manufacture of wines, liqueurs, and brandies; assortment of objects of pharmacy; drugs and minerals, and utensils for photography. *Cognac oil,* distilled from the most selected Hungarian wine lees; these are very convenient for use, and produce at a moment's notice cognac brandy, retaining the flavour of the wine. Cognac oils are used also for manufacturing artificial wines, and for the amelioration of inferior descriptions. *Tellurium metal,* only manufactured in this establishment. The tellurium ore comes from Nagyag, Transylvania, with silver and gold, as Tellurblätterer.

Messrs. John Gillon and Co., of Leith, showed a case containing preserved meats, including beef, mutton, chicken, and other dietetic preparations. Concentrated meat lozenges and extractum carnis are in this series.

Mr. Hadlow exhibited his very excellent and novel boxwood linen markers, with ink and specimens of work.

PROCEEDINGS OF SOCIETIES.

BRITISH ASSOCIATION, NOTTINGHAM MEETING.

Friday, August 24.

A Lecture "On the Results of Spectrum Analysis, as applied to the Heavenly Bodies," by WILLIAM HUGGINS, *F.R.S.*

Continued from page 175.)

MOON AND PLANETS.

I NOW pass to the results of our observations.

I refer in a few words only to the moon and planets. These objects, unlike the stars and nebulæ, are not original sources of light. Since they shine by reflecting the sun's light, their spectra resemble the solar spectrum, and the only indications in their spectra, which may become sources of knowledge to us, are confined to any modifications which the solar light may have suffered either in the atmospheres of the planets, or by reflection at their surfaces.

Moon.—On the moon the results of our observations have been negative. The spectra of the various parts of the moon's surface, when examined under different conditions of illumination, showed no indication of an atmosphere about the moon. I also watched the spectrum of a star, as the dark edge of the moon advanced towards the star, and then occulted it. No signs of a lunar atmosphere presented themselves.

Jupiter.—In the spectrum of Jupiter, lines are seen which indicate the existence of an absorptive atmosphere about this planet. In this diagram these lines are presented as they appeared when viewed simultaneously with the spectrum of the sky, which at the time of observation reflected the light of the setting sun. One strong band corresponds with some terrestrial atmospheric lines, and probably indicates the presence of vapours similar to those which are about the earth. Another band has no counterpart amongst the lines of absorption of our atmosphere, and tells us of some gas or vapour which does not exist in the earth's atmosphere.

Saturn.—The spectrum of Saturn is feeble, but lines similar to those which distinguish the spectrum of Jupiter were detected. These lines are less strongly marked in the ansæ of the rings, and show that the absorptive power of the atmosphere about the rings is less than that of the atmosphere which surrounds the ball. A distinguished foreigner present at the meeting, Janssen, has quite recently found that several of the atmospheric lines are produced by aqueous vapour. It appears to be very probable that aqueous vapour exists in the atmospheres of Jupiter and Saturn.

Mars.—On one occasion some remarkable groups of lines were seen in the more refrangible part of the spectrum of Mars. These may be connected with the red colour which distinguishes this planet.

Venus.—Though the spectrum of Venus is brilliant and the lines of Fraünhofer are well seen, no additional lines affording evidence of an atmosphere about Venus were detected. The absence of lines may be due to the circumstance that the light is probably reflected, not from the planetary surface, but from clouds at some elevation above it. The light which reaches us in this way by reflection from clouds would not have been exposed to the absorbent action of the lunar, and denser strata of the planet's atmosphere.

THE FIXED STARS.

The fixed stars, though immensely more remote, and less conspicuous in brightness than the moon and planets, yet because they are original sources of light, furnish us with fuller indications of their nature.

To each succeeding age the stars have been a beauty and a mystery. Not only children, but the most thoughtful of men often repeat the sentiment expressed in the well-known lines—

> "Twinkle, twinkle, pretty star!
> How I wonder what you are!"

The telescope was appealed to in vain, for in the largest instruments the stars remain diskless, brilliant points merely.

The stars have indeed been represented as suns, each upholding a dependent family of planets. This opinion rested upon a possible analogy alone. It was not more than a speculation. We possessed no certain knowledge from observation of the true nature of those remote points of light. This long and earnestly coveted information is at last furnished by spectrum analysis. We are now able to read in the light of each star some indications of its nature. Since I have not a magician's power to convert this theatre into an observatory, and so exhibit to you the spectra of the stars themselves, I have provided photographs of careful drawings. These photographs Mr. Ladd will exhibit upon the screen by means of the electric lamp. I will take first the spectra of two bright stars which we have examined with great care.

The upper one represents the spectrum of Aldebaran, and the other that of Betelgeux, the star marked α in the constellation of Orion.

The positions of all these dark lines, about 80 in each star, were determined by careful and repeated measures. These measured lines form but a small part of the numerous fine lines which may be seen in the spectra of these stars.

Beneath the spectrum of each star are represented the bright lines of the metals which have been compared with it. These terrestrial spectra appeared in the instrument as you now see them upon the screen, in juxtaposition with the spectrum of the star. By such an arrangement, it is possible to determine with great accuracy whether or not any of these bright lines actually coincide with any of the dark ones. For example:—

This closely double line is characteristic of sodium. You see that it coincides, line for line, with a dark line similarly double in the star. The vapour of sodium is therefore present in the atmosphere of the star, and sodium forms one of the elements of the matter of this brilliant but remote star.

These three lines in the green are produced, so far as we know, by the luminous vapour of magnesium alone. These lines agree in position exactly, line for line, with three dark stellar lines. The conclusion therefore appears well founded that another of the constituents of this star is magnesium.

Again, there are two strong lines peculiar to the element hydrogen; one line has its place in the red part of the spectrum, the other at the blue limit of the green. Both of these correspond to dark lines of absorption in the spectrum of the star. Hydrogen therefore is present in the star.

In a similar way, other elements, among them bismuth, antimony, tellurium, and mercury, have been shown to exist in the star.

Now, in reference to all those elements, the evidence does not rest upon the coincidence of one line, which would be worth but little, but upon the coincidence of a group of two, three, or four lines, occurring in different parts of the spectrum. Other corresponding lines are probably also present, but the faintness of the star's light limited our comparisons to the stronger lines of each element.

What elements do the numerous other lines in the star represent? Some of them are probably due to the vapours of other terrestrial elements which we have not yet compared with these stars. But may not some of these lines be the signs of primary forms of matter unknown upon the earth? Elements new to us may here show themselves, which form large and important series of compounds, and therefore give a special character to the physical conditions of these remote systems.

In a similar manner the spectra of terrestrial substances have been compared with several other stars. The results are given in the diagrams. Five or six elements have been detected in Betelgeux. Ten other elements do not appear to have a place in the constitution of this star.

β Pegasi contains sodium, magnesium, and perhaps barium.
Sirius ,, sodium, magnesium, iron and hydrogen.
α Lyræ (*Vega*) sodium, magnesium, iron.
Pollux ,, sodium, magnesium iron.

About sixty other stars have been examined, all of which appear to have some elements in common with the sun and earth, but the selective grouping of the elements in each star is probably peculiar and unique.

A few stars, however, stand out from the rest, and appear to be characterised by a peculiarity of great significance. These stars are represented by Betelgeux and β Pegasi. The general grouping of the lines of absorption in these stars is peculiar, but the remarkable and exceptional feature of their spectra is the absence of the two lines which indicate hydrogen, one line in the red, and the other in the green. These lines correspond to Fraünhofer's C and F. The absence of these lines in some stars shows that the lines C and F are not due to the aqueous vapour of our atmosphere.

We hardly venture to suggest that the planets, which may surround these suns, probably resemble them in not possessing the important element, hydrogen. To what forms of life could such planets be adapted? Worlds without water? A power of imagination like that possessed by Dante would be needed to people such planets with living creatures.

It is worthy of consideration that, with these few exceptions, the terrestrial elements which appear most widely diffused through the host of stars are precisely some of those which are essential to life, such as it exists upon the earth—namely, hydrogen, sodium, magnesium, and iron. Besides, hydrogen, sodium, and magnesium represent the ocean, which is an essential part of a world constituted like the earth.

We learn from these observations that in plan of structure the stars, or at least the brightest of them, resemble the sun. Their light, like that of the sun, enanates from intensely white-hot matter, and passes through an atmosphere of absorbent vapours. With this unity of general plan of structure, there exists a great diversity amongst the individual stars. Star differs from star in chemical constitution. May we not believe that the individual peculiarities of each star are essentially connected with the special purpose which it subserves, and with the living beings which may inhabit the planetary worlds by which it may possibly be surrounded?

When we had obtained this new information respecting the true nature of the stars, our attention was directed to the phenomena which specially distinguish some of the stars.

(To be continued.)

ACADEMY OF SCIENCES.

October 1.

(Concluded from page 175.)

"*On the Action of Magnesium on Neutral Metallic Salts,*" by M. A. Commaille. The author finds that hydrogen is always evolved when a metal is precipitated by means of magnesium, and the precipitation is never complete. With ferrous sulphate, hydrated protoxide of iron is precipitated. In an acid solution metallic iron comes down. With mixed chromic and chromous chloride, hydrated sesquioxide of chromium is precipitated. With manganous sulphate, the reaction is the same as with iron. With cobalt sulphate, the reaction is very slow; after a few days the hydrated oxide, Co_3O_4, deposits on the magnesium. With nickel sulphate the precipitate formed is the hydrated protoxide. With oxalate of uranium a golden-coloured deposit of hydrated sesquioxide is produced—U_2O_3,HO. With sulphate of zinc there is an energetic action, and the metal, the hydrated oxide, and sub-sulphate are precipitated. With chloride of cadmium the reaction is also very energetic, and a mixture of oxychloride of cadmium and metallic cadmium is precipitated. Bismuth salts being acid give a precipitate of pure metallic bismuth. Protochloride of tin gives spongy tin and stannic acid. The disengagement of gas is very strong with neutral chloride of lead; the deposit consists of lead mixed with oxychloride. Sulphate of copper gives, with magnesium, the metal, the hydrated protoxide, and a green subsalt. With chloride of copper no metal is precipitated, but a deposit of Brunswick green. With bichloride of mercury, calomel and binoxide of mercury are precipitated. With bichloride of platinum and chloride of gold the metal only is precipitated.

"*Analysis of the Waters of Vergèze; Microzyma and other Organisms found in this Water,*" by M. A. Béchamp. These waters are remarkable as containing considerable quantities of [illegible]utyric acids. Bunsen has already detected p[illegible] German spring. Scherer has likewise [illegible]basic, acetic, and formic acids in a B[illegible] is the first time that organic acids have been found in a French spring. Upon examining the deposit of this water under the microscope, a considerable number of mobile corpuscles were observed, similar to those seen in native chalk. The author supposes that these microzyma are the cause of the formation of the volatile fatty acids.

"*On the Synthesis of Resorcine,*" by M. W. Korner. The author starts with benzol; converts this into binitrobenzol; from this prepares paranitroaniline; transforms the nitrate of this base into nitrate and then sulphate of paradiazonitrobenzol. Under the influence of hydriodic acid this salt gives paraiodonitrobenzol, which, with tin and hydrochloric acid, is reduced to paraiodaniline. From the nitrate of this base the sulphate of paradiazoiodobenzol is formed. This salt decomposed by boiling water gives a new acid, paraiodophenic acid. This is solid and well crystallised; its most remarkable property is to give, under the influence of fused potash, a crystallised combination which is the inferior homologue of orcine described by MM. Hlasiwitz and Barth under the name of resorcine. The author hopes to show that phloroglucine and pyrogallic acids are trihydroxylic derivatives of benzol, and that, by starting from toluol, he will effect the synthesis of orcine.

"*Sixth Memoir on Heliochromy,*" by M. Niepce de Saint-Victor. The author has succeeded in preparing a plate of silver on which all the colours, and even white and black, are capable of being impressed in the camera. The paper contains several improvements in detail, principally with a view to obtain good blacks.

"*On the Development of Small Acari in Potatoes,*" by M. Guérin-Mèneville.

"*On the Earthquake of the 14th September, 1866,*" by M. Moll.

"*On the Conditions which influence the Development of Primitive Vaccine,*" by M. A. Chauveau.

October 8.

Chemical science appears to have almost exhausted itself at the last sitting, and left little of interest for the present meeting. The first paper read was

"*On the Theory of Heat according to the Vibratory Hypothesis,*" by M. Babinet. As might be imagined from the title, this was almost exclusively a mathematical paper. It was followed by some

"*Remarks, in reference to the preceding Communication, on Stahl's Explanation of Combustion,*" by M. Chevreul.

"*On Animals which have disappeared from Martinique and Guadeloupe since our Establishment on these Islands,*" by M. Guyon.

"*On Pluviometric Observations and their Importance in the Supply of Potable Water to Dense Populations,*" by M. G. Gremaud de Caux. Leverrier wisely observed that rain is one of the meteorological phenomena which stand in the most direct relations with agriculture. The author calculates that, even in thickly-populated parts of rural districts, far more than sufficient rain falls to supply the wants of the inhabitants. But he considers that five litres daily is sufficient water for each person, and therefore his calculations, however suitable to France, will scarcely be adapted to our insular prejudices in favour of cold tubbing.

"*Researches on Isatine,*" by Hugo Schiff. The author finds that the sulphites and bisulphites of certain bases possess the property of direct combination with aldehydes. By employing pure ether as a solvent for the sulphites and bisulphites, he has prepared acetyl-bisulphite of aniline, benzoyl-bisulphite of amylamine, and valeryl-bisulphite of amylamine; and with neutral sulphites, benzoyl-sulphite of aniline, œnanthyl-sulphite of aniline, valeryl-sulphite of aniline, and benzoyl-sulphite of toluidine. At a high temperature these bodies decompose, forming diamides. These compounds have as yet only been obtained with primary monamines. The sulphites of coniine, of quinoline, of ethylaniline, of toluylendiamide, and of rosaniline, do not combine with aldehydes. These reactions may serve as a test for aldehydes. Isatine will combine direct with alkaline bisulphites, forming analogous compounds; and following this out, the author has prepared isato-bisulphite of aniline,

$$\mathrm{S\Theta_2, Ꞓ_6H_7N, Ꞓ_8H_5N\Theta_2}$$

and isato-bisulphite of amylamine,

$$\mathrm{S\Theta_2, Ꞓ_5H_{13}N, Ꞓ_8H_5N\Theta_2}.$$

Similar compounds have been formed with toluidine and ethylamine, and in all cases white crystalline salts have been obtained, which possess the physical and chemical properties of the analogous derivatives of aldehydes. The author has also found that the diatomic residue $\mathrm{\Theta_8H_5N\Theta}$ of isatine can replace the typical hydrogen of organic bases in the same manner as the residues of aldehydes. By acting on isatine with amylamine and ethylaniline, the following compounds have been obtained :—

$$\mathrm{N_2}\begin{cases}\mathrm{Ꞓ_8H_5N\Theta}\\ \mathrm{Ꞓ_8H_5N\Theta}\\ \mathrm{2\Theta_5H_{11}}\end{cases} \qquad \mathrm{N_2}\begin{cases}\mathrm{Ꞓ_8H_5N\Theta}\\ \mathrm{2\Theta_6H_5}\\ \mathrm{2\Theta_2H_5}\end{cases}$$

Amylisatimide. Ethylphenylisatimide.

These bodies crystallise difficultly in small yellow plates slightly soluble in ether and very soluble in alcohol; they are decomposed by acids and water. The author considers on these and other grounds that isatine, although a crystalline nitrogenous body, ought to be considered as a kind of aldehyde.

"*On Means of utilising the Phenomena of Supersaturation,*" by M. Jeannel. The author suggests that this phenomenon may be utilised in the purification of certain salts. Thus, for the purification of commercial sulphate of soda, take 300 grammes of this salt and 100 grammes of distilled water; dissolve at a temperature of 33° in a glass flask; and while this is going on arrange a filter in a funnel, and pour through it 500 grammes of warm water at about 50°. Then place the funnel on a wide-mouthed flask well rinsed with distilled water, pour the warm saline solution on the filter, and cover it with a plate of glass. The solution will entirely pass through without crystallising, and will remain liquid in the flask even after cooling. When the funnel is removed, the solution, exposed to the air, rapidly crystallises and becomes heated. When quite cold, decant the mother liquor. Sulphate of magnesia, sulphate of zinc, and carbonate of soda may be purified in a similar manner. The acetate and tartrate of soda, soluble in their water of crystallisation at a temperature below 100°, may be easily filtered by this means. This process is not applicable to alum. The author proposes to use this phenomenon as a means of separating salts; thus, dissolve 335 grammes of nitre and 300 grammes of alum in 100 grammes of water; allow the mixture to cool without exposure to the air, and the nitre will crystallise out, whilst the alum will remain in a state of supersaturation. The separation of the two salts can thus be effected by decantation.

"*On Blue Slags,*" by M. C. Méne. The blue colour of certain slags is generally considered to be due to the presence of titanic acid. The author gives nineteen analyses, in which he shows that titanic acid is not always the cause of the blue colour; it being the colouring matter when the slags are vitreous, but not when they are compact. The author's process for detecting titanic acid is as follows:—Pulverise and porphyrise 10 to 15 grammes of slag, and treat it with cold dilute sulphuric acid (1 to 10), so as to avoid all heating. The mass soon becomes gelatinous; add plenty of water, and agitate with a glass rod. Filter, wash the precipitate, and boil the filtrate for a quarter of an hour, when the liquid will gradually become opaque, as if hydrate of alumina were suspended in it, and a white precipitate gradually forms in the vessel. Filter, redissolve in sulphuric acid, wash, and again boil, and upon the resulting precipitate the characteristic reactions of titanic acid may be obtained. In the discussion on this paper, M. Chevreul considered that the blue coloration might sometimes be due to the presence of a particular oxide of iron.

"*Note on the Rotting of Fruits,*" by MM. Letellier and Spineux.

"*On the Volcanic Phenomena of Santorin during the Month of August,*" by M. de Cigalla.

NOTICES OF BOOKS.

Bibliothèque Universelle et Revue Suisse. Archives des Sciences Physiques et Naturelles. Nos. 103 and 104. July and August, 1866.

The first article in No. 103 is entitled "*Researches on the Propagation of Electricity in Highly Rarified Elastic Fluids, and especially on the Stratifications of the Electric Light which accompany this Propagation,*" by A. de la Rive. The author has introduced a novel method of research, which appears capable of throwing considerable light on these obscure phenomena. The following is a brief outline of the method of procedure:—The apparatus employed to study the propagation of electricity through metallic vapours consists of a large glass globe furnished with four tubulures, and standing on a foot. The two tubulures which are at the extremities of the horizontal diameter are furnished with leather stuffing boxes traversed with metallic rods. To the extremities of these are fixed the metallic or carbon points, between which are produced the voltaic arcs of a pile of 60 to 80 Bunsen's batteries. The two tubulures situated at the extremities of the vertical diameter are traversed by two brass rods, terminated by the metallic spheres, between which passes, at the same time, an electric current from a Ruhmkorff's coil of moderate power excited with one or two large-sized Grove's batteries. The globe is first well exhausted and then filled with nitrogen, which is then rarified to 2 or 3 millimetres pressure. The Ruhmkorff current is then turned on, and the intensity of it is measured by means described in the paper. The horizontal metallic points are then caused to approach so as to produce a voltaic arc, which here acts solely as a source of heat. In a few minutes the intensity of the Ruhmkorff's current augments considerably, and its colour alters according to the nature of the points between which the voltaic arc is formed. With points of silver and zinc the induction current is of a decided blue colour, deeper with zinc than with silver. With points of copper, cadmium, aluminium, and magnesium, the tint is green, very deep with copper, apple-green with cadmium, very clear green with magnesium, and greenish-white with aluminium. With points of retort carbon, the tint of the induced current is a clear blue, which changes to a greyish-blue when the arc ceases. It is in the upper part of the globe where the metallic vapours from the voltaic arc rise that the effect is best seen. The striæ or stratifications of the electric light are still better seen in these vapours than in rarified gases. With the arc taken between points of iron there is a change of colour in the induced current, and a slight augmentation of its intensity; with platinum nothing was obtained but a very little increase in the intensity of the jet, which might be caused by the action of the high temperature on the conductibility of the rarified nitrogen. The second part of the paper is devoted to a *study of the stratifications of the electric light*, which the author considers to be a phenomenon analogous to the production of sonorous waves—that is to say, a mechanical phenomenon arising from a succession of isochronous impulses exerted on the rarified gaseous column by a series of rapidly succeeding electric discharges. The third part is devoted to a discussion of *particular phenomena which different parts of the electric stratification present.* The author has already shown that the rarified gaseous column traversed by the induction current is composed of alternate dilated and condensed layers with a dark and highly dilated space in the neighbourhood of the negative electrode. The most dilated parts of the column, offering less resistance to the passage of the current, should remain dark, whilst the more condensed parts, being worse conductors, should become superheated and luminous. The phenomenon would therefore be exactly analogous to that observed when a voltaic current of a certain strength is passed through a chain composed of alternate links of silver and platinum. The author proves in an ingenious manner that the dark spaces of the stratification conduct electricity better than the luminous portions. He also shows by thermometric observations that by the same reasoning which shows the worse conducting gaseous portion is more luminous than the better conducting portion, so the temperature of the former portion is more elevated than that of the second.

"*On the Glaciers of the Valley of Chamonix,*" by M. C. Martius.

"*On Traces of Glacier Action in the Environs of Baveno,*" by M. C. Martius.

No. 104 (August 25) contains very little likely to interest our readers. The articles are :—

"*Meteorological Résumé of the Year 1865 for Geneva and Great St. Bernard,*" by Professor Plantamour.

"*On the Limits of the Jurassic and Cretaceous Period,*" by M. Hebert.

"*Geological Chart of the Environs of Paris,*" by M. E. Collomb.

"*Description of a Sounding Instrument to measure the Depth of Lakes,* by M. C. Martius. The author uses a line with a weight at the end, lets it run off a reel till the weight touches the bottom, and then measures the length of rope which has run out. The novelty of the plan is not very evident.

Among the extracts from foreign journals which this number contains are the following :—

"*On the Metals of the Tantalum Group,*"* by C. W. Blomstrand. The author admits the accuracy of Marignac's researches on niobium and the constitution of niobic and tantalic acid. The analytical methods followed by the Swedish chemist are more laborious and less direct than those of Marignac, and do not admit of such accuracy, although they fully confirm the results of the latter.

"*On the Combinations of Uranium with Fluorine,*"† by H. C. Bolton. The *protofluoride*, UFl_2, is an insoluble green powder slightly attacked by acids. *Fluoxyuranate of potassium*, $3KFl,2(UOFl)$ is formed by mixing nitrate of uranium with fluoride of potassium, and recrystallising the difficultly soluble precipitate. It is citron-yellow, and forms oblique rhomboidal prisms. It does not attack glass. Alcohol and ether do not dissolve it. 100 parts of water at 21° C dissolve 12·5 parts. The corresponding soda and ammonia salts appear very difficult to prepare. *Fluoxyuranate of barium*, $3BaFl_2,4(UO,Fl)+2aq.$ is a crystalline citron-yellow precipitate, soluble in weak acids. *Uranoso-potassic fluoride*, $KFl,2(UFl_2)$ is precipitated as a green insoluble powder when a solution of fluoxyuranate of potassium is mixed with formic acid and exposed to the sun. Fluoxyuranate of potash precipitates salts of barium, calcium, and lead, but has no action on salts of silver, copper, mercury, zinc, and platinum.

"*On Combinations of Magnesium with Calcium and Aluminium,*"‡ by F. Wöhler. An alloy of aluminium and magnesium is formed by fusing the two metals under a layer of common salt. Equal equivalents of the metals form a tin-white brittle mass, burning at a red heat, like magnesium. The alloy of calcium and aluminium is formed by heating equal weights of sodium and aluminium with a large excess of chloride of calcium. It is lead-grey and very lustrous, sp. gr. 2·57, and unalterable in water or air.

The other notices which are contained in these two numbers are of papers which have already been before our readers.

Elementary Treatise on Physics, Experimental and Applied. Translated and edited from Ganot's "Éléments de Physique," by E. Atkinson, Ph.D., F.C.S., Professor of Experimental Science, Royal Military College, Sandhurst. Second edition, revised and enlarged. London: Baillière.

This is a new edition of a translation of a work which has been long and deservedly popular in France, and seems likely, through the labour of Mr. Atkinson, to become equally appreciated in this country. As stated in the preface, it is chiefly intended as a text-book for students, and for this purpose it is admirably adapted, giving the framework of the whole of the physical sciences; though of necessity much of the detail in any particular section must be acquired from more extensive works. The headings of the books will show the range of subjects which the treatise embraces; they are as follows :—I. Matter, Force, and Motion; II. Gravitation and Molecular Attraction; III. Liquids; IV. Gases; V. Acoustics; VI. Heat; VII. Light; VIII. Magnetism; IX. Frictional Electricity; X. Dynamical Electricity. At the end is also inserted a chapter entitled "Elementary Outlines of Meteorology and Climatology."

The fact that all this is contained in 800 pages necessarily implies much condensation and some omissions, and we think the author has acted wisely in confining himself almost entirely to the theoretical portions of these subjects, and especially to their mathematical developments. When once the principles of a science are well known, the practice of it will be easily understood and acquired; but the converse of this by no means holds good.

The first five books, comprising the more mechanical properties of bodies, occupy only about one-fourth of the entire space, the rest being almost equally divided between light and heat on the one hand, and magnetism and electricity on the other. The latest researches of Professor Tyndall on heat, and the separation of the obscure from the luminous rays, are given, and the subject of spectrum analysis is illustrated by coloured spectra of solar light, potassium, sodium, cæsium, and rubidium. The principles of photography are summed up in three pages, and the electric telegraph in eleven, but in treating of optics and the polarisation of light the author goes into more detail. The laws of electricity include almost all that are at present known; but we are sorry to find that several instruments of modern introduction are overlooked; thus, the original gold-leaf electroscope is the only one mentioned, and no account is given of Professor Sir William Thomson's reflecting mirror galvanometer, which has now come into very general use. We are glad, however, to see a short description and explanation of Wheatstone's electric bridge, which is too often omitted in works on electricity, although it is to that science what the balance is to chemistry, and, next to the battery and galvanometer, is perhaps the most important instrument the electrician possesses. In dynamical electricity is also given "Ohm's law" and its numerous applications; methods of testing the resistance of wires and the resistance and electromotive force of batteries; also tables of specific conductivity and the law of the changes of resistance caused by variations of temperature.

We can confidently recommend this work, and will conclude our notice by saying that the English, unlike that of many translations, is clear and vigorous and the printing good; the whole being illustrated by over 600 well-executed woodcuts.

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* Memoirs of the University of Lund.

† Zeitschrift für Chimie.

‡ Annalen der Chem. und Pharm.

NOTICES OF PATENTS.

300. *Improvements in Working and Treating India-rubber, Gutta Percha, and other similar Gums.* A communication from Frank Marquard, of Rahway, New Jersey, United States of America. Dated January 31, 1866.

The patentee directs that about two pounds of pure india-rubber or other similar gum be first taken and dissolved in about thirty-two pounds of chloroform; other solvents may be used, though chloroform is preferable. When the gum has been thoroughly dissolved in any properly constructed vessel, the solution is charged with a strong caustic ammonia gas, or treated with a preparation of chloride of ammonium, though he prefers the use of the caustic ammonia gas to bleach the rubber or other gum operated on. When the gum has been thoroughly bleached, which is ascertained by frequent inspection and testings, the charging with the gas or bleaching agent is suspended, and the solution is removed to a boiler or other suitable vessel having an agitator in it, and then subjected to a washing process with hot water until the gum is entirely freed from the bleaching agent used. This is effected by a constant agitation of the solution by keeping the agitator in motion in the washing vessel. At the same time that the washing process is going on, the degree of heat in the boiler may be increased to about 176° Fahrenheit to evaporate the chloroform from the gum, which by means of any proper arrangement of pipes may be led to a condensing vessel or chamber, where it may be collected to be used over again as a solvent for the gum. It will be obvious that the distilling operation may be carried on by a subsequent operation to the washing process, but whether carried on simultaneously with the washing process, or by a subsequent operation, the object is the same, to wit:—First, to free the gum from the chloroform at this stage of the process; and, second, to save the chloroform for subsequent use by collecting it in a condenser as it evaporates from the gum. The product thus obtained from the distillation of the gum is then in the form of a froth, which is strained or collected from the solution and then pressed and dried. It is then redissolved in a small quantity of chloroform to a consistency of a thick paste and mixed with finely prepared pure phosphate of lime, or carbonate of zinc, in such proportions as to give a body to it, and having the appearance of slightly dampened meal, in which condition it is subjected to pressure in hot moulds to give coherence to it and expel any excess of chloroform from it. With a sufficient degree of pressure this can be done at once, and the compound, after coming from the mould, may then be put in the lathe or other mechanism to be worked and shaped into all manner of forms and devices.

It will be obvious that the articles thus formed would be white, but to make articles to imitate coral, pearl, enamel, woods of various kinds, and other substances, it is only necessary to mix any of the various coloured dry pigments with the compound at the same time of mixing the phosphate of lime with it.

No. 330. *Treating Fatty and Oily Bodies.* George Gwynne, Mortimer-street, Cavendish-square. Dated February 2, 1866.

In 1854 Richard Albert Tilgman obtained a patent for "A New Method of obtaining Free Fat Acids and Solution of Glycerine" from natural fats and oils by "the action of water at high temperature and pressure," and in 1856 George Tomlinson Bousfield obtained a patent for a like process, but at a lower temperature and pressure than those recommended by Mr. Tilgman. For obtaining "solution of glycerine," the water process, as the patentee calls the above, is a good one, but it is a failure as far as the manufacture of candles is concerned. The fat acids obtained by this process require to be distilled before good candles can be made from them, and when so treated the product is of such an inferior quality as to make the water process an unprofitable one in England. Various plans have been suggested for remedying the defect here alluded to. One party proposed to treat the fatty or oily matter, when at the temperature of 500° Fahrenheit, with one per cent. of concentrated sulphuric acid, and then to subject it to the water process. Another party proposed to mix a little sulphuric acid with the water, by the action of which the fatty matter was converted into fat acids and solution of glycerine; while a third party proposed to mix a little lime with the aforesaid water, instead of a little sulphuric acid; but none of these plans have turned out successful. The patentee has discovered that if the fat acids obtained by the water process are subjected to a further treatment by certain acids, the defect hereinbefore alluded to will be remedied. This invention therefore consists in treating the fat acids obtained by the water process with certain acids. The acid most advantageous to employ, not only on account of its cheapness, but for its strong chemical action, is sulphuric acid. Take the fat acids in question, and if they are not already of the temperature of 300° Fahrenheit, raise them to this temperature; then pour upon them in divided streams three pounds of concentrated sulphuric acid for each 112 pounds of fat acids; then leave them to repose until the dregs have settled to the bottom of the vessel in which the operation is performed; then draw off the fatty matter from the dregs and thoroughly wash it, and after washing distil it in an atmosphere of steam. Remove the dregs into another vessel, and after thoroughly washing them, distil them in a cast-iron still in an atmosphere of steam. A certain amount of benefit can be obtained by boiling for some hours the fat acids obtained by the water process with half their bulk of water to which some sulphuric or other suitable acid has been added.

No. 338. *Galvanic Batteries.* A. Horwood and C. Brumfit. Dated February 3, 1866.

This is an invention for generating electricity in a galvanic battery, and consists of an amalgam of zinc and mercury in addition to acids. The inventors have actually so limited a knowledge of the subject upon which they profess to be able to enlighten the world as to think that the very old and well-known expedient of melting zinc and mercury together, and then casting the amalgam into forms most convenient for the cells of the battery, is novel and patentable. If their knowledge of the literature of electricity is defective, their chemistry is still worse. For they first assume that during the action of the battery an oxide will arise through the acid in the cells; they next suppose that this oxide will form short circuits of electricity between each electric battery cell; and then imagine that this local action can be diminished by putting grease or oil on the surface of acid. This wonderful invention received provisional protection only; so our readers may avail themselves of the brilliant idea without fear of actions for infringement.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

2374. B. Bayliss, Pontnewydd, near Newport, Monmouthshire, "Improvements in the manufacture of iron."—September 15, 1866.

2380. P. Brash, Leith, and W. Young, Straiton, Midlothian, "Improvements in the manufacture of oil from shale and other bituminous substances."—September 10, 1866.

2413. C. W. Siemens, Great George Street, Westminster, "Improvements in smelting metallic ores, and in furnaces to be employed for that purpose."—Petition recorded September 20, 1866.

2443. J. R. Johnson, Red Lion Square, Middlesex, and F. Gale, Long Lane, Bermondsey, "Improvements in waterproofing leather, canvas, and other fabrics."—September 22, 1866.

2449. A. F. Stoddard, Glasgow, N.B., "A new or improved artificial coal or fuel."—September 24, 1866.

2473. J. Hamilton, Glasgow, N.B., "Improvements in the manufacture of fuel for heating purposes."—September 25, 1866.

2479. J. C. Sellars, Birkenhead, Cheshire, "A new and improved metalfounder's blacking, and mode of treating or preparing the same."—September 26, 1866.

Notices to Proceed.

1469. G. F. Göransson, Gefle, Sweden, "Improvements in blast furnaces and in the manufacture of iron therein."—Petition recorded May 25, 1866.

1737. S. Holmes, Lincoln's Inn Fields, Middlesex, "Improvements in the manufacture of printing ink."—June 29, 1866.

1537. A. Paraf, Manchester, "Improvements in dyeing, printing, and other operations based on chemical reactions."—A communication from M. Paraf-Javal, Thann, France.—Petition recorded June 2, 1866.

1559. W. Lawrence, Paddington, Middlesex, "Improvements in the manufacture of malt, and in apparatus for drying malt and hops."

1560. W. Lawrence, Paddington, Middlesex, "Improvements in the manufacture, and apparatus for the treatment, of worts."—June 6, 1866.

1626. L. A. de Milly, Paris, "A new process in the treatment of concrete fatty acids for the manufacture of candles called 'stearine candles.'"—June 15, 1866.

CORRESPONDENCE.

Composition of the Solar Spectrum.

To the Editor of the Chemical News.

Sir,—As your correspondent, in the Chemical News for the 28th September, seems to be familiar with the objections made by foreign philosophers, and in foreign journals, to my theory of the composition of the solar spectrum, it might have been expected that he would have searched in English works for a reply to these objections. Had he done so, he would have found—

1. That I replied to objections made by my distinguished friend the Astronomer Royal, in the *Philosophical Magazine*, 1845, vol. xxx., p. 153.
2. That I replied to objections made by Dr. Draper, of New York, in the same work, vol. xxx., p. 461.
3. That I replied to objections made by the late distinguished Italian philosopher, M. Melloni, in the same journal, vol. xxxii., p. 489; and
4. That I replied to the objections made by M. Helmholtz and M. Bernard in the first edition of my "Memoirs of the Life and Writings of Sir Isaac Newton," published in 1845, chap. v., pp. 119-125;* and in the second edition, published in 1860, chap v., pp. 103-110.

I am, &c. D. Brewster.

Allerly, Melrose, October 15.

MISCELLANEOUS.

A Fire Self-extinguished.—A fire broke out on Saturday in the cellar of a druggist named Christian, in the Avenue Montaigne, Paris, and was brought to a termination in a singular manner. A boy had let a lighted lucifer fall on some rags, which became ignited, and the flames spread to some bottles and carboys containing various kinds of spirits and alcohol; these bursting soon flooded the cellar with a blazing liquid which emitted a smoke so suffocating that the firemen were unable to enter. Suddenly a loud explosion was heard, and the flames became extinguished as if by enchantment. Three bottles of sulphuric ether, containing in all about three quarts, had burst, and the vapour mixing with the atmospheric air had put an end to the combustion.

Magnesium Rods for Toxicological Purposes.—We have been favoured by Mr. Mellor, manager of the Magnesium Metal Company, with some bars of absolutely pure magnesium, which have been prepared for the purpose of replacing zinc for the detection of arsenic and other poisonous metals. We have submitted them to experiment, and find that they perfectly answer the object in view. Tested in Marsh's apparatus, we have not met with the faintest indication of anything which could simulate the appearance presented by arsenic. Chemists who have been in the habit of working with even the purest zinc ordinarily obtainable will appreciate this new application of magnesium. For information on the employment of this metal in toxicology, see the papers by M. Z. Roussin at pages 27 and 42, and the paper by Mr. W. N. Hartley at page 73 of this volume.

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. XIII. 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., II., and VII. are out of print. All the others are kept in stock. Vol. XIV. commenced on July 6, and will be complete in 26 numbers.

General Index to the First Fourteen Volumes of the Chemical News.—We have had an inquiry for such an index. Its compilation will be attended with considerable trouble and expense; if, however, we find our readers generally wish for one, it shall be commenced as soon as the present volume is completed. Intending subscribers will please notify their wishes to the publisher without delay.

F. C. S.—We are unable to tell you what the initials F. E. S. mean.

A Tyro.—Consult Mr. Carter Bell's table of chemical elements, which will give you all the information you require.

J. W.—The information was given three weeks ago.

K. C. Y.—Your letter has been handed to the publisher, who will attend to the request.

W. S.—Messrs. Prentice and Co. supply gun-cotton of all densities and compression.

F. W. W.—The acid is probably trithionic acid, which has been observed by M. St. Pierre to be formed from bisulphite of potash by spontaneous reduction.

"*Carbollic Acid.*"—There is no foundation for the assertion. It is merely one of the numerous hallucinations of a person who attained an unenviable notoriety in the chemical world some time ago.

George F.—Professor Wurtz's articles will be concluded in two or three numbers. They will immediately be published in a separate volume.

Alpha.—*Appearances of Good and Diseased Meat.*—See page 48 of our last volume, where you will find some very simple and excellent directions written by Dr. Letheby.

Iodine.—Will our correspondent favour us with further particulars on the subject spoken of in his letter? It is likely to be of commercial importance.

F. S. Johnstone.—The best work for your purpose on the testing and purification of water is "Air and Water; their Impurities and Purification;" written by Mr. Condy, whose name has become so well identified with sanitary matters in connexion with his very excellent disinfecting fluids.

W. wishes to know whether he can find in any English work a full account of the properties and methods of distinguishing by means of the microscope the various ferments found in beer, and whether it is known under what conditions one species can be transformed into another.

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* In the passage here referred to, p. 124, line 18, for *influential* read *uninfluential*, and in line 22 for *on* read *in*.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

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

Part III.

Connexion between Organic and Inorganic Chemistry.

Section V.—*Inorganic and Organic Nitrides.*

It remains for us, lastly, to pursue the analogies which may exist between the nitrides of inorganic chemistry and those of organic chemistry. Since the discovery of the compound ammonias has shown the evident relations that exist between the organic bases and ammonia, and has, so to say, formed the ammonia type, chemists have sought to connect the metallic nitrides with this type. On this point we will remind the reader of the ingenious views advocated by M. Weltzein* and by M. H. Schiff.†

The compounds in which metals are partially or wholly substituted for the hydrogen in ammonia have been called *metallic amines.*‡

As the metals differ from each other in their equivalence, or, in other words, as their atoms possess a different value of substitution, it is evident that they cannot be substituted in the same way for the hydrogen of ammonia. The monatomic metals—potassium, sodium, silver, &c.—may replace one atom of hydrogen in ammonia; the results are monamines.

Thus the compounds known by the name of amidides of potassium and of sodium may be compared to ethylamine; nitride of potassium, and perhaps fulminating silver, may be compared to triethylamine.

$$\left.\begin{matrix}K\\H\\H\end{matrix}\right\}N \qquad \left.\begin{matrix}Na\\H\\H\end{matrix}\right\}N \qquad \left.\begin{matrix}\text{Ꞓ}_2H_5\\H\\H\end{matrix}\right\}N$$

Amidide of potassium. Amidide of sodium. Ethylamine.

$$\left.\begin{matrix}K\\K\\K\end{matrix}\right\}N \qquad \left.\begin{matrix}Ag\\Ag\\Ag\end{matrix}\right\}N(?) \qquad \left.\begin{matrix}\text{Ꞓ}_2H_5\\\text{Ꞓ}_2H_5\\\text{Ꞓ}_2H_5\end{matrix}\right\}N$$

Nitride of potassium. Fulminating silver. Triethylamine.

The diatomic metals—copper, cobalt, mercury, &c.—can replace two atoms of hydrogen. We have compared them to ethylene, and there exist a certain number of metallic amines which may be compared to the ethylenic bases so well studied by Dr. Hofmann.

We know ammoniacal combinations of cobalt, copper, mercury, and platinum in which these metals replace 2 atoms of hydrogen in 2 molecules of ammonium, as ethylene is substituted for 2 atoms of hydrogen in 2 molecules of ammonium.

$$\left.\begin{matrix}\text{Ꞓo}''\\H_2\\H_2\\H_2\end{matrix}\right\}N_2 \quad \left.\begin{matrix}\text{Ꞓu}''\\H_2\\H_2\\H_2\end{matrix}\right\}N_2 \quad \left.\begin{matrix}[\text{Ꞓu}_2]''\\H_2\\H_2\\H_2\end{matrix}\right\}N_2 \quad \left.\begin{matrix}\text{Ᵽt}''\\H_2\\H_2\\H_2\end{matrix}\right\}N_2 \quad \left.\begin{matrix}(\text{Ꞓ}_2H_4)''\\H_2\\H_2\\H_2\end{matrix}\right\}N_2$$

Cobaltosonium. Cupriconium. Cuprosonium. Platosonium. Ethylene-ammonium.

Thus, to take some examples, acetate of cupriconium (ammoniacal acetate of copper), which crystallises in oblique rhomboidal prisms, contains:—

$$\left.\begin{matrix}\text{Ꞓu}''\\H_2\\H_2\\H_2\end{matrix}\right\}N_2.2(\text{Ꞓ}_2H_3\text{Ɵ}.\text{Ɵ})'.$$

The green salt of Magnus (ammoniacal protochloride of platinum) is the dichloride of platosonium,

$$\left.\begin{matrix}\text{Ᵽt}''\\H_2\\H_2\\H_2\end{matrix}\right\}N_2.Cl_2.$$

We must observe that it is produced by the fixation of 2 molecules of ammonia upon 1 molecule of protochloride of platinum,

$$\text{Ᵽt}''Cl_2,$$

as bromide of ethylene-ammonium,

$$\left.\begin{matrix}(\text{Ꞓ}_2H_4)''\\H_2\\H_2\\H_2\end{matrix}\right\}N_2,Br_2,$$

is formed by the fixation of 2 molecules of ammonia upon 1 molecule of bromide of ethylene $(\text{Ꞓ}_2H_4)''Br_2$.

The white precipitate which is formed when an aqueous solution of corrosive sublimate is treated with ammonia, and which is known by the name of chloramidide of mercury, is a dichloride of dimercurammonium:—

$$\left.\begin{matrix}Hg''\\Hg''\\H_2\\H_2\end{matrix}\right\}N_2.Cl_2,$$

analogous to the dibromide of diethylene-ammonium,

$$\left.\begin{matrix}(\text{Ꞓ}_2H_4)''\\(\text{Ꞓ}_2H_4)''\\H_2\\H_2\end{matrix}\right\}N_2.Br_2.$$

All these ammonio-metallic compounds are formed by the fixation of the elements of ammonia upon chlorides, bromides, &c., or upon metallic salts. But it often happens that an excess of ammonia is retained in these circumstances. Thus, when ammonia is made to act upon cuprous iodide, $[\text{Ꞓu}_2]''I_2$, there are 4 molecules of ammonia, $4NH_3$, retained, and not 2 only, as is the case with protochloride of platinum, for example. We thus obtain a well-defined compound crystallised in large prisms, and to which the analyses of M. Rammelsberg assign the composition $\text{Ꞓu}_2I_2,4NH_3$.

We may look upon this compound, and upon its numerous congeners, as containing an ammonium in the molecule of which a certain quantity of hydrogen has been replaced by an equivalent quantity of the ammonium radical $NH_4 = Am$. In this hypothesis, first suggested by M. Hofmann, and adopted by MM. Weltzien, Hugo Schiff, and other chemists, the iodide in question appears as the diiodide of a diamicuprosonium—that is to say, of the cuprosonium (page 193), in which 2 atoms of hydrogen have been replaced by $2NH_4 = Am_2$.

$$\left.\begin{matrix}[\text{Ꞓu}_2]''\\H_2\\H_2\\H_2\end{matrix}\right\}N \qquad \left.\begin{matrix}[\text{Ꞓu}_2]''\\(NH_4)_2\\H_2\\H_2\end{matrix}\right\}N_2.I_2 \text{ or } \left.\begin{matrix}[\text{Ꞓu}_2]''\\Am_2\\H_2\\H_2\end{matrix}\right\}N_2.I_2.$$

Cuprosonium. Iodide of diamicuprosonium.

Similar remarks apply to the other ammoniacal combinations of copper, cobalt, and platinum. According to the analysis of Berzelius, the composition of ammoniacal sulphate of copper is expressed, in equivalents, by the formula—

$$CuO,SO_3,2NH_3,HO.$$

This body may be regarded as a sulphate of diamicupriconium—

$$\left.\begin{matrix}\text{Ꞓu}''\\Am_2\\H_2\\H_2\end{matrix}\right\}N_2.S\text{Ɵ}_4+aq.$$

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[*] *Annalen der Chemie und Pharmacie*, vol. xcvii., p. 19.

[†] *Ibid.*, vol. cxxiii., p. 1.

[‡] Or metallic ammoniums, if the substitution is considered as taking place in ammonium.

Similarly, Henry Rose has analysed a combination of ammoniacal chloride of cobalt, which forms the chloride of diamicobaltosonium—

$$\left.\begin{array}{c}Co''\\ Am.\\ H_2\\ H_2\end{array}\right\}N_2.Cl_2.$$

(To be continued.)

Note on Fractional Distillations, by HENRY SEWARD.

In distilling fractionally a liquid containing several substances of different boiling points, it is noticed that the thermometer remains stationary for a considerable time at certain temperatures, and in the distillate collected within a few degrees round one of these fixed points, chemists naturally look for definite chemical compounds; and if, after tedious labour in a field previously little worked upon, an investigator obtain something of a uniform specific gravity, definite chemical composition, and tolerably constant boiling point (there being no known substance boiling at that temperature), it is natural for him to assume the discovery of a new compound.

It does not appear to be generally known that some mechanical mixtures, upon distillation, yield substances of tolerably fixed boiling points. For instance, a mixture of carbolic and cresylic acid, upon distillation, yields oils boiling pretty constantly at intermediate temperatures, the bulk of which may be collected at the same temperature upon re-distillation. The boiling point of carbolic acid being 184° C., and that of cresylic acid being 203° C., the thermometer appears to indicate that the distillate consists of three bodies, having respectively the boiling points of $(184 \times 2 + 203) \div 3 = 190{\cdot}3^\circ$, $(184 + 203) \div 2 = 193{\cdot}5^\circ$, and $(184 + 203 \times 2) + 3 = 196{\cdot}6^\circ$; the greater part consisting of an oil boiling at 193·5°, and having a specific gravity of 1056·3. Upon fractionating by re-distillation several times, those oils obtained at 190·3° and 196·6° easily split up, but the one at 193·5° appears tolerably constant, and at each distillation only yields a little liquid above and below that point. It was only after nearly fifty distillations that I could break it up into its components, carbolic and cresylic acid, and even then the separation was not complete. The cresylic acid obtained had the specific gravity 1034·1.

Now, as I was working upon a liquid the composition of which was pretty well known, the circumstance here mentioned occasioned no further inconvenience than a somewhat considerable expenditure of time; but had I been working upon a mixture whose composition I could not have suspected, the probability is that the result of my labours would have been the supposed discovery of a new tar acid, of the composition $(\rlap{-}C_6H_6\Theta + \Theta_7H_8\Theta) = \rlap{-}C_{13}H_{14}\Theta_2$, having the specific gravity 1056·3, and boiling at 193·5°, but decomposing somewhat on distillation.

Several liquids derived from coal tar, paraffin oil, or petroleum, have been described as having an almost fixed point of distillation, but decomposing slightly during the operation. It is not unlikely that future research will show that some of these are definite, although mechanical, mixtures of analogous liquids.

Fire-proof Gloves.—At a recent meeting of the Polytechnic Institute a glove of Hungarian make was exhibited. It is of asbestos, which the maker professed is adapted to enable an assayer to hold a heated crucible, but which the exhibitor had not tested. The cost was $20 per pair.—*American Journal of Mining.*

TECHNICAL CHEMISTRY.

The Smoke Question, by Dr.* F. C. CALVERT, *F.R.S.*

The action of the products of the distillation of coal upon vegetation varies a great deal according to the circumstances under which they have been produced; thus, the products of the perfect combustion of coals may be represented by carbonic acid, and water with small quantities of nitrogen and sulphuric acid, all of which are invisible gases having no action on vegetation except sulphurous acid. But if coals are introduced into a gas retort, and heat be applied, the products given off are numerous, chemists having already isolated and characterised more than thirty distinct substances, many of which are most destructive to both animal and vegetable life, being highly poisonous when administered in even minute quantities; therefore, the products obtainable from coals vary enormously according to the circumstances under which they are produced. The above statement will enable us better to understand what is commonly called "smoke," and the reasons why it varies so considerably in composition. Thus the smoke issuing from the chimneys of private dwellings may be considered on the whole as belonging to the class where perfect combustion occurs, for the gases, as they emerge from the chimney, carry with them only carbonic acid, carbonic oxide, and sulphurous acid, and a small quantity of the most volatile hydrocarbons which are given off, but this only takes place at the time and shortly after the coals are freshly added to the fire, the less volatile products being condensed in the flue of the chimney, forming what is called soot; but as soon as the volatile products (which are characterised by burning with flame when coals are put on the fire at first) are consumed, the carbonaceous mass which remains in the fireplace may be considered as undergoing perfect combustion, and emitting, as above stated, only gases, having little or no action on vegetation or man, more especially when they become diffused in the atmosphere. But the results of burning coals under the steam boilers employed in our large factories are very different.

1st. Because coals are constantly being added to the mass in combustion. There is not, consequently, that cessation of the distillation of tarry products above stated, as taking place in the fireplace of private dwellings, and it follows that the products of perfect combustion, which are generated near the grates of the fireplaces in factory furnaces, are constantly mixed with a considerable quantity of tarry substances produced by the distillation of the coals, and therefore through their imperfect combustion.

2nd. As stated above, in the chimneys of our dwellings the draught is such as to permit many of the imperfect products of combustion or most of the tarry products to condense, whilst in the tall chimneys erected in our factories the draught is such as to carry out from them the above noxious volatile products, and as many of them will easily condense into liquids and solids when they come into contact with a cold atmosphere, they cannot diffuse nor be carried far before they fall upon plants and other bodies existing in the neighbourhood of such chimneys, and as many of the tarry products are highly poisonous to plants, they affect vegetation in a very marked manner.

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* Read before the Social Science Congress, Manchester meeting, on the occasion of the discussion—"How far are smoke and the products of combustion arising from various manufacturing processes injurious to health?" "What measures ought to be taken to prevent the contamination of the atmosphere from such causes?"

3rd. "Black smoke" is a mixture of the products of the imperfect combustion of coal with carbon in a high state of division; the solid particles of carbon when floating in the atmosphere become, like all solids, centres of attraction for fluids, and thereby assist in the condensation of the liquid and poisonous products above mentioned, and help to carry and fix them on the surrounding vegetation, which is characterised by a deposit of such products upon the surface of the leaves and bark of plants, and which prevents that free contact with the elements of the atmosphere which is so essential to their health and growth; for, as you are aware, plants absorb carbonic acid from the atmosphere from which their carbon is derived, and they reject oxygen and watery vapour. Further, the intensity of these actions is in exact ratio with the intensity of light, and when "black smoke" is produced in large quantities it interferes with the rays of light arriving on the surface of the earth, and thereby affects vegetation materially. It appears to me that the above facts give an explanation of the activity of vegetation observed in London as compared with that witnessed in Manchester, Leeds, Sheffield, Birmingham, &c. I am well aware that the vegetation in these towns may be slightly affected by the large proportion of sulphurous acid which the smoke issuing from the factory chimneys contains as compared with the quantity of sulphurous acid produced by the consumption of a better class of coal in London; but sulphurous acid, like all gases, has such a high diffusive power, and the mass of air with which it mingles is so considerable, owing to the high temperature at which it leaves the top of the high chimneys, that, although it may somewhat affect vegetation, still I consider its action is comparatively small in proportion to the injury effected by the fixation of "black smoke" upon plants, &c., as described above. As to the comfort which the inhabitants of our large manufacturing towns would derive from the perfect combustion of the fuel in our large mills, works, &c., no one can venture to say, at all events, as a matter of health and comfort, an opinion can be formed by comparing the state of the atmosphere in large towns like Manchester on the Sabbath as compared with that which is witnessed on the other days of the week. It is hardly necessary to add that it is on record in evidence before a committee of the House of Commons that manufacturers can effect a saving of 15 or 20 per cent. by burning their smoke, and it is most painful to reflect that after such weighty evidence which has been adduced by many of the leading manufacturers of Manchester, such as Messrs. Bazley, J. Whitworth, Henry Houldsworth, &c., before a committee of the House of Commons some twenty years ago, we should still live in such a noisome, unsightly, and unwholesome atmosphere as we in this city experience; and lastly, to witness how Acts of Parliament are put on one side, when they are to be carried and enforced by local authorities who are in such cases the offenders and at the same time the authorities called upon to inflict fines and punishment.

A Mountain of Salt.—Washington correspondence alludes to specimens of salt sent to the Postmaster-General from the district of Pahranagat, in the State of Nevada, which are said to have been taken from "a mountain of pure salt, several layers in extent and several thousand feet in height." Through salt blocks of a foot square a newspaper can be read, they are so transparent. This salt deposit must prove of great value to the district, as it is largely used, in many processes, for the treating of silver ore.—*American Journal of Mining.*

NOTICES OF BOOKS.

Zeitschrift für Chemie. No. 17.

The following are the titles of all the articles in this number, with the exception of such as are quoted from other journals and have already been noticed:—

"*On the Action of Nitrate of Potash on Salts of Triethylamine,*" by A. Geuther.

"*On the Formation of Prussic Acid from Methylamine,*" by Bernhard Tollens.

"*On Formic Allyl Ether,*" by Bernhard Tollens.

"*Preliminary Communication on the Products of the Oxidation of Mesitylene,*" by R. Fitig.

"*Remarks on Poisoning by Charcoal Fumes,*" by A. Fröhde.

"*Specific Gravities of Solutions of some Vitriols (Metallic Sulphates),*" by Dr. Gerlach.

"*On Cements,*" by T. Schwartze.

"*On the Application of Hyposulphite of Soda to Qualitative and Quantitative Analysis and in the Preparation of Chemicals,*" by A. Fröhde.

"*On Palicourea Marcgravii St. Hil. (Ratsbane),*" by Dr. T. Peckolt.

"*On the Formation of Hyoscyamine,*" by Professor Dr. Ludwig.

"*On a Sulphate of Cobalt with Four Atoms of Water,*" by A. Fröhde.

The remainder of the number is filled with the introduction to Professor Stas's new memoir on the atomic weights.

Chemisches Central Blatt. Nos. 43, 44, 45, 46.

Nos. 44 and 45 contain an article

"*On the Gases which are evolved by the Destructive Distillation of Bodies,*" by Dr. E. Blumtritt.

No. 46 contains a short extract

"*On neutralising Acidity in Photographic Silver Baths,*" by Dr. Vogel.

With these exceptions the whole of these numbers are filled with articles which have already been noticed in our pages.

Journal für praktische Chemie. No. 14.

The articles in this journal are as follows:—

"*An Analysis of the Drinking Waters of Driburg, the Horster Mineral Wells, and the Sulphurous Mud Baths,*" by Dr. R. Fresenius.

"*On the Preparation of Oxygen,*" by Dr. C. Winkler.

"*On the Purification of Graphite,*" by the same author.

"*On the Preparation of Indium,*" by the same author.

"*On the Addition of Hydrogen to Acrolein.*"

"*On some Derivatives of Indigo Blue.*"

"*On Resorcine,*" by G. Malin.

"*On the Reaction of Zinc Ethyl on Sulphide of Carbon,*" by A. Graf-Grabowski.

"*Researches on Sulphate of Cobaltipentamine,*" by C. D. Braun.

"*On the Occurrence of Quercetine in Calluna vulgaris Salisb.,*" by Dr. F. Rochleder.

"*On the Equivalents of Cobalt and Nickel,*" by Dr. Sommeruga.

"*On New Constituents of Wine,*" by Professor Brucke.

"*On the Occurrence of Lactic and Acetic Acids in Beer,*" by Dr. Vogel.

Chemical Society.—The first meeting of the Session will take place on Thursday evening next at 8 o'clock, when the following papers will be read:—Dr. Sprengel: "Specific Gravities of Heterogeneous Liquids." Messrs. Chapman and Thorp: "Gradual Oxidation of Organic Bodies."

REPORT ON THE

CHEMICAL LABORATORIES

IN COURSE OF ERECTION IN THE

UNIVERSITIES OF BONN AND BERLIN.

Preliminary Remarks.

Of the six Prussian Universities,* two, and those the most important ones, the Universities of Bonn and Berlin, had hitherto remained without chemical institutions in keeping with the advancement of science, and corresponding to the demands of the present day. In Breslau, Königsberg, Greifswald, and still more lately in Halle, laboratories have been built on a scale fully meeting the requirements of those universities. A long time since, the Prussian Government had decided to provide in like manner for Bonn and Berlin, but a singular combination of circumstances had hitherto always frustrated these efforts, and it was reserved for his Excellency Dr. von Mühler, the present Minister of Public Instruction, to supply the long-felt want in a manner unprecedented in the history of chemical education. To the liberal spirit in which the leading officers of the Ministry of Public Instruction, more especially Dr. Lehnert, the Under-Secretary of State, and Messrs. Knerk and Olshausen, members of the Council, have seconded the intentions of their chief, the Universities of Bonn and Berlin will shortly be indebted for the establishment of chemical laboratories which, as regards extent and completeness, may be placed side by side with the best appointed scientific institutions of the world.

The difficulties that stood in the way of the realisation of these great undertakings were not a few. The procuring the very considerable grant that was necessary, the choosing and securing of the sites, the drawing out of plans, and submission of them to the different committees of inspection which superintend the construction of public buildings in Prussia, and lastly, the solution of certain intricate questions which arose from the joint participation of the University and the Academy of Sciences in the Berlin Institution, were some of the preliminary conditions which required adjustment before the erection of the contemplated buildings could be proceeded with. That these difficulties have all been speedily and entirely cleared away, that the chemical institution in Bonn is now fast approaching completion, and that the walls of the new edifice in Berlin are rapidly rising, are results entirely due to Mr. Knerk, whose energy, experience, and devotion (well known in all the Prussian Universities) have never failed to these great undertakings.

The Reporter does not, he believes, deceive himself in assigning to the foundation of the two great chemical institutions now being carried out under the auspices of the Prussian Ministry of Public Instruction a significance far beyond the more immediate impetus they are sure to give to the prosecution of chemical studies in the universities to which they belong. By the grant of means unusually large for the organisation of these new schools, a tribute of recognition has been paid to the influence of chemistry on the modern aspect of the world that cannot remain without effect upon other departments of physical science which have not been less productive of useful results.

Side by side with the two new chemical schools now springing into existence, other institutions are sure to be founded, similar in nature and appointed with the same liberality, for the prosecution of the two other great branches of natural science, physics and physiology, to which, as well as to chemistry, the future belongs.

This subject is already being freely agitated in the Prussian Universities, especially those of Bonn and Berlin. The leaders in the several branches of natural science are persuaded that the great efforts which at the present moment are being made for chemistry will, sooner or later, benefit their own departments. It is not, however, in Prussia, or in Germany alone, that the wholesome influence of this example appears to be felt. The exertions of the Prussian Ministry of Public Instruction in the cause of chemical science have attracted the attention even of foreign governments. Inquiries respecting the new institutions have already been made by several other countries, more especially by England and France, and it is not unlikely that the noble precedent set by Prussia will soon be followed by the establishment of similar schools elsewhere. It is in this sense, at all events, that the writer ventures to interpret the desire expressed by her Majesty's Government to obtain information on the subject of the two institutions in process of organisation in the Universities of Bonn and Berlin, which, at the request of the Prussian Minister, he has endeavoured to supply by drawing up the following statement. He would, indeed, consider himself fortunate if this Report, which, from the nature of the case, cannot be more than an outline, should assist in augmenting the interest already felt for the establishment of a great chemical institution in the metropolis of the world, an institution which England can no longer dispense with, since no country is more deeply interested than she in the rapid diffusion of the latest results of chemical inquiry.

It will materially facilitate the treatment of the subject to consider the two institutions apart from one another. The Reporter proposes, in the first place, to give an account of the laboratories of the University of Bonn, which were earlier conceived and earlier begun, and are, consequently, in a far more advanced stage than those of the University of Berlin.

The Chemical Laboratories of the Rhenish Frederick William University of Bonn.

The first negotiations respecting the building of a new laboratory in Bonn go back as far as 1861. In the summer of that year the Reporter was invited by his friends, Professors Plücker and Sell, to an interview with Mr. Beseler, the Curator of the University of Bonn. Fully appreciating the importance of a large chemical school for the development of the university committed to his charge, and of the rapidly advancing industry of the Rhenish provinces, Mr. Beseler had even then conceived the idea of founding the new institution, to which he has since devoted all the powers of his energetic nature. In fact, Bonn, from its very position, seemed intended for the site of a great central chemical establishment, no other German University being able to enter the lists with her in this respect.

Situated on the high road of Europe, on the banks of the mighty Rhine, surrounded by some of the most charming scenery of the world, distant but a few hours from the Belgian frontier, and scarcely farther removed from France, within reach of England by a short day's journey, in the midst of large agricultural, wine-growing, and mining populations, in close proximity with the great manufacturing districts of Rhineland and Westphalia (whose fast-increasing industry has earned for them the name of the German Lancashire), united with the focus of this large industrial territory by a network of railways whose meshes are augmenting daily, already the seat of one of the most flourishing universities in Germany—the city of Bonn embodied a number of conditions which could not fail to secure the rapid success of a large chemical institution established within its walls.

But little time elapsed before the first steps for the

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* The Report was written before the "Seven Days' War." With the newly-acquired territories, Prussia has gained three additional Universities—viz., Kiel, the University of the Elbe Duchies; Gottingen, that of the former Kingdom of Hanover; and Marburg, the University of the former Electorate of Hesse-Cassel.

August 10, 1866. A. W. H.

foundation of the new chemical school were taken. The negotiations already pending between the Minister of Public Instruction and the Curator of the University were soon concluded, and in the beginning of 1862 Mr. Beseler was commissioned by the Minister to inquire of the Reporter whether he would undertake the organisation and direction of a chemical laboratory to be established in the University of Bonn, on a magnificent scale, and liberally provided with all the requirements for modern investigation. The question thus opened led to a series of negotiations which ended, in the spring of 1863, in the Reporter complying with this honourable proposal.

The important duty of drawing out the plans of the new institution devolved on Mr. Augustus Dieckhoff, architect to the University. This was not an easy problem. The programme of an institution for the purposes of chemical education embraces a variety of conditions such as are seldom presented to an architect, and of which the artistic realisation is impossible without unlimited zeal. This difficult task could not have fallen into better hands. The felicity with which Mr. Dieckhoff has solved the problem, the thorough knowledge and perfect understanding of the various objects claimed in the programme, and the great care bestowed upon their attainment, must be evident to every one who examines with attention the drawings (unfortunately only small and imperfect sketches) which accompany this report.

In preparing the programme, the composition of which fell to the lot of the Reporter, it appeared all-important to gather information as exact as possible respecting the chemical institutions already in existence, either by examination of the plans or, better still, by personal inspection of the buildings themselves, and consultation with their several directors.

The Reporter was fortunate enough to obtain drawings and plans of nearly every existing laboratory, and he avails himself of this opportunity of expressing his hearty thanks to all those who have kindly assisted him in their collection. The chief experience, however, was gathered during a journey of several months through Germany, which, in company with the architect, he undertook in the autumn of 1863. On this occasion nearly all the German laboratories were studied, from that of Giessen,[†] the first German university laboratory, erected by the father of the Reporter more than a quarter of a century ago for Liebig, down to the more recently founded chemical schools of Karlsruhe,[‡] Munich,[§] Zurich, Heidelberg,[||] and Gottingen, and the splendid institution just completed in the University of Greifswald.[¶]

The fruit of this expedition was the development of a goodly series of designs, following each other in rapid succession. After many animated discussions, an elaborate plan, embodying the experience thus gathered from all quarters, was at last fixed upon, to which, in the beginning of the winter of the same year, all those more especially concerned had given their adhesion. This plan, the detailed contract for which amounted to 123,000 thalers (18,450*l.*), passed, with scarcely an alteration, the several stages of supervision, and was ultimately sanctioned by Government.

The first turf was turned late in the autumn of 1864; the spring of 1865 saw the foundation-stone laid; and the building, the construction of which was entrusted to an able young architect, Mr. Jacob Neumann, who had already most efficiently assisted in preparing the plans, is at present being roofed in, so that in the summer of 1867 it may be handed over to the University.

Of the several institutions of the Rhenish University, part only is situated in the former Electoral Castle at Bonn, granted to the University at its foundation in the year 1818; others, for instance, the natural history collections, the magnificent and world-renowned astronomical observatory, the chemical laboratory used up to the present time, the botanic gardens, the agricultural academy, formerly affiliated to the University, but now an independent college, are placed in the village of Poppelsdorf, about fifteen minutes' walk from the city of Bonn, but connected with it by one of the finest chestnut avenues in Germany. Some of the institutions last mentioned are lodged in the castle at Poppelsdorf, formerly the summer residence of the Elector; and it is in close proximity to this castle that a tract of land, the freehold property of the University, was chosen for the site of the new laboratory. A glance at the plan of situation (Fig. 1, page 198) and the synopsis accompanying it, shows the position of the building, with the adjoining castle, the avenues to the town, and the several University buildings more or less distant. A more favourable situation could scarcely have been found.

The land allotted by the University is of very considerable extent. The spacious building, covering with its four enclosed courts[**] an area of 45,000 square feet,[††] is surrounded by a handsome garden, which at the back extends to some depth, leaving ample room for the erection of any outbuildings that may be required at some later time. Thus, unfettered by narrowness of space, or the prospect of having air or light shut out by the close proximity of other buildings, the architect was enabled to lay out the plan of the edifice with a degree of freedom that has materially promoted the beauty and harmony of his work. Even the soil of the site proved to be of a perfectly unexceptionable character, so that the foundations were laid without any difficulty.

The slight distance from the city of Bonn might have appeared at first sight a disadvantage. Since, however, the natural-science institutions of the University, as has been already pointed out, are, almost without exception, concentrated at Poppelsdorf, it was of material consequence to the students that the chemical laboratory should also be in that neighbourhood. Moreover, the institution was thus removed from the immediate proximity of the rapidly growing town—a circumstance which doubtless will not give less satisfaction to the occupiers of numerous suburban villas, than to the chemists whose lot it will be to work in the new laboratory. Nor is it possible, in enumerating the advantages of the site chosen for the institution, not to bestow a passing notice on the magnificent scenery surrounding this lovely spot on every side. Nothing equals the view from the upper windows of the house—on one side, the chestnut avenues and the city of Bonn with the lofty spire of its cathedral; on the other side, the castle with the adjacent botanic gardens; in the distance, the Kreuzberg with its chapel; and farther still, on the opposite bank of the Rhine, the graceful outlines of the Siebengebirge.

[†] An excellent description of the Giessen Laboratory, accompanied by an atlas of fine drawings, was published soon after the completion of the building. It is entitled: "Das chemische Laboratorium der Ludwigs-Universität Giessen, dargestellt von J. P. Hofmann. Mit einem Vorwort von Justus Liebig. Heidelberg, 1842."

[‡] Full information respecting this laboratory is supplied by a pamphlet: "Das chemische Laboratorium an der grossherzoglichen polytechnischen Schule zu Karlsruhe. Herausgegeben von Dr. C. Weltzien und H. Lang. Karlsruhe, 1853."

[§] A detailed description of the Munich Laboratory is published under the title: "Das chemische Laboratorium der Königlichen Akademie der Wissenschaften in München. Unter Mitwirkung von Justus von Liebig, erbaut von A. von Voit. Braunschweig, 1859."

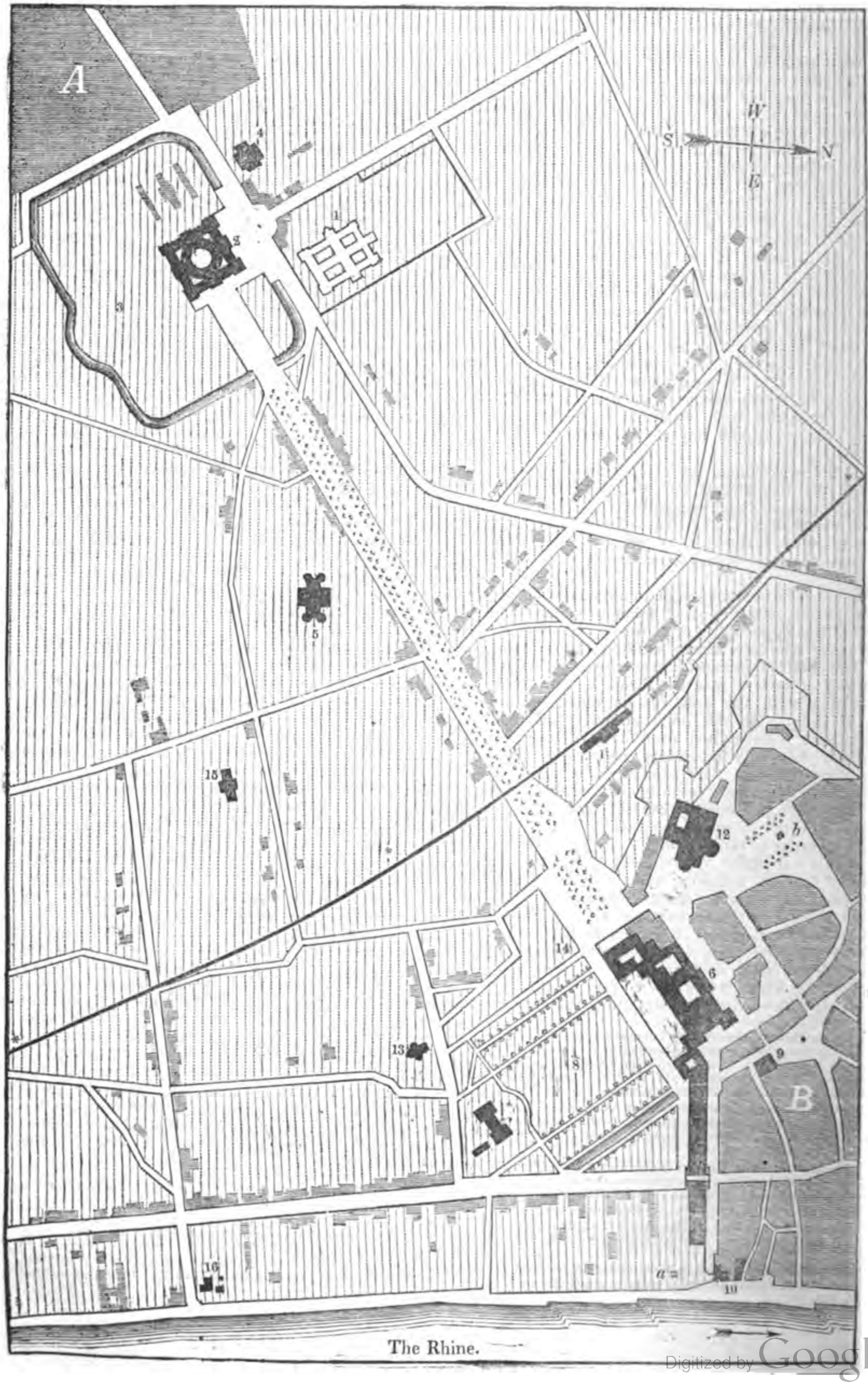
[||] Described in a separate pamphlet: "Das chemische Laboratorium an der Universität zu Heidelberg. Herausgegeben von H. Lang. Karlsruhe, 1858."

[¶] Comp. "Das chemische Laboratorium der Universität Greifswald, von G. Müller;" in "Zeitschrift für Bauwesen redigirt von G. Erbkam," Jahrgang xiv., S. 330.

[**] These four courts have suggested to a witty member of the University the name of *Chemical Escurial* for the building.

[††] All the measures employed in this Report are Rhenish, at present the legal Prussian measure, but which will shortly, it can no longer be doubted, give place to the French mètre. It appeared useless to convert the Rhenish measure into English, the difference between the two being so very trifling. A Rhenish foot of 12 inches is equal to 1·022 English foot.

FIG. 1.—PLAN OF SITUATION OF THE NEW LABORATORIES OF THE UNIVERSITY OF BONN.



SYNOPSIS.

(A.) *Poppelsdorf.*
(B.) *Bonn.*
1. New Chemical Laboratories.
2. Poppelsdorf Castle.
3. Botanic Gardens.
4. Agricultural Academy.
5. Observatory.
6. University.
7. Anatomical School.
8. Garden of the University (*Hofgarten*).
9. Townhall.
10. General Office of Mines.
11. Railway Station.
12. Cathedral.
13. Jesuit Church.
14. Site for the new Protestant Church.
15. Frederick William Hospital.
16. Arndt's Residence.
a. Statue of Arndt.
b. Statue of Beethoven.
** Railway from Coblence to Cologne.

As yet only one public road leads to the south-east side of the building, turning off to the castle. The further development of building enterprise in the neighbourhood of Bonn will, however, doubtless before long provide a second street, returning to the town on the north-east side of the ground.

The new chemical institution is provisionally intended for sixty students; the space, however, has been meted out so liberally that accommodation could be supplied without inconvenience to a much greater number; besides this, the building has been so constructed as to allow of enlargement at any future time by raising a second story, without detracting from the harmony of its structure, either as regards outward appearance or internal arrangement.

In addition to the various apartments required for educational purposes, for practical analysis, for scientific and technical investigations, and, lastly, for the lectures, there are in the new building sets of rooms for the castellan of the institution, for the *famulus* and servants, apartments for three assistants, and also a magnificent residence for the director, consisting of a suite of rooms, which, as regards number and size, could be very seldom met with in a private house. Lastly, there is a considerable number of well-lighted basement rooms, which have as yet no special use assigned to them, but the construction of which, on account of the greater depth of the foundations on the street side, could not be avoided. On any subsequent enlargement of the institution, however, these rooms could not fail to be adapted to some useful purpose.

The various departments of the building are spread over three floors – the basement, the ground floor, and the first floor. The first floor, however, extends over but a small portion of the structure, and is exclusively occupied by the private apartments of the director. But few of the rooms devoted to the purposes of the institution are found in the basement—as, for instance, the store-rooms, the rooms for metallurgical and other operations requiring large quantities of fuel, those for medico-legal and chemico-physiological research, &c. All the remaining space intended for educational purposes—viz., the laboratories, with their adjoining rooms for special operations, and side-rooms, balance-rooms, rooms for volumetric analysis, combustion-rooms, lecture-theatres, the museums of specimens, the study and private laboratory of the director, the apartments of the assistants and other officers of the institution—are, one and all, on the ground floor—an advantage which could not have been obtained had the site of the building been of more limited dimensions.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

BRITISH ASSOCIATION, NOTTINGHAM MEETING.

Friday, August 24.

A Lecture "On the Results of Spectrum Analysis, as applied to the Heavenly Bodies," by William Huggins, *F.R.S.*

(*Continued from page 188.*)

COLOURS OF THE STARS.

When the air is clear, especially in Southern climes, the twinkling stars do not all resemble diamonds, here and there may be seen in beauteous contrast richly coloured gems.

The colour of the light of the stars which are bright to the naked eye is always some tint of red, orange, or yellow. When, however, a telescope is employed, in close companionship with many of these ruddy and orange stars, other fainter stars become visible, the colour of which may be blue, or green, or purple.

Now it appeared to us to be probable that the origin of these differences of colour among the stars might be indicated by their spectra.

Since we had found that the source of the light of the stars was incandescent solid or liquid matter, it appeared to be very probable that at the time of its emission the light of all the stars was white alike. The colours observed amongst them must then be caused by some modification suffered by the light after its emission.

Again, it was obvious that if the dark lines of absorption were more numerous, or stronger, in some parts of the spectrum, then those colours would be subdued in power, relatively to the colour in which few lines only occur. These latter colours remaining strong would predominate, and give to the light, originally white, their own tints.

These suppositions have been confirmed by observation.

Mr. Ladd will throw upon the screen the spectrum of Sirius, which may be taken as an illustration of the stars, the light of which is white.

As might be expected, the spectra of these stars are remarkable for their freedom from strong groups of absorption-lines. The dark lines, though present in great number, are all, with one exception, very thin and faint, and too feeble to modify the original whiteness of the light. The one exception consists of three very strong single lines; one line corresponding to Fraünhofer's C, one to F, and the other near G. Two of these certainly indicate the presence of hydrogen. This peculiarity, which seems invariably connected with colourless stars, is very suggestive, and invites speculation. May it be a sign of a temperature of extreme fierceness?

Let us now examine the spectrum of an orange star.

This diagram represents the spectrum of the brighter of the two stars which form the double star in Hercules. In the spectrum of this star the green and blue parts of the light, and also the deep red, are subdued with strong groups of lines, while the orange and yellow rays preserve nearly their original intensity, and therefore predominate in the star's light.

The question yet remains to be answered:—Will the faint telescopic stars, which are blue, green, and purple, and which are never found alone in the heavens, but always under the protection of a strong ruddy or orange star, furnish spectra in accordance with this theory?

With some little difficulty, and by means of a special arrangement of the spectrum apparatus, we succeeded in observing the spectra of the components of some double stars. There will now be thrown upon the screen the well-known double star β Cygni. In a large telescope the colours of the two stars are beautifully contrasted, as they now appear upon the screen. The upper spectrum represents the orange star, the lower one that of its beautiful but feeble companion. In the orange star you observe that the dark lines are strongest, and most closely grouped in the blue and violet parts of the spectrum; and the orange rays, therefore, which are comparatively free from lines, predominate.

In the delicate blue companion, the strongest groups of lines are found in the yellow, orange, and in part of the red. In the arrangement of these groups of lines we have a sufficient cause for the predominance of the other portions of the spectrum, which unite in the eye to give the blue purple colour of the light of this star.

We have, therefore, shown that the colours of the stars are produced by the vapours existing in their atmosphere. The chemical constitution of a star's atmosphere will depend upon the elements existing in the star, and upon its temperature.

VARIABLE STARS.

The brightness of many of the stars is found to be variable. From night to night, from month to month, or from season to season, their light may be observed to be continually changing, at one time increasing, at another time diminishing. The careful study of these variable stars by numerous observers, has shown that their continual changes do not take place in an uncertain or irregular manner.

The greater part of these remarkable objects wax and wane in accordance with a fixed law of periodic variation which is peculiar to each.

We have been seeking for some time to throw light upon this strange phenomenon by means of observation of their spectra. If in any case the periodic variation of brightness is associated with physical changes occurring in the star, we might obtain some information by means of the prism. Again, if the diminution in brightness of a star should be caused by the interposition of a dark body, then, in that case, if the dark body be surrounded with an atmosphere, its presence might possibly be revealed to us by the appearance of additional lines of absorption in the spectrum of the star when at its minimum. One such change in the spectrum of a variable star we believe we have already observed.

Betelgeux is a star of moderate degree of variability. When this star was at its maximum brilliancy in February last, we missed a group of lines, the exact position of which we had determined, with great accuracy by micrometric measurements, some two years before.

We have observed the spectra of several variable stars at different phases of their periodic variation, but our results are not yet complete.

It is worthy of notice that the variable stars which have a ruddy or an orange tint possess spectra analogous to that of Betelgeux and β Pegasi.

TEMPORARY STARS.

With the variable stars, modern opinion would associate the remarkable phenomena of the so-called new stars, which occasionally, but at long intervals, have suddenly appeared in the sky. But in no case has a permanently bright star been added to the heavens. The splendour of all these objects was temporary only, though whether they died out or still exist as extremely faint stars is uncertain. In the case of the two modern temporary stars, that seen by Mr. Hind in 1845, and the bright star recently observed in Corona, though they have lost their ephemeral glory, still continue as stars of the tenth and eleventh magnitudes.

The old theories respecting these strange objects must be rejected. We cannot believe with Tycho Brahe that objects so ephemeral are new creations, nor with Riccioli that they are stars, brilliant on one side only, which have been suddenly turned round by the Deity. The theory that they have suddenly darted towards us with a velocity greater than that of light, from a region of remote invisibility, will not now find supporters.

On May 12 last a star of the second magnitude suddenly burst forth in the constellation of the Northern Crown. Thanks to the kindness of the first discoverer of this phenomenon, Mr. Birmingham, of Tuam, I was enabled, conjointly with Dr. Miller, to examine the spectrum of this star on May 16, when it had not fallen much below the third magnitude.

The spectrum of this star consists of two distinct spectra. One of these is formed by four bright lines. The other spectrum is analogous to the spectra of the sun and stars.

These two spectra represent two distinct sources of light. Each spectrum is formed by the decomposition of light, which is independent of the light which gives birth to the other spectrum.

The continuous spectrum crowded with groups of dark lines shows that there exists a photosphere of incandescent solid or liquid matter. Further, that there is an atmosphere of cooler vapours which give rise by absorption to the group of dark lines.

So far, the constitution of this object is analogous to that of the sun and stars, but in addition there is the second spectrum, which consists of bright lines. There is therefore a second and distinct source of light, and this must be, as the character of the spectrum shows, luminous gas. Now the two principal of the bright lines of this spectrum inform us, by their position, that one of the luminous gases is hydrogen. The great brightness of these lines shows that the luminous gas is hotter than the photosphere. These facts, taken in connexion with the suddenness of the outburst of light in the star, and its immediate very rapid decline in brightness, from the second down to the eighth magnitude in twelve days, suggested to us the startling speculation that the star has become suddenly enwrapped in the flames of burning hydrogen. In consequence, it may be, of some great convulsion, enormous quantities of gas were set free. A large part of this gas consisted of hydrogen which was burning about the star in combination with some other element. This flaming gas emitted the light represented by the spectrum of bright lines. The spectrum of the other part of the star's light may show that this fierce gaseous conflagration had heated to a more vivid incandescence the solid matter of the photosphere. As the free hydrogen became exhausted the flames gradually abated, the photosphere became less vivid, and the star waned down to its former brightness.

We must not forget that light, though a swift messenger, requires time to pass from the star to us. The great physical convulsion which is new to us is already an event of the past with respect to the star itself. For years the star has existed under the new conditions which followed this fiery catastrophe.

(To be continued.)

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 2, 1866.

Edward Schunck, *Ph.D., F.R.S., &c., President, in the Chair.*

Among the donations announced was one from Mr. Cottam, of a framed memorial, presented by the Society to Dr. Dalton in 1844, on the occasion of his communicating to them the 50th annual result of his meteorological observations. In a letter accompanying the memorial, dated September 5, 1866, Mr. Cottam says: "At the Doctor's death it remained in the hands of our old friend, Peter Clare, at whose sale it was purchased by my late father, and has since hung up in my office as a fine specimen of caligraphy. I think the Society's rooms will be the most suitable place for it, and that the centenary anniversary of the Doctor's birth is a suitable occasion for its presentation."

On the motion of Mr. Binney, seconded by Mr. Gaskell, the thanks of the Society were unanimously voted to Mr. Cottam for his interesting donation.

A paper was read "*On the Portraits of Sir Isaac Newton; and particularly on one of him by Kneller, painted about the time of the publication of the 'Principia,' and representing him as he was in the prime of life,*" by Samuel Crompton, M.D.

The writer pointed out that all Newton's great discoveries were made prior to 1688, and directed attention to the following dates: That he was born in 1642, died in 1727, and that he discovered fluxions in 1665-6, the unequal refrangibility of light in 1666, the reflecting telescope in 1668, and published the "*Principia*" in 1687; and that with that publication, which Whewell has designated "The Great Charter of Modern Science," his career, as an original discoverer, appears to have terminated. He quoted passages from Mr. Edleston's correspondence of Newton and Cotes, and from Sir David Brewster's larger life of Newton, to show that his appointment to the Mint, in a great measure, stopped further researches. "Henceforward," says Mr. Edleston, "his official duties rendered it impossible for him to work continuously at his former pursuits; and his studies in mathematics and natural philosophy were by snatches, and in the intervals of business." "His duties at the Mint," says Sir David, "allowed him but little time for the performance of so laborious a task as the publication of a second edition of the '*Principia*,' and when his consent was at last obtained to put the work to the press, they greatly interrupted its progress." Again, in one of his letters to Flamstead, he says that he did not like to be known to be attending to anything but the King's business, meaning the duties of the Mint. Therefore, after the publication of the "*Principia*," he may be practically regarded as a retired philosopher.

The writer then attempted to show that the current portraits of Newton do not give us any correct representation of Newton the philosopher. He exhibited various engravings of Newton. He pointed out that Vertue's print, after Vanderbank, is inscribed "Isaacus Newtonus Eq. Aur. æt. 83. J. Vanderbank pinxit 1725, Geo. Vertue sculpsit 1726;" and, therefore, that the date of that celebrated picture, in possession of the Royal Society, represents him in extreme old age. This picture, therefore, he contended, was not a portrait of the great Newton, but of Newton the Master of the Mint, who assayed Wood's halfpence; and that it could not, for one moment, be accepted as a representation of Newton in the plenitude of his intellectual power, of whom Halley sang in 1687:—

> Newtonum clausi reserantem scrinia veri,
> Newtonum Musis charum, cui pectore puro
> Phœbus adest, totoque incessit numine mentem,
> Nec fas est propius mortali attingere divos.

Nor was it the portrait of him as he was when he published the second edition of his "*Principia*," but a representation of him as a grand and venerable ruin covered with the lichens of time.

But this picture of Vanderbank's the writer greatly preferred to the Houbraken and other prints published about 1710 or 1712; and he contended that the portrait published as the best extant one by Sir David Brewster as the frontispiece to his larger life of Newton, by no means gives a desirable representation of Newton the philosopher. It was rather an affected representation of Newton the dandy, and of Newton the prosperous man of the world, with a carriage and horses, and with three male and three female servants. The writer looked upon these prints with pity; and could not for one moment allow that any one of them represented that Isaac Newton, the yeoman's son, while at work in the wells of truth, and wresting from nature secrets hidden from the foundation of the world. In order to form some idea of the immortal Newton as distinguished from Queen Anne's Newton, he asked us to consider attentively the letter written by Newton's former assistant, Humphrey Newton, to Mr. Conduit, in 1727, descriptive of Isaac's manner of life and appearance between 1684 and the beginning of 1689.

"In the last year of King Charles II., Sir Isaac was pleased, through the mediation of Mr. Walker, then schoolmaster at Grantham, to send for me up to Cambridge, of whom I had the opportunity, as well as honour, to wait of for about five years. In such time he wrote his '*Principia Mathematica*,' which stupendous work, by his order, I copied out before it went to the press. . . . His carriage then was very meek, sedate, and humble, never seemingly angry, of profound thought, his countenance mild, pleasant, and comely. I cannot say I ever saw him laugh but once, which was at that passage which Dr. Stukeley mentioned in his letter to your honour,[*] which put me in mind of the Ephesian philosopher who laughed only once in his life time, to see an ass eating thistles when plenty of grass was by. He always kept close to his studies, very rarely went a visiting, and had as few visitors. . . . I never knew him to take any recreation or pastime, either in riding out to take the air, walking, bowling, or any other exercise whatever; thinking all hours lost that was not spent in his studies, to which he kept so close that he seldom left his chamber, except at term time, when he read in the schools as being Lucasian professor, where so few went to hear him, and fewer that understood him, that oft times he did in a manner, for want of hearers, read to the walls. . . . So intent, so serious upon his studies, that he ate very sparingly, nay, ofttimes he has forgot to eat at all, so that, going into his chamber, I have found his mess untouched, of which, when I have reminded him, he would reply,—'Have I?' and then, making to the table, would eat a bit or two, standing, for I cannot say I ever saw him sit at table by himself. . . . He very rarely went to bed before two or three of the clock, sometimes not till five or six, lying about four or five hours, especially at spring and fall of the leaf, at which times he used to employ about six weeks in his laboratory, the fire scarcely going out either night or day, he sitting up one night and I another till he had finished his chemical experiments, in the performance of which he was most accurate, strict, exact. What his aim might be, I was not able to penetrate into, but his pains, his diligence at these set times made me think he aimed at something beyond the reach of human art and industry. I cannot say I ever saw him drink either wine, ale, or beer, excepting at meals, and then but very sparingly. He very rarely went to dine in the hall, except on some public days, and then if he was not minded, would go very carelessly, with shoes down at heels, stockings untied, surplice on, and his head scarcely combed. . . When he has sometimes taken a turn or two (in his garden) he has made a sudden stand, turned himself about, run up y^e stairs like another Archimedes, fall to write on his desk standing without giving himself the leisure to draw a chair to sit down upon . . . His brick furnaces, *pro re natâ*, he made and altered himself without troubling a bricklayer. . . He very seldom sat by the fire. . . He never slept in the day time that I perceived; I believe he grudged y^e short time he spent in eating and sleeping. . . His bed maker in a morning has sometimes found both dinner and supper scarcely tasted, which the old woman has very pleasantly and mumpingly gone away with. . . His thoughts were his books; though he had a large study seldom consulted with them. When he was about 30 years of age his grey hairs was very comely, and his smiling countenance made him so much the more graceful."

Surely, Dr. Crompton contended, none of the engraved portraits of Newton represents the great Newton of those years. The conceited, double-chinned Kneller's of 1710-20, give no idea of him. Dr. Crompton then exhibited an admirable engraving by Mr. Oldham Barlow,[†] of the recently recovered portrait of Newton, painted by Kneller in 1689, and asked whether it did not fulfil every required condition? Eyes capable of penetrating into the heart of things—a brow that could measure the universe—a face "full of godlike reason" and in its intensity and force indicating a very beagle of truth—yet what simplicity! and how contemplative! The identical white locks spoken of by Humphrey Newton, to be in a few years shorn to make way for the wig of the Houbraken print!

Dr. Crompton then gave the history of the portrait from whence this engraving has been taken, and said he identified it at the Art Treasures' Exhibition, as Newton as he was when he wrote the "*Principia*," and pointed out at that time that it was the only known portrait of Newton worthy of notice—that he obtained, in conjunction with Dr. Joule, Mr. Fairbairn, Dr. Schunck, Mr. Binney, and Dr. Angus Smith, leave from its noble owner to have it photographed; and he exhibited a print then taken—that Mr. Barlow, happening to be at his house, saw an impression of it, and expressed a wish to engrave it—that Dr. Crompton

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[*] When Sir Isaac once laughed 'twas upon occasion of asking a friend, to whom he had lent Euclid to read, what progress he had made in that author, and how he liked him. He answered by desiring to know what use and benefit in life that study would be to him, upon which Sir Isaac was very merry.

[†] Of Victoria Road, Kensington, London.

obtained Lord Portsmouth's permission for the use of the original picture. He then read letters from Lord Portsmouth, proving that the portrait came into his lordship's possession by the marriage of his ancestor Lord Lymington, to the grand-niece of Newton, Miss Conduit, and that it had been in a neglected condition and recently cleaned and lined. Dr. Crompton added that Sir David Brewster told him that he went to Hurstbourne Park to examine Newton's MSS. and portraits, but that he did not see it, yet it was there. The picture, Dr. Crompton added, is in Kneller's best manner, is painted with great care, is signed in the left corner "Isaacus Newtonus," and in the right, "Godfrey Kneller fec. 1689." Dr. Crompton exhibited an engraving prefixed to Dr. Edleston's Correspondence of Newton and Cotes, which he said was from an India-ink drawing in Magdalen College, Cambridge, undoubtedly closely allied to the Kneller picture, but greatly inferior; being, in Dr. Crompton's opinion, a bad copy by an inferior hand, but, no doubt, made for Mr. Pepys, in whose collection it was.

Dr. Crompton showed that Newton was in London during the greater part of 1689, as Member of the Convention Parliament, when it is certain that this portrait was painted; and he added, that he had not been able to discover any other portrait of him painted earlier than, or about, this interesting period of his life, nor any other, till several years later (probably twenty), when success had greatly changed his countenance.

PHOTOGRAPHICAL SECTION.

October 4, 1866.

Dr. J. P. Joule, *F.R.S., &c., Vice-President of the Section, in the Chair.*

A paper was read "*On a Process for Printing Photographs in Various Colours,*" by J. A. Gatty, Esq.

My process is based upon the property possessed by ferricyanide of potassium, of forming clear solutions with certain metallic salts, producing insoluble compounds when the mixture is brought into contact with a deoxidising agent, the rays of the sun acting as such, a perfect precipitation takes place upon paper or other material prepared with the above-named solution. In producing the specimens sent herewith, I applied to the paper a concentrated solution, formed of equal parts of ferricyanide of potassium and nitrate of lead, having found the latter to answer very well, not only as a means of forming a precipitate, but also for assisting in the production of numerous colours. After drying the paper, it was exposed to the sun for about half an hour, and then washed in water in order to dissolve all the unaffected ferricyanide of potassium and nitrate of lead. I have noticed that the sun acts much quicker when there is a little moisture present. I have, therefore, placed a damp cloth between two or three thicknesses of paper behind the prepared paper. After washing, the photographic image remains behind as a pale greenish precipitate, easily transformed into various colours, as the following experiments will show:—

No. 1. (Blue.) Has been steeped in a weak solution of nitrate of iron for about ten minutes, and then washed in water.

No. 2. (Green.) Same as No. 1, but steeped in a weak solution of bichromate of potash after the nitrate of iron.

No. 3. (Reddish Brown.) Has been steeped in a solution of nitrate of copper, and then washed.

No. 4. (Brown.) Has been developed by steeping it in a mixture of weak solution of nitrate of iron and nitrate of copper.

No. 5. (Dark Brown.) Has also been treated with nitrate of iron and nitrate of copper, but containing a larger proportion of the former.

These few experiments will show that a very large number of shades may be obtained by using different salts and mixtures thereof in developing the photograph. A further series of colours may be obtained by destroying the blue with caustic soda, which, after washing, will leave behind oxides of iron and lead, which may be dyed with vegetable colouring matters.

All the above experiments have been made about four years ago, which goes to prove that the colours are permanent. I hope shortly to be able to resume my experiments, and work the process out more perfectly.

Mr. Dancer remarked that he had some prints (which were shown to the meeting) produced by Mr. Mercer in 1856, which appeared to be done by a process similar to the one just described, prussiate of potash being one of the substances used, but he was not acquainted with the details of the process.

It was considered a useful process for certain purposes, and deserved more attention than it had hitherto received.

ACADEMY OF SCIENCES.

October 15.

The papers brought forward at this meeting were principally physical, chemistry not being represented at all. The first of the papers on physical optics was

"*New Researches on the Spectral Analysis of the Light of Stars,*" by Father Secchi. After pointing out several objections to the ordinary direct vision spectroscopes, particularly Hoffmann's, the author noticed some improvements in the instrument described in his last letter, which consist in placing the cylindrical lens very near the eyepiece, and the direct vision prism after the lens. This instrument produces an angular dispersion between the solar rays B and H of about 6° 51′. The eye-piece is movable, so as to include the whole spectrum, and magnifies 500 times. In order to determine the absolute position of the rays and their degree of frangibility, the author makes use of the spectra of the planets Venus and Mars, in which all the solar rays are perfectly visible, and easy to be measured; adding, "This is a great advantage, and is due to the enormous dispersion of the prism, before which the diameter of the planet almost disappears." From this it is evident that the system adopted by the Roman astronomer must be considered inferior to the one followed by English observers, inasmuch as he uses no slit, but takes as his line of light the image of the star elongated through a cylindrical lens. The author divides the stellar spectra into three types. The first and most dominant type is that exhibited by white stars, such as α Lyræ, Sirius, &c. Their characteristic is a strong black band in the green-blue in the position of the solar F, and a second band in the violet a little nearer the preceding than the solar ray G. Half the visible stars belong to this type. Two remarkable exceptions have been found. The star γ Cassiopeiæ is perfectly complementary to this type, and instead of having a dark ray in the position F, it has a luminous band. This may be easily verified by directing the instrument first on to β Cassiopeiæ, which belongs to the ordinary type, and then on to γ Cassiopeiæ. The black band of the first is immediately replaced by the luminous ray of the second. The other exception is β Lyræ. These few exceptions merit earnest attention. If it be true that the black rays are due to absorption by a certain substance (hydrogen in this case), we have here the direct light emitted by this body. A modification of this type is presented by the stars of the constellation Orion (α excepted), which have the common resemblance of fine rays, with one more or less evident in the place of *f*, but having no large bands, and in which the violet lines are very difficult to see. It is remarkable that over the large space occupied by this constellation the observer rarely sees different types from this; this part of space may be said to be occupied by a family of stars which are distinguished from those in the rest of the sky.

A second remarkable type consists of stars having coloured bands in the red and orange. This includes α Orionis, α Tauri, Antaris, β Pegasi, &c. The most remarkable and typical star of this class is α Herculis. This star gives a spectrum which has the appearance of a series of columns illuminated from one side; the stereoscopic effect of the convexity of these bands due to the shading is so surprising that it cannot be beheld without astonishment. The star δ^2 Lyræ has a similar appearance; only, instead of having convex, it has concave columns. The third type consists of stars with fine lines; it includes Arcturus, Capella, Pollux, &c., and also our own sun. The author says that the spectra of these stars perfectly resemble that of the sun, with fine lines in the same places. In these stars are seen the principal solar rays B, D, *b*, E, F, G, and a great many secondary rays. The author concludes his paper with several theoretical reflections on these remarkable phenomena, and gives a list of the principal stars of each type. In a supplementary note he enters into more detail concerning the spectrum of α Herculis, and gives a drawing of the curious columnar appearance.

"*On the Cases of Cholera which occurred at Marseilles before the Arrival of the Pilgrims from Mecca in* 1865," by M. Grimaud de Caux.

"*On the Discovery of Ancient Monuments in one of the Islands of the Bay of Santorin*," by M. de Cigalla.

"*Remarks on some Rays of the Solar Spectrum*," by M. A. J. Angström. The author considers that the rays A and B, which Janssen says are due to the vapour of water, are not so caused, although he admits they are telluric rays. In support of this view he relies upon the fact that on observing the spectrum at Upsal, when the temperature was 27° below the centigrade zero, most of the telluric rays disappeared, whilst the groups A and B, and a third, called by Brewster *c*, were as strong as ever. The origin of these rays is therefore considered not to be due to the vapour of water, but to a gas, probably carbonic acid.

The author has compared the solar spectrum with one formed by two iron electrodes with a battery of fifty elements, and has found more than 460 rays corresponding to the lines of iron; and, starting from this observation, he draws some comparisons between the metallic spectra produced by a Ruhmkorff's machine, and a battery of fifty elements. Two observations which the author has made are of interest; one is the certain presence of manganese in the sun, proved by the coincidence of nearly thirty lines, and the other is the discovery of a new ray of hydrogen situated nearly halfway between G and H, and which M. Angström calls *h*. This ray can be seen in Geissler's tubes.

"*Discovery of a New Planet of the* 11*th Magnitude, named Antiope*," by M. Robert Luther.

NOTICES OF PATENTS.

No. 341. *Red Dye.* J. Holliday. Dated February 3, 1866.

This improvement relates to the production of red colouring matter, or dye, by the use of nitro-naphthaline, binitronaphthaline, or trinitronaphthaline, with a salt of aniline or its homologues; preferring the hydrochlorate of aniline of a high boiling point or the hydrochlorate of toluidine. In carrying out the invention, mix about twenty parts, by weight, of hydrochloric acid of commerce with twenty parts of toluidine and ten of nitronaphthaline. Heat this mixture up to 440° F., or thereabouts, until the red dye, or colour, is formed in a somewhat bronze mass. Purify the dye by ordinary processes. This also received provisional protection only.

No. 394. *Composition for Preserving Metals, Wood, &c.* Henry Edward Francis de Briou, M.D., Middlesex. Dated February 8, 1866.

This invention has for its object improved compositions for preserving metals from oxidation, corrosion, and galvanic action; for protecting metals used in the construction of ships against the destructive effects of sea water and preventing their fouling; for protecting wood from the attacks of animalcula, and preserving wood from damp, rot, and decay; for excluding damp from walls, and for use in submarine and other telegraphy.

The patentee takes a composition made with vulcanised india-rubber, such as is described in the specification of a former patent granted to him, and dated July 19, 1864, No. 1804, or made in accordance with a part of the present invention by the substitution of vegetable pitch or resin for mineral pitch, and he renders the composition fluid or semi-fluid by compounding it with bisulphide of carbon. In preparing such a composition proceed as follows:— Take, say, 66 pounds of vulcanised india-rubber and cut it into small pieces, then place it in a large open kettle, by preference of copper, and heat it by a fire underneath; the contents of the kettle are constantly stirred until all the india-rubber is reduced to a liquid stâte, and care is constantly taken not to apply more heat than is necessary; this will be about 360° Fahrenheit; then add 20 lbs. of vegetable pitch or asphaltum, and continue the heat and the stirring until it is melted and thoroughly mixed; afterwards add 10 lbs. of shellac and 10 lbs. of common resin, and in a similar manner incorporate these with the other ingredients. These operations will require usually from three to six hours, according to the quantity operated on. The contents of the kettle should be carefully stirred the whole time; then the fire is withdrawn, and the composition is poured or ladled out into wooden or metal vessels to cool and harden. The composition thus prepared is rendered fluid, so that it can be used without the aid of heat, by means of bisulphide of carbon. Place it in closely-stopped vessels, together with bisulphide of carbon in the proportion conveniently of 5 lbs. of composition to one gallon of bisulphide of carbon; the vessels should be shaken and turned about daily for eight or ten days, by which time the composition will be completely dissolved and fit for use as a paint and otherwise. To spread the paint over the surfaces to be protected, use common painters' brushes. The paint, which is kept ready for use in large tin jars hermetically closed, is poured out into paint pots such as are used by painters in small quantities at a time, and spread at once to prevent the evaporation of the bisulphide of carbon and the consequent thickening of the paints. Two coats are necessary for ships' bottoms and other submerged substances, and when it is used for ships' bottoms poisonous compounds are incorporated with the outer coating as hereinafter specified. For objects exposed to atmospheric influences the paint should be used more liquid. It is thinned by the addition of a proportion of bisulphide of carbon, which varies according to the degree of consistence required in the paint. For delicate artistic iron works or castings in metals and alloys the paint must be very thin; a single coat is sufficient, but a varnish should be spread over it. Upon submerged wood the paint is applied of the same consistence and prepared in the same manner as for ships' bottoms. For timber left exposed to the air or employed for building purposes or upon railways, the paint ought to be thinner in order better to penetrate the pores of the wood—one coat is sufficient. For submerged wood two coats are used. Brick or stone walls can be covered on one or both sides, one or two coats of the paint being employed. Felt used under the copper sheathing of ships, for roofing, or other purposes, is rendered perfectly water-tight by being dipped into the fluid composition and made to pass between two cylinders. Woollen, cotton, silk, or other stuffs, linen, canvas bands of every material, can be rendered waterproof by being coated with the liquid composition. Wrapping paper, cardboard, and other kinds of paper are made waterproof by spreading a thin coat of the paint between two sheets and passing them between hot cylinders. As regards its employ in submarine and aerial telegraphy, the patentee uses it in submarine cables to form the core which surrounds the conducting wires; he passes the core through semi-fluid cold paint or composition, and then through a die to equalise the coating. He also saturates with the paint in a very liquid condition the inner covering of the core, whether made of hemp or other fibrous material, and the outer covering when a hempen one is used, and he employs it as a paint for the outer covering when this is made of iron wires instead of hemp. In aerial telegraphy he uses it as a liquid paint for saturating narrow bands woven with hemp or other fibrous materials, and he winds them round the conductors in order to effect insulation and to protect the wires.

When it is desired that the composition shall resist the attacks of marine animals, he compounds it with poisonous materials, which prepare as follows:—Take a substance formed by the decomposition of concentrated hydrocyanic acid in dry chlorine (a kind of chloride of cyanogen), to which add cyanide of mercury and the ferrocyanide of copper in equal proportions, thus forming a compound which readily mixes with the vulcanised india-rubber composition. The proportions are—

Hydrocyanic acid and chlorine (chloride of cyanogen)	1 ounce
Chlorocyanide of mercury	2 ounces
Ferrocyanide of copper	2 ounces
Vulcanised india-rubber composition . .	25 lbs.

These ingredients are to be well stirred together.

This preparation is principally used for copper, zinc, the brasses and alloys. For iron the cyanide of mercury is sometimes replaced by Prussian blue in the proportion of 3 ounces for 25 lbs. of vulcanised india-rubber composition.

For submerged wood, copper, zinc, or iron, mix together—

Arsenite of copper	5 ounces
Bicyanide of mercury.	2 ounces
Vulcanised india-rubber composition .	25 lbs.

For all except the very roughest work the disgusting odour of the bisulphide of carbon, which is so plentifully used as a solvent, would probably prove an insuperable barrier to the use of this composition.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

2418. C. Crump, Southcombe, Paignton, Devonshire, "Improvements in solvents for resins and resinous substances, caoutchouc, gutta-percha, oils, and fats."—Petition recorded Sept. 20, 1866.

2450. A. F. Stoddard, Glasgow, N.B., "A new or improved fuel."

2452. J. Calvert, Strand, "Improvements in the treatment and manufacture of iron and steel."—Sept. 24, 1866.

2460. W. Cormack, Commercial Road, Middlesex, "Improvements in means and apparatus for effecting the revivification of animal charcoal."

2472. J. J. Lundy, Leith, N.B., "Improvements in the treatment of the residues resulting from, and obtained in, the purification and distillation of mineral oils, for the purpose of utilising the same."

2476. H. Aydon and G. B. Jerram, Queen Street, Westminster, "Improvements in furnaces and in the method and apparatus for supplying such furnaces with fuel or other combustible matters."—Sept. 25, 1866.

2494. J. Burgum, Birmingham, "Improvements in puddling and heating furnaces, and other furnaces used in the manufacture of iron and steel."

2496. A. V. Newton, Chancery Lane, "An improvement in the process of distilling petroleum and other oils."—A communication from O. Lugo and T. O. L. Schrader, New York, U.S.A.—Sept. 27, 1866.

2534. D. Barker, Northfleet, Kent, "Improvements in the manufacture of artificial fuel."—Oct. 3, 1866.

2525. P. R. Hodge, Cannon Street, London, "Certain improvements in apparatus for the filtration of fluids."—Oct. 1, 1866.

NOTICES TO PROCEED.

1564. A. Parkes, Birmingham, "Improvements in the manufacture of compounds in the nature of kamptulicon."—Petition recorded June 6, 1866.

1593. S. Lees, Salford, Lancashire, "Improvements in furnaces for consuming petroleum and other hydrocarbons."

1594. T. J. Leigh, Denmark Street, Camberwell, Surrey, "Improvements in the method of burning coals (whether large or small coals), coal dust, coke, coke dust, charcoal, wood, and other combustible substances, as also hydrocarbons and gases, and in the arrangement of the furnaces applicable thereto."—June 12, 1866.

1623. W. Knaggs, Euston Square, Middlesex, "Improvements in the manufacture of sugar, and in the apparatus employed therein."—June 14, 1866.

1778. C. Doughty, Lincoln, "Improvements in apparatus for distilling the grease of cotton seed, oil, and other fatty matters."—July 4, 1866.

2413. C. W. Siemens, Westminster, "Improvements in smelting ores, and in furnaces to be employed for that purpose."—Sept. 20, 1866.

CORRESPONDENCE.

Phosphorescent Light.

To the Editor of the Chemical News.

Sir,—I should be interested to have an explanation of the cause or causes of the following phenomenon which I observed one night lately. In my bedroom there is, among other chemicals, a bottle containing ordinary phosphorus under water in the usual way. Without being in the slightest degree shaken or warmed, the air in the upper part of the bottle emits a bright phosphorescent glow of light at regular intervals of about ten minutes, lasting one or two seconds. There is no light whatever apparent excepting at these moments.

I am, &c. A. W. W.

Ulverstone, October 22.

ANSWERS TO CORRESPONDENTS.

General Index to the First Fourteen Volumes of the Chemical News.—We have had an inquiry for such an index. Its compilation will be attended with considerable trouble and expense; if, however, we find our readers generally wish for one, it shall be commenced as soon as the present volume is completed. Intending subscribers will please notify their wishes to the publisher without delay.

W.—We have sent a reply by post.

A Student.—Your best plan will be to apply to the Secretary of the Chemical Society, Burlington House.

Metallurgist.—By all means avoid the use of mineral acids as far as possible when arranging materials for a blowpipe tour.

J. A.—If our correspondent will send his address, we will communicate with him.

A Parent.—We would rather not take the responsibility of advising on such a subject.

E. C.—In the spectroscope protochloride of manganese gives four green and one large orange ray. Borax gives several green rays, but no orange.

F. J. Smith.—The mineral is most likely pickeringite, an analysis of which was given by Dr. Howe at page 233 of our seventh volume.

W. Skey, Wellington.—We have to thank our correspondent for a series of seven papers which have just come to hand from New Zealand. Their publication will be commenced immediately. We shall be glad to receive the other communications mentioned in our correspondent's letter.

Toxicologist.—You will probably be able to purify the sulphuric acid from arsenic by converting the latter into arsenic acid, by adding a little bichromate of potash, and then distilling. Arsenious acid is volatile with the vapour of sulphuric acid, but arsenic acid appears to be fixed. For further particulars see a paper by Mr. Lyte in our ninth volume, page 98.

Received.—C. Crump; S. H. J.; W. B. G.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

New Researches on the Law of Chemical Proportions, and on Atomic Weights and their Mutual Relations, by J. S. Stas.*

(Continued from page 88.)

If the observations which I have just presented are correct, the demonstration of the hypothesis, which must rest with him who asserts it to be a law of nature, will be the more difficult to accomplish in proportion as the unit becomes still more diminished. Chemists who lower this unit, in proportion as exact experiment proves the slight foundation of their proposed unit, find themselves strangely mistaken in the results of the principles which they lay down.

But I acknowledge that all the objections which may be raised against Prout's law cannot replace the rigorons demonstration of the law of definite proportions, which is incumbent upon those, who rely upon it to declare the hypothesis of the English chemist unfounded. The objection of M. Marignac, who questions if the compound bodies contain their elements in the rigorous proportions of their atomic weights, continues then in all its force, and maintains the weight which the authority of his name gives it. It follows from all that goes before, that the problem which I have tried to solve is not susceptible of a strict solution, until I have proved by new experiments that the law of definite proportions is the expression of a mathematical relation.

These considerations have led me to attempt a rigid demonstration of this law, however difficult, and at first inaccessible, the problem may have appeared to me. As it is generally understood, it consists of two natural distinct truths, although the one, properly speaking, is only the consequence of the other. These truths are, the constancy of composition of every combination, and the invariability of the proportions in weight of the elements forming all combinations. Although, to my mind, there remains no doubt of the fixed composition of chemical combinations, I have nevertheless sought to discover whether the composition of the bodies called *stable* is not, *in a very narrow limit*, a function of the conditions under which the combinations are formed—such as *temperature* and *pressure*. I have thus approached the problem of the law in all its generality. On considering it attentively, we perceive that its solution may be arrived at by two different means—by the direct way, and by the indirect way, which at once solves the question of the law of definite proportions, and that of Prout's hypothesis. I understand by the direct way, that by which it is shown that the relation of weight, which all bodies preserve when uniting one to one, two to two, &c., remains invariable.

In the first of these memoirs, entitled "*New Researches on the Laws of Chemical Proportions*," are recorded the experiments which I tried in order to solve these important problems. This consists of two parts. The first has for its title "*On the Constancy of Composition of the Combinations called Stable.*" With a view of settling the question whether, at the time of the formation of compound bodies, pressure or temperature exercise an influence on the relations which the elements constituting them preserve between themselves, I have resumed the determination of the proportional relation between silver and chloride of ammonium, which has already been the subject of such long investigations on my part. I have selected this method because it enables me sometimes to bring in temperature, sometimes pressure, as the condition of formation, and also because the operation can be executed with a precision bordering on mathematical exactness. The results at which I have arrived prove that in the limit to which I was obliged to confine myself to render the experiment possible, *temperature exercises no influence on the composition of chloride of ammonium or chloride of silver; and that pressure is without any influence on the composition of chloride of ammonium.* Indeed, the proportional relation between chloride of ammonium and silver is represented by a constant, whatever may be the mode in which ammoniac chloride and argentic chloride are formed. The second part of this memoir is entitled, "*On the Invariability of the Relations by Weight of the Elements forming Chemical Combinations.*" In order to solve this problem, I have tried to discover if, in binary and ternary bodies, having each *two common elements*, these common elements invariably exist in the same relations by weight—or, in other words, if in two bodies AB and ABC, the relations by weight between A and B are exactly the same in AB as in ABC.

For this purpose I have instituted three series of researches; the results to which they have led me are contained in three notices, entitled:—1st. *Researches on the transformation of iodate of silver into iodide under the influence of sulphurous acid, made for the purpose of proving if the relation by weight between the iodine and silver is the same in these two bodies;* 2nd. *Researches on the transformation of bromate of silver into bromide under the influence of sulphurous acid, made for the purpose of proving if the relation of bromine to silver is the same in the two bodies;* 3rd. *Researches on the transformation of chlorate of silver into chloride, under the influence of sulphurous acid, made for the purpose of proving whether the relation by weight of chlorine to silver is the same in these two bodies.* It follows from these three series of investigations that, under the influence of sulphurous acid, iodate, bromate, and chlorate of silver, *produced under the normal conditions of their formation, can be reduced to the state of iodide, bromide, and chloride without a fraction, however small, of iodine, bromine, chlorine, or silver becoming liberated.* The invariability of the respective weights of the elements constituting these compounds has thus been proved.

It necessarily follows from the combinations of the two orders of facts which I have just tried to establish, that bodies unite in absolutely fixed and invariable proportions—that these proportions are true constants—and that the laws of chemical proportions which have served as an experimental ground-work to the *atomic theory* are mathematical laws, as chemists have admitted for almost half a century.

The legitimate conclusion which may be deduced from it is, then, that compounds produced under the normal conditions of their formation must *necessarily* contain their *simple* elements in the rigid proportions of these constants. These researches, which have been carried out in a most laborious and accurate manner, authorise me to say that the doubt raised by M. Marignac on the subject of the synthesis of nitrate and of sulphide of silver has no foundation in principle, and the objections that the celebrated Genevese chemist has deduced from it are as unfounded as the doubt itself.

I said before that the law of definite proportions might be demonstrated in an indirect way. By this I mean the way which consists in trying whether the atomic weight

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* *Memoirs of the Royal Academy of Belgium.*

of the same body remains invariable, when it is determined not only by the aid of independent methods, but by means of different bodies. Indeed, the atomic weights determined under these conditions can only be identical, provided there is invariability between the relation by weight of the elements of the combinations—that is to say, provided the law of chemical proportions is not a limited one. Although it might be proved *à priori* that the indirect way cannot lead to a rigorous demonstration, I have nevertheless attempted it, because it contains in itself the solution of Prout's hypothesis, which has been the aim of my work.

(To be continued.)

Formation of a Substance resembling Artificial Tannin from Coal, by WILLIAM SKEY, *Analyst to the Geological Survey of New Zealand.*

WHEN either bituminous coal or lignite is heated with nitric acid for some considerable time, and then the whole evaporated to dryness, a dark brown substance is left, a large portion of which is soluble in water, and the more readily when heated with it.

The substance thus dissolved by the water has a bitter and somewhat astringent taste, and it readily precipitates gelatine and albumen from their aqueous solution.

Both the soluble and insoluble portions are readily soluble in alcohol and ether, in caustic or carbonated alkali, and also in concentrated sulphuric acid, forming therewith a dark red solution, and from which the part insoluble in water is reprecipitated by dilution; and, further, they appear to contain the elements of nitric acid, as manifested by chemical tests, and by their behaviour on ignition, their combustion being very rapid and complete, accompanied with a slight explosion.

These reactions would seem to indicate that, by the action of nitric acid upon coal, substances are produced analogous to the artificial tannin and picric acid obtained by the action of the same acid upon resin, and therefore distinct from the humic acid series of compounds produced from coal by the application of alkaline agents, with which, I apprehend, they have been confounded.

If, therefore, artificial tannin should ever be used in the manufacture of leather as a substitute for natural tannin as existing in barks, &c.; in lignite, which best admits of the operation above described (by reason of its permeability to liquids), an abundant source of this material is open to us.

TECHNICAL CHEMISTRY.

The Smoke Question,* by P. SPENCE, *Esq., F.C.S.*

THAT smoke, in every form of it with which we are acquainted, is a nuisance, I need not attempt to prove. That it is disagreeable to the eyes, painful to more than one sense when it supplants pure air to the breathing organs, that it surrounds us with filth in a form from which we cannot escape, and that, as a result of all these things, it is, *per se*, detrimental to comfort and to a certain extent pernicious to health, I am not going to deny. That, however, the black smoke of our manufacturing operations is, as one would naturally imagine from the continuous outcry made against it, the worst form of the evil—that, in fact, it is, all things duly considered, an evil at all in a sanitary point of view, I am here point-blank to deny; and as I have for years made it the subject of thought and investigation, I think I shall be able to substantiate my opinion.

If in getting rid of black or visible smoke we were to get rid at the same time of the products of combustion altogether, no doubt it would be an immense advantage; but if by getting rid of visible smoke we only increase the quantity and intensify the power of the substances produced in their evil effect on vegetation and animal life, then the benefit is not apparent; and if by getting rid of visible smoke we merely get rid of a body not only inert for evil, but in other circumstances fully allowed to be a body of a health-producing character, then we not only do no good, we do positive harm.

In the discussion on this subject I shall take it that the smoke nuisance means the black smoke produced in our manufacturing processes by the imperfect combustion of coal. Those who speak of doing away with the smoke nuisance have generally very indefinite ideas of the subject. They do not mean, of course, to annihilate the gases resulting from the combustion of coal, neither do they mean to remove these; they mean only that the visible results should be exchanged for the invisible, the seen for the unseen, and this, they seem to think, is doing away with the nuisance. Then what are the visible results of imperfect combustion, and what are the invisible results of perfect combustion, of coal? I cannot enter here upon the theory of perfect and imperfect combustion of coal, but shall merely say the visible substance in the black smoke from our furnace chimneys is nearly pure carbon, and that the invisible results, when combustion is perfect, are carbonic acid gas, nitrogen gas, and sulphurous acid. These gases are all thoroughly poisonous to animal life, and one of them destructive to vegetation. Now carbon, especially in a newly precipitated form, is not only a harmless body—a dirty one, I allow—but it is one of the most powerful disinfectants known. The most fetid and noxious gaseous emanations from our sewers, if passed through a layer of two or three inches of fresh charcoal—which is merely newly precipitated carbon—are rendered perfectly sweet and harmless. Then the carbon in the form of soot diffused is just in the best form to act as a precipitant or oxidising agent on any diffused miasmatic bodies on which it is capable of acting, and its bad effects are merely mechanical ones; it darkens our skin and it soils our linen. Its good effects are not acknowledged, but it seems impossible that so much carbon can float in the air without a purifying effect on miasma, with which it wages deadly warfare whenever they are brought into contact.

Now, what are the invisible results of perfect combustion? You consume in Manchester and Salford some 50,000 tons of coal per week; your coal contains 80 per cent. carbon, and as 6 carbon gives 22 carbonic acid, you get 183,000 tons carbonic acid on an average per week. Your coal contains also 2 per cent. of sulphur, or you have 1000 tons per week sent into your atmosphere. At present a large part of that is precipitated in a solid form in your black smoke; when you get perfect combustion it will all go as sulphurous acid, rapidly becoming sulphuric acid; 1 ton sulphur produces 3 tons of the strongest oil of vitriol, so that you will have, with perfect combustion, 3000 tons per week, or about 500 tons per day, of oil of vitriol poured over your town and neighbourhood.

Now take the town of Swansea. In that town some 2000 tons of copper ore are weekly smelted, and hitherto

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* Read before the Social Science Congress, Manchester meeting, on the occasion of the discussion—"How far are smoke and the products of combustion arising from various manufacturing processes injurious to health?" "What measures ought to be taken to prevent the contamination of the atmosphere from such causes?"

all its sulphur converted into sulphurous acid and sent into the atmosphere. But the copper ore contains 25 per cent. of sulphur, and there is therefore only 500 tons of sulphur, or half your quantity, sent out; yet, for a radius of, say, two miles on all sides of Swansea, the land is as bare as a board, and not a green leaf or a living twig is to be seen. When you get perfect combustion of coal in Manchester, I cannot see how the throwing out into the atmosphere here of 3000 tons of sulphurous acid per week will be less destructive to vegetation than 1500 tons per week is at present in Swansea.

But it may be said that theoretically it may appear that black smoke is not pernicious, but practically every one knows that it is detrimental to health. Now here again I believe the sanitary smoke consumers are mistaken. No doubt our towns are unhealthy, much more so, I believe, than they may be made were the zeal and efforts now so largely developed turned into a right direction; but, if you are following an *ignis fatuus*, you may spend all your zeal and strength in running it down, and only find at last that you have got into a mire.

There is only one mode that seems likely to afford us just data for judging whether black smoke is unhealthful—that is, to compare towns that are in most other respects similar, and only or chiefly differ as to the existence or degree of black smoke with which they are surrounded. Let us, then, take for this purpose the four boroughs or towns I shall now name, and in the relative position that I now put them—Liverpool, Manchester, Salford, and Sheffield. Liverpool we may take as a town free from black smoke, as it has no manufactories, and the smoke proceeding from steamers on the river is only transient, and can have little permanent effect. For the consolation of the denizens of Manchester, I should put it next on the list as having a tolerably liberal share of the article, but by no means one of the worst places in that respect, as tall chimneys are spread so well that at few points is there much concentration of the smoke. Salford, I believe, in proportion to its population, has a larger share of large coal-consuming works, and they are also concentrated into masses, giving more density to the supposed evil. But the fourth in my list is *par excellence* a smoky town, as every one who has passed through Sheffield will allow, and there black smoke is not an unavoidable accident, but a necessary incident of the staple industry of the place. A friend of mine, largely interested in its trade, informs me that in Sheffield they find they cannot make good steel unless they make abundance of black smoke; and I must at least give them credit for success in the production of the latter. If our sanitary friends are right in their theory of the unhealthiness of black smoke, we ought to find the death-rate of these towns to ascend in some proportion to the amount of black smoke with which they are severally afflicted, modified, of course, by any peculiar causes of mortality that may affect any one of these towns more than the others. I am not aware of any cause of increased mortality special to Liverpool, Salford, or Manchester. The industry of Sheffield is, however, fairly chargeable with shortening the lives of its workers; steel tool and instrument grinding is so unhealthy that the workers in large numbers fall an early prey to pulmonary disease. Taking these things with us, we ought to find that, assuming the death-rate of Liverpool as a basis, that of Manchester ought to increase in proportion to its amount of black smoke, the increase in the death-rate becoming to some extent an indication or measure of its fatality. Salford, as being somewhat more smoky than Manchester, should give a slightly increased rise in its death-rate, and Sheffield with its maximum, shall I say, of black smoke, and its added unhealthiness of occupation, should give a marked rise in its death-rate, and be by much the highest in the list. I am not aware that the matter can be more fairly put if we are, on this question, to reason from facts as well as from theory; and as the chief fact—namely, the death-rate—will be undisputed, I do not see how we can avoid the conclusions to which, as now placed, they lead us. Now the average death-rate of Liverpool is 44 per thousand annually. Manchester, with its black smoke moderately developed, must then slightly exceed this number. Its average annual death-rate is, however, really 33 per thousand. Salford by the theory must, to a somewhat larger extent, exceed 44; but its actual death-rate for three years' average is under 28 per thousand. But Sheffield must rise the highest, if black smoke and steel filings concur in their deadly effects, and here we ought to have a death-rate of 50 to 60 per thousand annually, at the least. Its death-rate actually is only 27 per thousand, or the lowest on the list. Thus the facts are decidedly in the inverse ratio of the theory of the sanitary smoke consumers, but harmonise completely with what I believe to be true theory, founded on a consideration of the nature and ordinary effects of the body with which we are dealing. Would it not be well, therefore, for our sanitary friends to leave this matter to the economists? While we have nothing to gain on the score of health by consuming our smoke, and may have something to lose, we have much to gain in the economy of our fuel. At present we get not much, if anything, over half the available heat; and as Professor Jevons has sounded the warning note of our coal supply being limited, and as there is a probability of that limit telling at a comparatively early period upon its price, there is an increasing inducement to get perfect combustion as the chief means to get all possible economic results, but in a sanitary sense that will come soon enough. Black smoke will not be abated to any great extent till it can be done economically, and by bringing the law to your aid, you only compel the manufacturer to take up the first patent nostrum that is forced upon his distracted attention, and which, as soon as your legal fangs are removed, he throws up in disgust, whereas, if you give him time, his own interest is constantly pressing him to adopt any proved means of getting all he can out of his coal, and to do this he must first get perfect combustion, and so consume his smoke, in your sense of smoke consumption, but which I forewarn you will be found to be a great increase of the smoke nuisance.

PROCEEDINGS OF SOCIETIES.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, by Dr. Percy, F.R.S.

Lecture No. X.

Before proceeding with the subject of this morning's lecture, I will draw your attention to an experiment of Daubrée concerning the production of coal—that variety which has been termed anthracite. He took fragments of fir wood, and heated them in a close tube with water at a high temperature, and consequently at a high pressure. He tells us that the wood was transformed by this process into a black mass having a bright lustre. It was perfectly compact, and, in fact, was a mass resembling pure anthracite. I do not know whether this experiment has been repeated: at all events, it is well worthy of further attention on the part of chemists and others. It has long been supposed that bituminous coal is converted into anthracite simply by the application of heat; but something more than this is required to satisfy the conditions, I am certain, for if it were simply a matter of heat, we ought to get not anthracite, but coke, and we ought to get also a proportionate increase in the quantity of fixed inorganic matter, or ash, in the coal. Thus, if I take a piece of bituminous coal which contains a certain amount of ash, say 5 per cent., and convert it into anthracite by exposing it to heat so as to dissipate a certain amount of volatile matter, or so-called bituminous matter, then the residue ought to contain a much larger proportion of ash, of course, than the bituminous coal upon which we have made the experiment; but in certain varieties of anthracite that assuredly is not the fact. We find some anthracites containing only a very small proportion of ash. Well, now, in this case it is clear that the anthracite cannot be the result of direct igneous action. I do not mean to assert this as a general rule, but if we establish the fact even in a few instances, it is sufficient to prove to us that there must have been some other condition obtaining, in order to account for the conversion of bituminous coal into anthracite. Now, what is that other possible condition? Well, it seems to me exceedingly probable, and to others also, though we are not in a position to establish it with certainty, that hot water has played an important part in this conversion—that the anthracite has been the result of thermo-hydric or hydrothermic action, and that the water has in some way or other removed to a large extent the inorganic matter, or ash. If water will make this change, as we believe it will, we get a clue to the mode in which coal has been formed—I do not say in every case, but in many. If, as Daubrée tells us, hot water converts wood into anthracite, *a fortiori* it will convert wood into bituminous coal.

We will pass on now to the consideration of diamond. I began on the last occasion to describe the physical properties of diamond. What we have to consider especially is the knowledge we have concerning the conditions under which diamond occurs in nature. It is a subject which has excited very great attention heretofore, and still occupies the attention of chemists and others; but, unhappily, so far all attempts to produce the diamond have been unsatisfactory in their results.

The diamond, undoubtedly, is one of the most beautiful gems in nature, as we are all prepared to admit. It crystallises in the cubical system—either as a regular octahedron, or in some form of the cube—the dodecahedron, and so on.

Now, there are many points concerning diamonds, which we observe in different specimens, calculated to throw some light, at all events, upon the subject of their formation. We have black diamonds; we have diamonds which have all the physical properties of the diamond save that of transparency; they are black and coke-like; they possess the crystalline structure of the diamond and the hardness of the diamond, and will cut glass like it. It is perfectly certain that ordinary diamonds cannot have been the result of exposure to a high temperature, for this reason: if we take an ordinary diamond and heat it strongly, we render it opaque and convert it into a coke-like mass. That settles the point of high temperature, I think, definitely.

Now, with regard to the matters included in diamonds. This is a subject which has received great attention, but much further information is required before we can arrive at anything like satisfactory conclusions. It has been said that crystals of gold have been found enclosed in diamonds. That, I believe, is a mistake, and that what has been supposed to be gold has, in reality, been another crystal of diamond. Now, if we had found a crystal of gold in diamond, or some readily fusible matter like gold, it is perfectly evident then that we get an indication as to temperature, and we should be justified from such an observation in concluding that the diamond could not have been the result of high temperature. Then, again, it has been asserted that iron pyrites has been found in diamonds, but that assertion requires further proof. It would be really a most important point to establish, as it would furnish a decided clue as to the mode of formation of diamond—or I ought to speak with rather more caution, and say it possibly might do so.

The diamond has often been made the subject of investigation by burning. Many a diamond has been burned in oxygen gas. Although it consists of pure carbon, yet it ignites with great difficulty under ordinary conditions. Still we can burn it, and convert it completely into carbonic acid by exposing it to a sufficiently high temperature in oxygen gas; and even, of late, experiments have been made with the diamond with regard to the production of steel. It has been found that diamond is capable of converting pure iron into steel, just as carbon in any other form produces steel. Take a piece of diamond, place it on a piece of iron, and heat them together in oxygen gas—not to a very high temperature; the diamond drills a hole in the iron, and forms a readily fusible compound of carbon and iron. Now, as to the results of the combustion of diamond, specially with regard to the residue which is left after such combustion—for that is the point which most concerns us. It appears that after such burning a little incombustible residue is left, which is described by some as a spongy network having a reddish-yellow colour at some times, as being at other times in the form of crystalline straw-coloured particles, and at other times as colourless and consisting, it is asserted, of crystalline fragments. Similar residues have been obtained from large diamonds and very carefully examined. This residue contains, we are informed, both silica and iron, and some have also asserted that an organic structure is to be found in this residue; but that is a point which requires further confirmation before we receive it as settled. If we could establish that point of organic structure in this residue, then, I think, we should be justified in coming to a conclusion that diamond must have been the result of some organic process, as is now supposed by a great many persons.

Let us next glance at the mode of occurrence of diamond in nature, and I will pass over this part of our subject as briefly as I possibly can. It is one of considerable interest.

Diamond occurs in a rock which is called itacolumite, from Itacolumi, the name of a town. It is nothing more than a quartzose rock. We have very fine specimens illustrating this point in the museum above. Itacolumite occurs in Brazil and elsewhere. We shall be struck with the remarkable similarity of the conditions under which diamond is found in different parts of the world. Itacolumite is a sort of sandstone which is soluble, granular, and very friable. It often contains talc, chlorite, and mica. It generally has a schistose or slate-like structure, and sometimes it is more or less flexible. It is said that hornblende is sometimes found in the schist accompanying this itacolumite. A paper on the occurrence of diamonds in South America was written a short time ago (in the year 1860), a translation of which is to be found in the *Annales des Mines* of that date. The paper is a very interesting one respecting the present important inquiry concerning the antiquity of man. The writer says, "A very curious fact is the discovery in the cascalho"—that is, the stuff in which the diamond is found—"of small fragments of quartz having the form of an anvil." These are evidently the work of human hands. They are very small, and they are supposed to have been used as ornaments. "They have been polished, and have no doubt," he says, "been made by the Indians, to whom they served as earrings." Then the paper states, "The cascalho is which they have been found had not been previously worked in historical times, and formed the bed of a river almost entirely dried up. It was found covered with more than six metres of vegetable soil"—nearly 19 feet—"on which had grown many magnificent palm trees." The authors go on to tell us that the polished cut quartz articles were accompanied by other articles, such as arrow points. There were also bones, and they conclude that these remains demonstrate very great antiquity with regard to man. I called attention to this subject last year. I do not know whether any further investigation has been made concerning it. It is well worthy of attention on the part of those who are concerned in this most interesting inquiry.

Before we deal with the theories of the production of the diamond, I may say that all experiments to make diamond have hitherto failed, and failed most completely. You will find in chemical works at different times processes described whereby carbon has been separated from combination, and obtained in a crystalline form; but all these statements, I believe, are entirely erroneous. There was a statement concerning the action of silver upon bisulphide of carbon, or of phosphorus upon bisulphide of carbon. We were told that the silver would lay hold upon the sulphur and separate the carbon gradually, and that the process required time. I tried this experiment with bisulphide of carbon and silver during ten years, but without success. It is true there was a darkening on the surface of the silver, showing the formation of sulphide of silver, but that arose from the fact that the bisulphide of carbon originally operated upon contained free sulphur. One gentleman especially has devoted much time in attempting to make diamonds, and some time ago I received a very minute quantity of crystalline matter for examination which it was thought might be diamond, but it turned out to contain about 99½ per cent. of silica. This shows how persons may make mistakes as to the results they obtain. Liebig has the notion that diamond is the result of the final natural decay of vegetable matter, but in nature we do not find diamond under those conditions where we observe these final products of natural decay—in our coal fields, for example. Anthracite is one of the final results of this decay; and no one, I believe, has ever found diamond in a coal field, where one ought to find it if it is the result of this final decay. We find graphite in nature, which is a crystalline form of carbon, just where we should expect to find it, but we do not find diamond there. There is nothing like substantial evidence to support Liebig's conclusion. At present it is a mere hypothesis: not one single substantial fact can be urged in support of it, except that which I mentioned a short time ago, if it be a fact—that of the occurrence of organic structure in diamond.

(To be continued.)

BRITISH ASSOCIATION, NOTTINGHAM MEETING.

Friday, August 24.

A Lecture "On the Results of Spectrum Analysis, as applied to the Heavenly Bodies," by William Huggins, *F.R.S.*

(Continued from page 200.)

NEBULÆ.

I pass now to objects of another order.

When the eye is aided by a telescope of even moderate power, a large number of faintly luminous patches and spots come forth from the darkness of the sky, which are in strong contrast with the brilliant, but pointlike images of the stars. A few of these objects may be easily discerned to consist of very faint stars closely aggregated together. Many of these strange objects remain, even in the largest telescopes, unresolved into stars, and resemble feebly shining clouds, or masses of phosphorescent haze. During the last 150 years, the intensely important question has been continually before the mind of astronomers, "What is the true nature of these faint comet-like masses?"

The interest connected with an answer to this question has much increased since Sir William Herschel suggested that these objects are portions of the primordial material out of which the existing stars have been fashioned, and further that in these objects we may study some of the stages through which the suns and planets pass in their development from luminous cloud.

The telescope has failed to give any certain information of the nature of the nebulæ. It is true that each successive increase of aperture has resolved more of these objects into bright points, but, at the same time, other fainter nebulæ have been brought into view, and fantastic wisps and diffused patches of light have been seen, which the mind almost refuses to believe can be due to the united glare of innumerable suns still more remote.

Spectrum analysis, if it could be successfully applied to objects so excessively faint, was obviously a method of investigation specially suitable for determining whether any essential physical distinction separates the nebulæ from the stars.

I selected for the first attempt, in August, 1864, one of the class of small but comparatively bright nebulæ.

My surprise was very great, on looking into the small telescope of the spectrum apparatus, to perceive that there was no appearance of a band of coloured light, such as a star would give, but, in place of this, there were three isolated bright lines only.

This observation was sufficient to solve the long-agitated inquiry in reference to this object at least, and to show that it was not a group of stars, but a true nebula.

A spectrum of this character, so far as our knowledge at present extends, can be produced only by light which has emanated from matter in the state of gas. The light of this nebula, therefore, was not emitted from incandescent solid or liquid matter, as is the light of the sun and stars, but from glowing or luminous gas.

It was of importance to learn, if possible, from the position of these bright lines, the chemical nature of the gas or gases of which this nebula consists.

Measures, taken by the micrometer, of the most brilliant of the bright lines, showed that this line occurs in the spectrum very nearly in the position of the brightest of the lines in the spectrum of nitrogen. The experiment was then made of comparing the spectrum of nitrogen directly with the bright lines of the nebula. I found that the brightest of the lines of the nebula coincided with the strongest of the group of lines which are peculiar to nitrogen. It may be, therefore, that the occurrence of this one line only, indicates a form of matter more elementary than nitrogen, and which our analysis has not yet enabled us to detect.

In a similar manner the faintest of the lines was found to coincide with the green line of hydrogen.

The middle line of the three lines which form the spectrum of the nebula, does not coincide with a very strong line in the spectra of about thirty of the terrestrial elements. It is not far from the line of barium, but it does not coincide with it. Besides these bright lines there was also an exceedingly faint continuous spectrum. The spectrum had no apparent breadth, and must therefore have been formed by a minute faint light. Now, this nebula possesses a minute but bright nucleus. We learn from this observation that the matter of the nucleus is almost certainly not in a state of gas, as is the material of the surrounding nebula. It consists of solid matter, which may exist in the form of an incandescent fog of solid or liquid particles.

The new and unexpected results arrived at by the prismatic examination of this nebula, showed the importance of examining as many as possible of these remarkable bodies. Would all the nebulæ give similar spectra? Especially it was of importance to ascertain whether those nebulæ, which the telescope had certainly resolved into a close aggregation of bright points, would give a spectrum indicating gaseity.

The observation, with the prism, of these objects is extremely difficult on account of their great faintness. Besides this, it is only when the sky is very clear and the moon is absent that the prismatic arrangement of their light is even possible. During the last two years I have examined the spectra of more than sixty nebulæ and clusters. These may be divided into two great groups. One group consists of the nebulæ which give a spectrum similar to the one I have already described, or else of one or two only of the three bright lines. Of the sixty objects examined about one-third belong to the class of gaseous bodies. The light from the remaining forty nebulæ and clusters becomes spread out by the prism into a spectrum which is apparently continuous.

I will exhibit upon the screen diagrams of a few of the more remarkable of the nebulæ which are gaseous in their constitution.

(To be continued.)

ACADEMY OF SCIENCES.

October 22.

At the sitting this day the first communication read was an article

"*On the Theory of Heat according to the Vibratory Hypothesis*," by M. Babinet. The author has gone rather deeply into the mathematics of the question, but he bases his arguments upon one or two observations which are somewhat novel. Thus, it was found by MM. Favre and Silbermann that the decomposition of oxide of silver took place with the loss of a very insignificant amount of heat. They also found that in the decomposition of oxygenated water there is a large evolution of heat, and the same phenomenon is observed in most chemical combinations. M. Babinet has investigated these several phenomena mathematically, and explained them. He then discusses the cause of the evolution of heat in the combustion of sulphur, oxide of carbon, and hydrogen.

"*On the Harmony of the Molecule of Ammoniacal Alum*," by M. Gaudin. Possessing special and exclusive information as to the exact arrangement of the molecules of organic or inorganic chemical compounds, M. Gaudin from time to time enlightens his fellow-chemists on this important subject. In this paper we are informed that the "molecule of ammoniacal alum is composed of an axis of seven atoms, around which are arranged thirty-two linear molecules of three atoms, representing four molecules of sulphurous acid and twenty-eight molecules of water. The axes of seven atoms form three perpendicular lines between them, two by two, where the atoms figure always A between two B, as the rows with three atoms between them to form nets, as the nets between them to form masses, as the masses between them to form the molecule." The author concludes—"From this it must be felt that my system cannot but be true, or I should have found something more beautiful than nature." We have not the least doubt of it.

"*Note on the Employment of a Double Wire Rheometer in Experiments on Radiant Heat*," by M. P. Desains. The author employs a kind of differential apparatus essentially composed of a single source of heat, of two piles, of a double wire rheometer, and finally of a rheostat. The apparatus is so arranged that the equilibrium, once obtained, remains uniform however the heat from the source varies; but if the smallest variation takes place in one of the radiations the needle quits the zero point. The author has applied this apparatus to the examination of the absorption of heat by transparent gases, and finds that it gives very delicate and certain indications.

"*On Coriamyrtin and its Derivatives*," by M. Y. Riban. This is a continuation of a paper read on the 17th of September last. He now assigns to it the formula $Ɵ_{30}H_{36}O_{10}$. Bromine and iodine compounds have been prepared and examined, and the action of bases and acids upon it is described.

"*On the Analysis of the Milk of the Cat*," by M. A. Commaille. He finds that this milk affords a very substantial nourishment, rich in albuminoid matters. We trust the hint will not be thrown away upon enterprising physicians of the metropolis, which would afford peculiar facilities for the stocking and maintenance of diminutive dairy farms.

REPORT ON THE
CHEMICAL LABORATORIES
IN COURSE OF ERECTION IN THE
UNIVERSITIES OF BONN AND BERLIN.

The Chemical Laboratories of the Rhenish Frederick William University of Bonn.

(*Continued from page 199.*)

The Ground Floor.

As this floor had to contain no less than forty-four rooms, exclusive of vestibule, corridors, and closets, its dimensions must necessarily be very considerable. The ground floor (Fig. 2, page 211) is shown on a scale of $\frac{1}{100}$th of the real size, a proportion retained in all the drawings illustrating the Report on the Bonn institution, with the exception only of the plan of situation. The experienced eye will rest with pleasure on the beautiful outlines of the building symmetrically developed in every direction. Four outer wings enclose an area of very considerable size, divided into four quadrangles or courts by a cruciform interior building. Those parts of the edifice surrounding the two back courts are exclusively devoted to the purposes of practical instruction in chemical analysis and research. The wing of the central structure which separates the two front courts from each other includes the lecture theatre, with the rooms pertaining to it; in the south-west side wing of the left front court is the private laboratory of the director, with the rest of the rooms devoted to his use. The corresponding north-east side wing of the right front court is occupied by the apartments of the assistants and other officers. The ground floor of the front part of the building, lastly, is devoted to the scientific collections of the institution and a small theatre for special lectures.

We shall first consider the distribution of space on the ground floor, which, as already stated, constitutes the main part of the building. The several apartments marked by letters are specified by name in the synopsis (page 212), in which the dimensions of each room are likewise given.

The following remarks may assist the reader in understanding the objects for which the various rooms are destined, and their situation with regard to one another:—

The main entrance for students, as well for those working in the laboratory as for those who only attend the lectures, lies in the principal side-front facing the city of Bonn.

After ascending the massive flight of stairs, we enter the large vestibule (A), the rich architectural decoration of which at once bespeaks the dignity of a great public building dedicated to science. Before the spectator stretches a long corridor (*a a a*) of considerable width, the main artery of the entire building. It is brilliantly lighted by a number of windows* on the left side. The large folding doors at the further end of the corridor, visible from and directly

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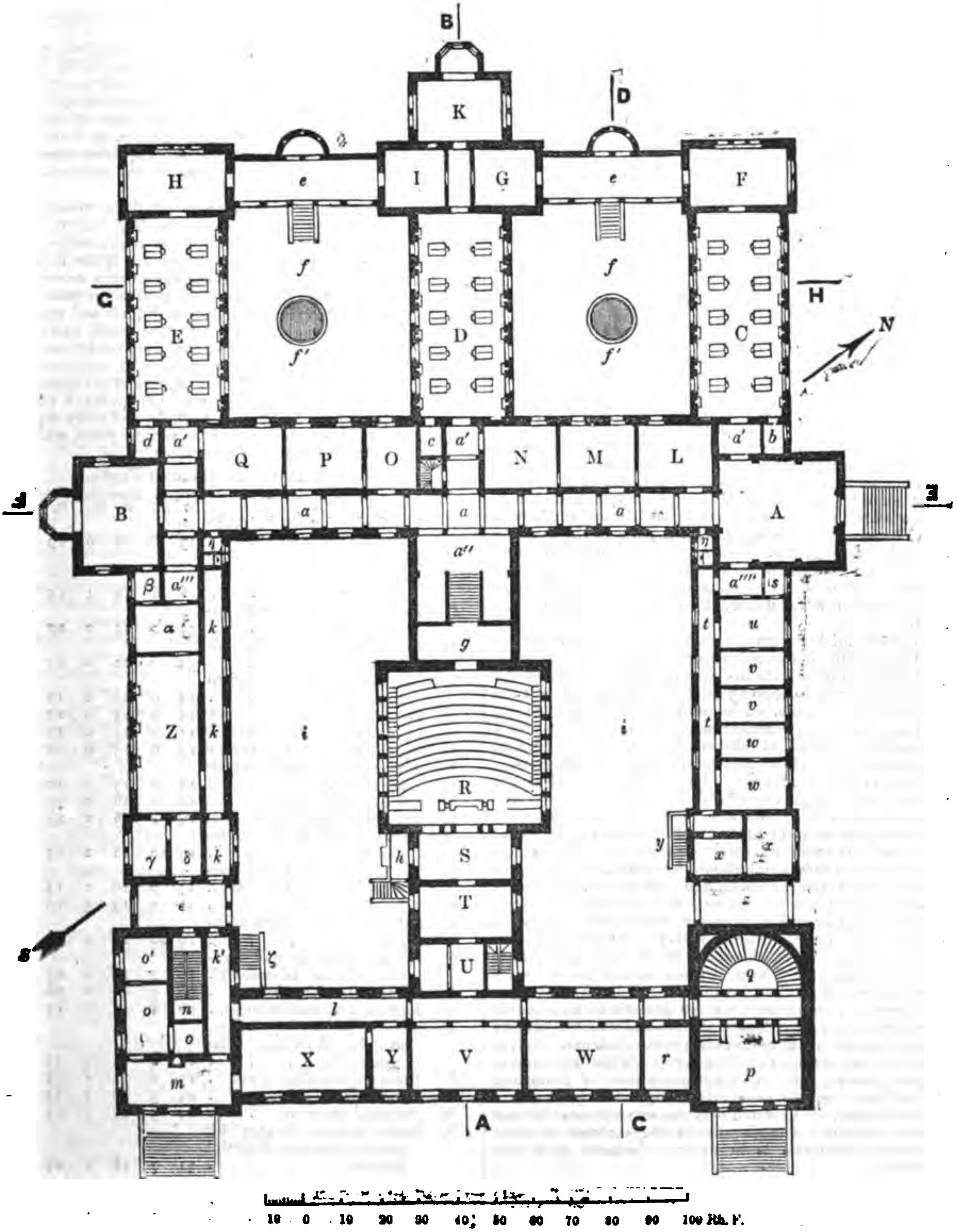
* These, as well as all other windows facing the courts, are 9 feet in height and 4 feet wide, whilst the external windows of the ground floor are 9 feet high and 4 feet 3 inches wide.

FIG. 2.
ROOMS ON GROUND FLOOR.



opposite to the main entrance, lead to the director's spacious study (B), which is provided with a large bay-window for microscopic observation; from this central situation the various parts of the great building are quickly and easily accessible.

On the right side the great corridor branches out into three side-corridors (a', a', a'), leading to the entrance of the three principal laboratories (C, D, E).

Each of these three laboratories, profusely lighted by ten windows, symmetrically arranged on the two sides, provides twenty students with more than sufficient space and every convenience for work.

Permanent working places for sixty students — the number which, as already mentioned, the institution is to accommodate—were thus secured. According to this disposal of the space, the students range themselves in three classes:—

1. Beginners—that is to say, those who, having become acquainted with the rudiments of chemistry by attending lectures, enter the laboratory to practise chemical manipulation, to make preparations, and to go through an elementary course of qualitative analysis.

2. Advanced students, or those who, having acquired practice in qualitative experiments, are occupied with quantitative analysis, both ponderal and volumetric.

3. Young chemists, sufficiently conversant with the principal departments of the science to engage in original experimental investigations, either suggested by the director or chosen by themselves.

A division of this nature, whereby the three classes are distributed in separate rooms, seemed expedient for more than one reason. Not only was it possible to fit up each laboratory in a manner suitable to the wants of each particular class, but the situation of the rooms themselves could be so adapted to the remaining parts of the building as to offer the greatest facilities to each division. And even greater advantages as regards readier supervision and increased means of maintaining discipline in all parts of the institution were afforded by an arrangement of this kind.

The good arising from a large number of students working together in an extensive institution is unmistakable. If the student only have his eyes open to the work of his neighbours, he has opportunities of gaining, in a comparatively short time, an amount of experience which, working alone or in company with few, he could scarcely gather during years of diligent labour. The chemical atmosphere in which he breathes promotes his progress.

These advantages, on the other hand, cease when the number of learners exceeds those limits within which personal supervision is possible. Whenever the beginner is conscious that he is unable to procure help at any moment; whenever the more advanced student feels that he no longer receives individual attention; lastly, whenever the young chemist, though working independently, is no longer satisfied that an experienced eye watches over his steps, the chemical institution, however excellently it may be organised in other respects, will yield very indifferent results indeed. It is, therefore, of the first importance for the director of such an institution to have the necessary amount of teaching power at his command. According to the Reporter's experience, it is not possible for an assistant to superintend, for any length of time and with satisfactory results, the labours of more than twenty students. Acting upon this experience, the Minister of Public Instruction decided to appoint for the institutions both of Bonn and Berlin three scientific assistants, who, under the guidance of the director, are to watch over the experimental labours of the students. The disposal of the students in three separate laboratories is in exact accordance with this provision.

Of these three laboratories, all accessible, as has been stated, from the main corridor, the one (C) on the right side of the vestibule is apportioned to the beginners, and will, to avoid unnecessary repetition, be called the First Laboratory; the central one (D) is set apart for advanced students, and will be known as the Second Laboratory; whilst that (E) in the immediate neighbourhood of the director's study will be occupied by young chemists engaged in original investigations, and will be designated as the Third Laboratory.

In these three laboratories the students have their permanent working places. To each one is allotted, for this purpose, a table amply supplied with gas and water, as well as lock-up drawers and cupboards in which to keep apparatus, reagents, &c.—in a word, his entire chemical estate, so to speak. At these working benches, all ordinary chemical work and all operations, not requiring special arrangements provided in other parts of the institution, are carried on.

Considering the great importance of these rooms, a strong temptation presents itself to the Reporter to give here an exhaustive description of their organisation, on which the utmost care has been bestowed. If he resists this temptation, it is partly because the various arrangements, especially the appliances for general ventilation and the tubes for carrying off injurious liquids and gases, though provided for even to the minutest detail, exist as yet only in their first rudiments, and may consequently be still materially modified in the process of completion, and partly because too detailed a description of the internal fittings of each room would prevent his giving a clear general outline of the building as a whole, and more especially of the mutual connexion of its various parts, which after all must be the object of this report.

SYNOPSIS OF ROOMS ON GROUND FLOOR.

	Name of Room.	Length.		Breadth.		Height.	
		ft.	in.	ft.	in.	ft.	in.
A	Vestibule of main entrance on north-east side . .	29	8	26	6	29	0
B	Director's study, with bay window for microscopic observation . . .	26	6	19	4	15	0
C	First laboratory, for beginners	54	0	22	0	17	0
D	Second laboratory, for advanced students . .	54	0	22	0	17	0
E	Third laboratory for original research	54	0	22	0	17	0
F	Operation room, laboratory C	25	6	15	0	17	0
G	Operation room, laboratory D	15	0	15	0	17	0
H	Operation room, laboratory E	25	6	15	0	17	0
I	Ante-room of gas analysis laboratory . . .	15	0	15	0	17	0
K	Gas analysis laboratory .	22	0	16	0	17	0
L	Room for volumetric analysis	19	2	16	2	15	0
M	Balance-room of second laboratory . . .	19	10	16	2	15	0
N	Room for fusions and ignitions of second laboratory.	19	7	16	2	15	0
O	Library	16	2	13	3	15	0
P	Balance-room of third laboratory	19	10	16	2	15	0
Q	Room for fusions and ignitions of third laboratory .	19	7	16	2	15	0
R	Great lecture theatre . .	40	0	40	0	28	0
S	Lecture preparation room .	25	8	18	0	15	6
T	Store-room for apparatus, models, drawings, diagrams, &c. . . .	25	8	13	10	15	6
U	Professor's waiting-room .	17	6	12	1	15	6
V	Mineralogical museum .	29	5	18	1	15	6
W	Chemical museum . .	29	5	18	1	15	6
X	Small lecture theatre for recapitulations and special lectures	31	7	18	1	15	6
Y	Waiting and preparation room for small lecture theatre	18	1	8	11	15	6

	Name of Room.	Length.		Breadth.		Height.	
		ft.	in.	ft.	in.	ft.	in.
Z	Director's private laboratory	40	1	15	11	15	0
a, a, a	Main corridor of institution	144	8	9	0	15	0
a', a', a'	Passages leading to principal laboratories	…		…		…	
a''	Staircase and passage leading to great lecture theatre	25	8	9	0	26	0
a'''	Side passage to director's private laboratory	17	6	9	0	15	0
a''''	Side passage to wing containing assistant's apartments	8	9	9	0	14	0
b	Closets attached to laboratories for apparatus and instruments	7	5	5	8	15	0
c				5	8		
d				5	0		
e, e	Roofed colonnades for open-air work	37	3	10	0	14	0
f, f	Back courts of institution	56	1	46	10		
f', f'	Reservoirs in the back courts (10 feet in diameter)	…		…		…	
g	Landing overlying thoroughfare between the two front courts	29	2	9	0	13	0
h	Platform leading from lecture preparation room down into front court	12	0	5	0		
i, i	Front courts of institution	115	6	45	0		
k, k, k	Corridor of front side wing facing south-west	62	9	4	9	15	0
k'	Prolongation of corridor (k) into front block	15	0	6	6	15	0
l	Corridor of front block	41	10	6	3	15	6
m	Vestibule of left main entrance of front façade	27	8	11	9	15	6
n	Side staircase of left main entrance leading to director's residence on first floor	…		…		…	
o, o	Third assistant's apartments	18	4	11	6	15	6
o'	Room belonging to third assistant's apartments	11	9	11	6	15	6
p	Vestibule of right main entrance of front façade	27	8	21	1	15	6
q	Main staircase of right entrance leading to director's residence on first floor	…		…		…	
r	Porter's lodge in main entrance	18	1	11	0	15	6
s	Porter's lodge in main side entrance	7	5	5	8	14	0
t, t	Corridor of front side wing facing north-east	62	9	4	9	14	0
u	Cloak-room	15	11	13	7	14	0
v, v	Castellan's room	15	11	8	2	14	0
w, w	First assistant's apartments	15	11	8	2	14	0
				13	7		
x, x	Second assistant's apartments	12	4	9	5	14	0
				15	0		
y	Staircase leading from right front court to the apartments of assistants and castellan	…		…		…	
z	Carriage-way to right front court	25	6	11	0	…	
α	Director's waiting-room	15	11	13	7	15	0
β	Passage connecting director's waiting-room and study	7	5	5	8	15	0
γ	Director's balance-room	15	0	8	5	15	0
δ	Director's fusion, ignition, and combustion room	15	0	8	5	15	0
ε	Director's roofed colonnade for open-air work	22	0	11	0	15	0
ζ	Steps leading from left end of front block down to left front court	…		…		…	
η, η	Closets	7	11	4	9	15	0

Turning now our attention to the side apartments attached to the three laboratories, we have, in the first place, to mention three Closets (*b*, *c*, *d*) in direct communication with the main rooms. They are in charge of the respective assistants. and are intended for preserving delicate and costly apparatus, platinum and silver vessels, expensive reagents, everything, in fact, of which special care has to be taken. Two of these closets (*b* and *d*), belonging to the laboratories in the wings of the building, are lighted from the side, the central one (*c*) by means of a skylight.

In the three laboratories the students, as already stated, have their permanent benches allotted to them. Now, though working space has been most liberally provided, and gas and water amply supplied in these rooms, which are, moreover, furnished with every facility for carrying off vapours and liquid products, there are still certain operations which cannot be well conducted in them.

On this account they are connected with a series of rooms devoted to special purposes. There are, in the first place, to be mentioned three rooms (F, G, H) directly communicating with the laboratories, and situated opposite to their main entrances; we will call them, for the sake of distinction, Operation Rooms.

All kinds of work, such as distillations, making of gases, heating of bodies in particular gas-atmospheres—in short, all experiments requiring large and complicated apparatus—are conducted at the benches fitted up in these rooms or in the "evaporation niches" let into their walls. Should, however, on any particular occasion, even more space be required, were it likely that, in spite of the excellent draught of the chimneys, noxious vapours might escape into the rooms, or were, lastly, sulphur compounds to be prepared, like mercaptan or similar substances, the disgusting smell of which would infect the air of the operation rooms and of all the adjoining apartments, provision has likewise been made for such contingencies. Each operation room communicates with a covered Colonnade (*e*, *e*), opening towards a back court, and fitted up with gas and water and all the requisites for work. From these colonnades, the basement of the building, containing a variety of rooms devoted to the objects of the institution and more especially the metallurgical laboratories, is accessible by means of spiral staircases placed in spacious semicircular projections from the outer walls. Flights of steps, on the other hand, lead from the open sides of the colonnades down to the two Back Courts (*f*, *f*) lying between the three laboratories, and here the student finds an additional supply of water in the large central Reservoirs (*f'*, *f'*), the tabular parapets of which serve as working benches for a variety of operations. The colonnades afford, moreover, facilities for passing at the back from one laboratory to the other, communication between those three important parts of the institution being thus by no means confined to the large corridor (*a*, *a*, *a*) in front.

The three operation rooms, situated behind their respective laboratories, are not of equal dimensions. In apportioning their size, especial attention had to be paid to the wants of the beginner and of the independent worker. The beginner who practises the various forms of chemical manipulation, as preparing gases, making chemical preparations of all kinds, &c., requires ample space. In like manner the young chemist, engaged in actual research, may at any moment have to fit up new or reconstruct old apparatus, often of a complicated nature, for the particular objects of his investigation; tools of the most various description—hammers, files, vices, &c.—are thus constantly required, not to mention the blowpipe-table, which is scarcely ever at rest. For him too it is of vital importance that he should not be cramped in space. For this reason the operation rooms (F and H), connected with the two wing laboratories and expressly intended for the classes just mentioned, are made as large as possible.

The students of the second laboratory, principally occupied with quantitative analysis, for the special operations of which several other places, described below, are provided, have therefore had a less spacious operation room (G) allotted to them. By this arrangement an additional small apartment was gained, symmetrical with the operation room, and serving as approach to a very important part of the institution—viz., the Laboratory for Gas Analysis (K). This spacious apartment, which probably will be divided into several parts, projects from the middle of the building at the back, and is thus almost equally accessible from the three laboratories. It is, on the other hand, sufficiently removed, more especially by the intervening Ante-room (I), from those parts of the building where the chemical business of the institution is most active, to allow of the delicate measurements here made being carried out without disturbance.

The laboratory for gas analysis is lighted by two large side windows and also by three smaller windows situated in a central projection; but all the light coming from the south, already partially intercepted by the third laboratory with its operation room, can be shut out by means of strong well-closing shutters, thus securing to this apartment the uniform temperature so important in gas analysis.

The operation room (G) of the second laboratory, the ante-room (I) to the gas analysis laboratory, and the passage between these two apartments, are lighted by skylights.

(To be continued.)

NOTICES OF BOOKS.

A Description of the new Telescopes with Silvered-glass Specula; and Instructions for adjusting and using them. By John Browning, F.R.A.S., F.M.S., F.M.S.E. London: Straker and Sons.

This is a very useful little book on a subject which is attracting increasing attention amongst men of science. The author is well known by the valuable optical *instruments of precision* which have been issued from his workshops, and we are glad to see that he has now been induced to turn his attention to the grinding and manufacture of silvered-glass reflectors having the proper parabolic curvature.

There are few chemists who have not at one time or another felt the want of a good process for silvering glass surfaces. Many descriptions are to be found in books, but they do not always fulfil the promises made for them by their authors; our readers will, therefore, be glad to preserve for future reference the following excellent description, which we quote from this work:—

"*To Silver Glass Specula.*

"Prepare three standard solutions:—

"*Solution* A.—Crystals of nitrate of silver, 90 grains; distilled water, 4 ounces. Dissolve.

"*Solution* B.—Potassa, pure by alcohol, 1 ounce; distilled water, 25 ounces. Dissolve.

"*Solution* C.—Milk sugar (in powder) ½ ounce; distilled water, 5 ounces. Dissolve.

"Solutions A and B will keep, in stoppered bottles, for any length of time. Solution C must be fresh.

"*The Silvering Fluid.*—To prepare sufficient for silvering an 8-inch speculum:—Pour 2 ounces of solution A into a glass vessel capable of holding 35 ounces. Add, drop by drop, stirring all the time (with a glass rod), as much liquid ammonia as is just necessary to obtain a clear solution of the grey precipitate first thrown down. Add 4 ounces of solution B. The brown-black precipitate formed must be just re-dissolved by the addition of more ammonia, as before. Add distilled water, until the bulk reaches 15 ounces, and add, drop by drop, some of solution A, until a grey precipitate, which does not re-dissolve after stirring for three minutes, is obtained; then add 15 ounces more of distilled water. Set this solution aside to settle. Do not filter. When all is ready for immersing the mirror, add to the silvering solution 2 ounces of solution C, and stir gently and thoroughly. Solution C may be filtered.

"*To Prepare the Speculum.*—Procure a circular block of wood 2 inches thick, and 2 inches less in diameter than the speculum. Into this should be screwed three eye-pins, at equal distances. To these pins fasten stout whipcord, making a secure loop at the top. Melt some pitch in any convenient vessel, and having placed the wooden block face upwards on a level table, pour on it the fluid pitch, and on the pitch place the back of the speculum, having previously moistened it with a thin film of spirit of turpentine, to secure adhesion. Let the whole rest until the pitch is cold.

"*To clean the Speculum.*—Place the speculum, cemented to the circular block, face upwards, on a level table, pour on it a small quantity of strong nitric acid, and rub it gently all over the surface with a brush made by plugging a glass tube with pure cotton wool. Having perfectly cleaned the surface and sides, wash well with common water, and finally with distilled water. Place the speculum face downwards in a dish containing a little rectified spirit of wine, until the silvering fluid is ready.

"*To Immerse the Speculum.*—Take a circular dish about 3 inches deep, and 2 inches larger in diameter than the speculum. Mix in it the silvering solution and the solution C, and suspend the speculum, face downwards, in the liquid, which may rise about ¼ of an inch up the side of the speculum.* When the silvering is completed, remove the speculum from the solution, and immediately wash with plenty of water, using at least 2 gallons, and finally with a little distilled water. Place the speculum on its edge on blotting paper to drain and dry. When perfectly dry, polish the film by gently rubbing, first with a piece of the softest wash-leather, using circular strokes, and finally with the addition of a little finest rouge. A 'flat' may be silvered by fastening with pitch to a slice of cork, cleaning as above described, and using as much silvering fluid as will form a stratum about ½ inch deep beneath the mirror."

In addition to the above, the reader will find a clearly written description of reflecting telescopes, mounted on alt-azimuth and equatorial stands, with directions for using and preserving the silver surface of the speculum, and on working glass specula, &c. Not the least interesting part of the book will be found on the last few pages, which contain price-lists of all that can be of interest to the astronomer or man of science in the way of specula, silvered and unsilvered, telescopes mounted and unmounted, together with "perfect planes," prisms, and spectroscopes.

Outline Facts of Chemistry, with Exercises; intended chiefly for Pupils in Government Science Classes. By T. Ward, F.C.S. Parts I. and II. London: Simpkin and Marshall. Manchester: Heywood. 1866.

A notice of the first part of this work appeared in vol. xiii., p. 117, of the Chemical News. The second part, which treats of the metals and their compounds, is now published, and the two are bound together, forming a convenient-sized note-book for the pocket. The new notation is adopted throughout, and tables of the Centigrade and Fahrenheit scales and the French weights and measures are supplied, together with exercises, by means of which the student may test his proficiency. The more important facts are given in larger type for the use of beginners, and a copious index supplies a ready means of reference. We may safely predict a favourable reception for this little book.

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* The silvering will be completed in from 50 to 70 minutes, according to temperature; 50 minutes will be found sufficient in summer.

CONTEMPORARY SCIENTIFIC PRESS.

[Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted.]

Annalen der Chemie und Pharmacie. No. 1. July.

"*Researches on Isomerism in the Benzoic Series.*" "*On Amido-benzoic Acid and Amido-dracylic Acid,*" by F. Beilstein and P. Geitner.

"*On the Formation of Glycerine from Trichlorhydrin,*" by E. Linnemann.

"*On the Chemical Constituents and Colouring Matter of some Lichens* (*Rocella fuciformis*, Acharius; *Rocella tinctoria*, De Candolle)," by O. Hesse.

"*On Turpeth Resin,*" by H. Spirgatis.

"*On Crotonic Acid,*" by C. Bulk.

"*On an Improved Gas Combustion Furnace for performing Organic Analyses,*" by E. Erlenmeyer.

"*On an Apparatus for heating Substances enclosed in Sealed Tubes,*" by the same author.

"*On the Products of the Decomposition of certain Resins by Fusion with Potash,*" by H. Hlasiwetz and L. Barth.

"*On the Artificial Formation of Resins,*" by the same authors.

"*On Eugenic Acid,*" by H. Hlasiwetz and A. Grabowski.

"*On Umbelliferone,*" by the same authors.

No. 2. August.

"*On Malonic Acid,*" by C. Heintzel.

"*Researches on the Oxacids of the Aromatic Series,*" by C. Graebe.

"*On the Behaviour of Anisol towards Hydriodic Acid,*" by the same author.

"*On the Action of Sulphurous Acid on Hydrated Oxide of Platinum,*" by C. Birnbaum.

"*On Ditolyl, a New Compound Isomeric with Dibenzyl,*" by R. Fittig.

"*On Methyl-xylol and Ethyl-xylol,*" by T. Ernst and R. Fittig.

"*On some New Derivatives of Valerianic Acid,*" by J. Clark and R. Fittig.

"*On the Action of Hydriodic Acid on Glycerine,*" by E. Erlenmeyer.

"*On the Action of Bromacetic Acid on Aniline,*" by C. Michaelson and E. Lippmann.

"*On the Composition of Wiserine,*" by V. Wartha.

"*On a New Series of Hydrocarbons,*" by C. Schorlemmer.

"*On Borocalcite,*" by K. Kraut.

No. 3. September.

"*Researches on Isomalic Acid,*" by H. Kammerer.

"*On some Decompositions of Chloride of Ethyl,*" by L. Meyer.

"*On some Chlorinated Substitution Products of Toluol,*" by H. Limpricht.

"*On Isomerism in the Benzoic Series: On the Behaviour of the Homologues of Benzene towards Chlorine,*" by F. Beilstein and P. Geitner.

"*On the Compounds produced by the Action of Absolute Alcohol on Terchloride of Phosphorus,*" by M. Meuschutkin.

"*On a New Series of Organic Sulphur Compounds,*" by A. Saytzeff.

"*On Ethyl-Sulphurous Acid,*" by G. Wischin.

Why?—We cut the following from yesterday's *Times*:—"We have been given to understand that her Majesty has been pleased, on the recommendation of Lord Derby, to grant to Dr. Arthur Hill Hassall, the eminent physician and analyst, a pension from the Civil List, in recognition of his public services."

NOTICES OF PATENTS.

No. 484. *Compound for preventing and removing Incrustation in Steam Boilers, &c.* Peter Ward, Bristol. Dated February 15, 1866.

This invention has for its object improvements in preparing materials for preventing and removing incrustation in steam boilers, for lubricating machinery, and for scouring cloth and other substances. In preparing the compound for the prevention and the removing of incrustations in steam boilers, the patentee uses 5 cwt. of commercial caustic soda, 10 cwt. of dry peat in a pulverised state, and about 10 cwt. to 15 cwt. of water. The whole is put into a cast-iron pan and boiled until all the peat has become dissolved, and the evaporation may be continued until the mass has become so far concentrated that when cold it will be about the same consistency as soft soap. When caustic potash is used, the proportions should be regulated according to the strength or quality of the alkali employed, 9 cwt. of commercial potash (containing 48 per cent. of potash) being about equivalent to the 5 cwt. of soda in the soda compound. In preparing water for use in steam boilers, he adds from ¼ to 1½ lbs. of either of the above compounds to each 100 gallons of water (an excess of compound will do no harm), according as the water contains more or less earthy matter in solution. In preparing lubricating grease from the above compound, he mixes therewith enough of petroleum or other cheap oil or fatty matter to give the compound a good lubricating quality. 12 cwt. of the peat compound and 8 cwt. of petroleum oil make a very suitable grease for any ordinary purpose. The oil or other fatty matter should be mixed with the peat compound whilst hot, and agitated from time to time until cold, when it will be ready for use for lubricating in lieu of oil or grease. In preparing the compound for scouring purposes, soft or hard soap may be combined therewith whilst in the process of preparing.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

2360. A. Cairns, Liverpool, "Improvements in the construction of liquid compasses."—Petition recorded Sept. 14, 1866.

2400. A. R. Stark, Woolwich, Kent, "Improvements in the manufacture of gas."—Sept. 18, 1866.

2470. G. E. Van Derburgh, New York, U.S.A., "Improvements in the composition and production of artificial stone cements and other compositions."—Sept. 25, 1866.

2593. G. T. Bousfield, Loughborough Park, Brixton, Surrey, "Improvements in separating sulphur from soda waste."—A communication from P. W. Hofmann, Ph D., Dieuze, France.—Oct. 6, 1866.

2607. T. Outram, Grutland, near Halifax, "Improvements in the manufacture of cast iron."—Oct. 9, 1866.

2623.—A. H. Brandon, Rue Gaillon, Paris, "Certain new and useful improvements in electrical apparatus."—A communication from G. L. Leolanché, Paris.—Oct. 10, 1866.

Notices to Proceed.

1633. W. B. Brown, Manchester, "An improved anti-acid oil."—Petition recorded June 16, 1866.

1640. W. B. Patrick, Mincing Lane, London, "Improvements in the treatment of animal charcoal used by sugar refiners or others in order to its re-use."—June 18, 1866.

1642. A. Paraf, Manchester, "Improvements in fixing colouring matters on textile fabrics, yarns, or other materials."—June 19, 1866.

1657. J. Möller, Shaftesbury Villas, Hornsey Rise, Islington, Middlesex, "Improvements in obtaining and preparing colouring matter for printing, dyeing, and other purposes"—June 20, 1866.

CORRESPONDENCE.

Manufacture of Tetrachloride of Carbon.

To the Editor of the Chemical News.

Sir,—Before reading Dr. Müller's letter in the Chemical News of October 9, I had no knowledge whatever of the results which had been obtained by him. Having read the paper to which he refers, I fully admit the justice of his claim.

I do not understand him to state in his letter that he was aware that tetrachloride of carbon could be produced as an article of commerce by the reaction in question.

I am, &c. C. Crump.

Southcombe, Paignton, October 28.

Process for the Estimation of Resin in Soaps.

To the Editor of the Chemical News.

Sir,—In an article under the above heading, by Mr. G. Sutherland, which appeared in the last number of the Chemical News, the author, after first decomposing the soap with hydrochloric acid, treats the mixture of the resinous and fatty acids with nitric acid at a boiling temperature, his object being to convert the resinous acids into the soluble terebic acid, and to leave the weight of the fatty acid present unaltered; but I am afraid our friend has overlooked the facts that stearic acid is converted immediately into margaric acid, and that margaric and oleic acids, by boiling with nitric acid, furnish the homologous members of the acetic series, down to rutic acid,

$$\left.\begin{matrix}C_{10}H_{19}O\\H\end{matrix}\right\}O,$$

and also five members of the succinic acid series. So that, instead of giving the weight of the fatty acid in the soap, this process gives the weight of the acids of the acetic series which have not been washed away or volatilised at the low temperature mentioned. The members of the succinic acid series will have been removed by the washing, so that the results obtained are in truth of no value. I am, &c. S. H. J.

Wolverhampton, October 23.

MISCELLANEOUS.

Two Cases of Poisoning by the External Use of Belladonna.—The volume of "London Hospital Reports" just issued contains accounts of two cases in which severe symptoms of poisoning were produced by the external application of belladonna preparations. They are so interesting, and a wide knowledge of them may be so useful, that we quote them at some length. The first was the case of a nobleman for whom a liniment containing two drachms of liquor belladonnæ in two ounces of soap liniment had been ordered. After using it he hastily summoned his physician, who found him with all the usual symptoms of poisoning by belladonna—widely-dilated pupils, considerable cerebral excitement, and rapid pulse. Another liniment without the belladonna was prescribed, and the doctor left. The next day he was again hastily summoned, and found his patient with a solicitor, three keepers, and a "mad doctor," who had already signed a certificate of insanity. It turned out that the liniment containing belladonna had by mistake been applied a second time, and hence a return of the cerebral excitement rather exaggerated. We need not describe the delusions of the patient. Dr. Brown soon explained to the "learned psychologist" and the solicitor that the patient's state was attributable to the belladonna, and that the symptoms would quickly disappear, as indeed they did. "The case," remarks Dr. Brown, "is instructive, first of all as illustrating the small quantity of this drug from either the external or internal use of which symptoms of poisoning may arise; in the next, to act as a danger signal, to warn us from incarcerating, upon a single interview, a patient of whose history and previous treatment we know nothing." The next is a case (related by Dr. Fraser) of a servant girl who was taken to the London Hospital by her mistress, who was afraid the girl was "going out of her mind." She was extremely restless, would wander about the room, stand first on one foot and then on the other, but was quiet for a moment when spoken to, and answered a question with an effort, generally breaking off in the middle as if she had forgotten what she had to say. It was noticed at once that her pupils were widely dilated and fixed. It was subsequently discovered that she had had pain in her breasts for some days, and had gone to a chemist who had given her a lotion composed of extract. belladonnæ ʒss., aquæ ℥j., with directions to apply it on cotton wool covered with oiled silk. She applied some in the evening and again in the morning, and in the afternoon the symptoms appeared which induced her mistress to take her to the hospital. The girl expressly denied having swallowed any of the lotion. She did not recover so quickly as the before-mentioned patient, but was quite well in six days.

The Metropolitan Waters for October, 1866, by Professor Frankland, F.R.S.—The marked improvement in the amount of organic matter in the river waters supplied to the metropolis which was observed last month has not been maintained in the case of the waters supplied by the Southwark, the Lambeth, and the East London Companies. The table exhibits the effect of filtering the East London Company's water through animal charcoal. A comparison of the results yielded by this water before and after filtration shows this marvellous effect of animal charcoal in removing, not only organic, but also mineral impurities, from water filtered through it. Thus, the organic and other volatile matter contained in the East London Company's water is reduced to less than one-fourth by this operation, and the residual quantity contains but mere traces of organic matter, since the filtered water on evaporation leaves a snow-white residue, which is scarcely perceptibly altered in colour on ignition; the hardness is also reduced from 20·2 to 7·1. In fact, the waters of the New River and East London Companies, although so different in purity as delivered to consumers, become almost identical after filtration through animal charcoal. This filtration was not performed on the small scale for the purposes of the analysis, the sample examined having been taken from the daily supply of about 700 inhabitants in Columbia Square, Shoreditch.

ANSWERS TO CORRESPONDENTS.

C. R.—The delay has been unavoidable.

W. R. G.—The demand for our earlier numbers, though large, is not nearly sufficient to warrant the reprinting of Vols. I. and II.

Carbo.—Sulphate of magnesia is not considered so good a test for phosphoric acid as molybdate of ammonia.

A Constant Reader must also be a careless one, as the article asked for was given in our pages three weeks ago.

Doubtful.—You can easily see if the pink colour of the manganese salt is due to the presence of cobalt or of a higher oxide of manganese by adding sulphurous acid. If due to cobalt, the colour will remain, whilst if due to a higher oxide of manganese the solution will be bleached.

Magnesium.—We do not think the bars are yet to be obtained in commerce.

A. B. S.—Acetylene was first discovered by M. Ed. Davy, but its synthetical formation is due to M. Berthelot, who has worked a good deal upon it.

A Gas Engineer.—The detection of bisulphide of carbon in coal gas is a difficult problem. Several plans have been recommended, but they all require some knowledge of chemistry to enable them to be fairly tried. Dr. Hofmann's process with triethylphosphine is the most sensitive known, but the base is tedious and difficult to prepare. We have heard that very good results have been obtained by using Dr. Herzog's process, given at page 330 of our third volume.

Received.—W. L. Scott.

Books Received.—The Student's Text-book of Electricity, by Henry M. Noad, Ph.D., F.R.S., &c.; On the Eozoonal Rock, by Professors W. King and T. H. Rowney; Thorley's Farmer's Almanack, 1867; Little Experiments for Little Chemists, by W. H. Walenn, F.C.S.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Removal of Nitric Acid from Sulphuric Acid by Charcoal, by WILLIAM SKEY, *Analyst to the Geological Survey, New Zealand.*

In certain analytical operations, also for voltaic batteries, it is sometimes necessary to use sulphuric acid which is uncontaminated with nitric acid; but their separation has hitherto been a matter of difficulty, only attained by methods of a very protracted nature.

In the case of dilute sulphuric acid, however, this can be effected by shaking it up with a little freshly burned charcoal in a state of powder for a few minutes and afterwards filtering.

Sulphuric acid which has passed through this operation does not give any reaction of nitric acid when left in contact with crystallised sulphate of iron, although before the action may have been very decided.

But if concentrated sulphuric acid, which is only very slightly admixed with nitric acid, be taken and agitated with charcoal as before, it will be found, even after a very long contact, that a crystal of sulphate of iron immersed in it is turned of a pink colour just as quickly as if charcoal had not been used.

This refusal of charcoal to absorb nitric acid from its solution in concentrated sulphuric acid, would seem to indicate that this acid is retained by the charcoal in the first instance in the form of a hydrate, the dilute condition of the sulphuric acid employed preventing its decomposition.

On the Isomorphism of Thallium-Perchlorate with the Potassium and Ammonium-Perchlorates, by Prof. H. E. ROSCOE, *F.R.S., &c.*

The recently ascertained isomorphism of the thallium- and ammonium-sulphates* renders it highly probable that the perchlorates of these metals also exhibit isomorphous relations.

Thallium-perchlorate equals the alkaline-perchlorates in stability. It can be readily prepared either by dissolving metallic thallium in aqueous perchloric acid, or by the double decomposition of thallium-sulphate and barium-perchlorate. From solution the anhydrous salt is easily deposited in colourless rhombic crystals, which are transparent, bright, well-defined, and non-deliquescent. The specific gravity of the crystals is 4·844 at 15·5° C.; they dissolve in ten times their weight of water at 15°, and in about $\frac{3}{5}$ths of their weight of water at 100°; the salt is also slightly soluble in alcohol. Thallium-perchlorate does not lose weight when heated to 200° C., and the temperature may even be raised to within a few degrees of the boiling-point of mercury without producing the slightest decomposition of the salt. On the further application of heat, a black mass is formed, and the salt finally volatilises as thallium-chloride.

The crystalline form of thallium-perchlorate is that of a right rhombic prism, in which the faces of the rhombic octahedron and the basal faces of the prism generally appear; the crystals being lengthened, as is the case with the alkaline-perchlorates, sometimes in the direction of the prismatic, and sometimes in the direction of the octahedral faces.

The angles observed by Mitscherlich† in the case of potassium- and ammonium-perchlorates agree exactly with the above. The following analysis, made in my laboratory by Mr. T. E. Thorpe, shows that the formula of the salt is $TlClO_4$.

I. Determination of Thallium.—The crystals were well dried in vacuo over sulphuric acid, and precipitated with platinum-tetrachloride, the passage of the finely divided precipitate through the filter being avoided by evaporating to dryness on the water-bath, and taking up with absolute alcohol.

(a) Salt prepared by direct solution of the metal in perchloric acid: 0·1831 salt yielded 0·2476 chloroplatinate.

(b) Salt prepared by double decomposition: 0·4502 salt yielded 0·6060 chloroplatinate.

II. Determination of Perchloric Acid.—A solution of potassium-acetate was added to the thallium-perchlorate, and the whole evaporated to dryness on a water-bath, the acetates of thallium and potassium washed out with absolute alcohol, and the insoluble potassium-perchlorate collected on a weighed filter; 0·4570 thallium-perchlorate yielded 0·2100 potassium-perchlorate. Hence:—

	Calculated.		Found. I.	Found. II.	Found. III.
Tl .	204·0	67·21	67·38(a)	67·18(b)	
Cl .	35·5	21·09			32·96
O_4 .	64·0	11·70			
	303·5	100·00			

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

PART III.

CONNEXION BETWEEN ORGANIC AND INORGANIC CHEMISTRY.

SECTION V.—*Inorganic and Organic Nitrides.*

(Continued from page 194.)

Reiset's salt, which is formed when Magnus's salt or chloride of platosonium is digested with an excess of ammonia, may be regarded as the dichloride of diamiplatosonium—

$$\left.\begin{matrix}\text{Pt}'' \\ Am_2 \\ H_2 \\ H_2\end{matrix}\right\}N_2.Cl_2.^*$$

These examples, which might be greatly multiplied, will suffice to show that the capacity of saturation of the ammoniaco-metallic bases is not always in proportion to the quantity of nitrogen which they contain. Thus, the ammonium of Reiset's salt contains 4 atoms of nitrogen, two of which are in Am_2, and unites only with 2 atoms of chlorine.

We know, by the valuable researches of Dr. Hofmann, that it is the same with the polyamines or organic polyammonias. Thus the ethylenic triammonias or ethylenic triamines† can form three kinds of salts, which are as follows, for the diethylenic triamine, which we will take as an example—

$$\left.\begin{matrix}(\text{Ꞓ}_2H_4)_2 \\ H_5\end{matrix}\right\}N_3,3HCl.$$

$$\left.\begin{matrix}(\text{Ꞓ}_2H_4)_2 \\ H_5\end{matrix}\right\}N_3,2HCl.$$

$$\left.\begin{matrix}(\text{Ꞓ}_2H_4)_2 \\ H_5\end{matrix}\right\}N_3,HCl.$$

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* Lang, *Phil. Mag.*, xxv., 248.

† Pogg. *Ann.*, xxv. (1832), p. 301.

* Hofmann.

† Hofmann, *Comptes Rendus*, vol. lii., p. 947.

The second of these salts is a diacid triamine, the third a monacid triamine. In accordance with the system of notation adopted above, the diacid salt may be formularised in the following manner:—

$$\left.\begin{matrix}(\Theta_2H_4)_2\\ NH_4\\ H_3\end{matrix}\right\}N_2.Cl_2 \quad \text{or} \quad \left.\begin{matrix}(\Theta_2H_4)_2\\ Am\\ H_3\end{matrix}\right\}N_2.Cl_2$$

Inversely, nothing prevents us from considering the cuprous, cobaltous, and platinous ammoniacal combinations in question as diacid tetramines—that is to say, incompletely saturated:—

$$\left.\begin{matrix}[\Theta u_2]''\\ H_{10}\end{matrix}\right\}N_4,H_2I_2, \quad \left.\begin{matrix}\Theta o''\\ H_{10}\end{matrix}\right\}N_4,H_2Cl_2, \quad \left.\begin{matrix}Pt''\\ H_{10}\end{matrix}\right\}N_4,H_2Cl_2$$

Ammoniacal cuprous iodide. Ammoniacal chloride of cobalt. Reiset's salt.

I do not put forward these formulæ as being preferable to those before given; my aim is merely to show that we know, in inorganic and organic chemistry, of combinations formed by the fixation of ammonia upon a chloride, a bromide, &c., and whose capacity of saturation is not in proportion to the quantities of ammonia retained.

But there are other analogies which we meet with without going out of the group of compounds that we have been considering. Dr. Hofmann has proved that trimethylamine, Me_3N, may unite with dibromide of ethylene, $\Theta_2H_4Br_2$, to form a bromide

$$\left.\begin{matrix}(\Theta_2H_4Br)'\\ Me_3\end{matrix}\right\}N.Br.$$

In this body we see the group

$$\Theta_2H_4Br = \Theta_2H_4Br_2 - Br$$

takes the place of 1 atom of hydrogen in a compound ammonium. Similarly the group

$$[PtCl_2]'' = Pt^{iv}Cl_4 - Cl_2$$

may replace 2 atoms of hydrogen.

When a current of chlorine is directed upon the green Magnus's salt (chloride of platosonium), it is changed by absorbing 2 atoms of chlorine into chloride of chloroplatammonium (Gerhardt).

$$\left.\begin{matrix}[Pt_2Cl_2]''\\ H_2\\ H_2\\ H_2\end{matrix}\right\}N_2.Cl_2$$

There also exists a chloride of diamichloroplatammonium—

$$\left.\begin{matrix}(PtCl_2)''\\ Am_2\\ H_2\\ H_2\end{matrix}\right\}N_2.Cl_2$$

It is formed by the union of chlorine with chloride of diamiplatosonium or Reiset salt.

All the formulæ we have given above in which diatomic metals enter are double those which M. H. Schiff has adopted in his remarkable work. It appears to us, in fact, that these metals may unite several molecules of ammonia, as ethylene does in the ethylenic ammonias.

(To be continued.)

New Researches on the Law of Chemical Proportions, and on Atomic Weights and their Mutual Relations, by J. S. Stas.*

(Continued from page 206.)

In order to render the proofs as rigid as can be, I have thought it indispensable radically to change the system of synthesis and analysis used by all chemists. Till now, syntheses, like analyses, have been made by *difference*. This method, in synthesis, presupposes that the weight of the element employed is found integrally in the resulting compound, and, moreover, that the compound produced and weighed, contains absolutely only the simple or complex body which was at first combined. In this system, the operation of analysis or synthesis does not contain in itself the means of rightly determining the error which it involves. It only permits an idea of the accuracy of the result to be formed, by the frequent repetition of the same operation; therefore, this being the case, it is *impossible to allow for the constant error.* The method by difference, alike presents the inconvenience of not furnishing, by the operation itself, an idea of the purity of the material or materials used in the experiment. For all these reasons, I have thought, that in syntheses and analyses which have for their object the determination of atomic weights, it is necessary to employ a method in which the weight of the combined elements, as well as that of the separated elements, is fixed by the experiment itself. Thus, for a synthesis of two bodies A and B, the weight of A, the weight of B, and after their union the weight of the product A B, must be determined; and in the same manner, in the analysis of a compound A B C, when it is wished to ascertain the relation of A B to C, the weight of A B C, the weight of A B, and the weight of C which is derived from it, should be determined separately. It is only in proportion as these conditions are realised, that the limit of error which all operations involve, can be exactly measured.

I have applied this system rigorously to the synthesis of iodide and bromide of silver, and to the analysis of the iodate of this metal; for the reasons which I point out in my work, I have failed in the complete application of it which I tried to make in the analysis of bromate and chlorate of silver. It may besides be imagined that it is only very exceptionally that these principles will be able to be realised in all their rigour in the synthesis and analysis of bodies. The results at which I have arrived are recorded in my second memoir entitled "*New Researches on the Atomic Weights of Silver, Iodine, Bromine, and Chlorine, made for the purpose of proving whether the atomic weight of silver, determined by the aid of these three bodies, is the same, and whether these atomic weights are agreeable to Prout's hypothesis.*" This memoir consists of the nine following notices:—

1st. *On the systems employed in making syntheses and analyses.*
2nd. *Syntheses by difference of iodide of silver.*
3rd. *Abridged and complete syntheses of iodide of silver.*
4th. *Syntheses by difference of bromide of silver.*
5th. *Abridged and complete syntheses of bromide of silver.*
6th. *Complete analyses of iodate of silver.*
7th. *Analyses by difference of iodate of silver.*
8th. *Analyses by difference of bromate of silver.*
9th. *Analyses by difference of chlorate of silver.*

The results which proceed from these long and difficult labours are, that the composition of iodide, bromide, and chlorate of silver, determined, twenty years ago, by M. Marignac, is strictly correct; that the composition of iodide of silver is absolutely irreconcilable with Pront's hypothesis; that neither does the composition of the iodate, bromate, and chlorate agree with this hypothesis; that the atomic weight of silver, deduced from these *three independent data*, is almost absolutely the same, and is identical with the atomic weight

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* *Memoirs of the Royal Academy of Belgium.*

deduced from the synthesis of the chloride and the analysis of the chlorate made by M. Marignac, and from the synthesis of the sulphide and the analysis of the sulphate effected by me.

In fact, the mean atomic weight of silver is :—

1st. *According to the syntheses of the chloride and the analyses of the chlorate made by M. Marignac*	107·915
2nd. *By my syntheses of the sulphide and analyses of sulphate*	107·920
3rd. *By my syntheses of the iodide and analyses of iodate*	107·928
4th. *By my syntheses of bromide and analyses of bromate*	107·921
5th. *By my syntheses of chloride and analyses of chlorate*	107·937

If the doubt raised by M. Marignac on the subject of my syntheses of sulphide and nitrate of silver had received no satisfactory solution by the direct proofs to which I have submitted the law of chemical proportions, the agreement presented by the atomic weight of silver determined by means of *four absolutely independent data* would be sufficient, it seems to me, to dispel it for ever.

In a word, I desired greatly to submit the other results contained in my "*Researches on the Reciprocal Relations of Atomic Weights*" to a fresh verification, by making use of new and independent methods, especially after having been accused of turning my back on truth and progress.†

Among the bodies which have been the object of my investigations, nitrogen is the one whose atomic weight departs most from Prout's law — considering, of course, its relatively slight weight. According to this hypothesis, its atomic weight is represented by 14·00. But I found that it is equal to 14·06 by deducing it from chloride of ammonium, supposing, of course, by an entirely gratuitous hypothesis, that the relation of hydrogen to oxygen is as 1 : 16·00; and I found that it is, at the maximum, 14·046, and at the mean, 14·041, by deducing it from the synthesis of nitrate of silver. I should like to have submitted these results to a direct control by the analysis of nitrous oxide, effected according to the system explained above—that is to say, by weighing the compound and each of its isolated elements. Unfortunately, I have hitherto found no mechanician who has dared to undertake the construction of the apparatus, in the conditions which I think indispensable for the success of the experiment.

This plan failing me, I have had recourse to an *indirect* way which furnishes extraordinarily concordant and certain results, when the trouble is taken of applying it to compounds into which variable elements enter by the side of the constant elements. I thought to find this means in the *transformation of chlorides into nitrates.* This method has, moreover, been practised by Dr. Penny of Glasgow. The chlorides on which I have operated are those of potassium, sodium, and lithium. I have also made new syntheses of nitrate of silver, in order to be able to control my old experiments, and deduce with certainty the atomic weight of nitrogen from the relative weights of chloride and nitrate produced by a unit weight of silver. By the help of new researches, I have proved the atomic weight of lithium, which was determined three years ago, by M. Carl Diehl, and confirmed more recently by the labours of M. Troost.

It is indeed imagined that it must be possible by the transformation of a chloride into nitrate, or by the determination of the proportionate weights of chloride and nitrate obtained by the aid of a unit weight of metal, to prove the accuracy of any given atomic weight, if that of the elements composing the chloride is sufficiently determined.

According to the law of chemical proportions and the composition of nitrates, the difference between the weight of a molecule of a chloride and that of a molecule of the corresponding nitrate ought to be equal to a *constant*, represented by the difference existing between the atomic weight of chlorine and the sum of the weights of one atom of nitrogen and three atoms of oxygen. According to Prout's hypothesis, by taking chlorine = 35·50, nitrogen = 14·00, and oxygen = 16·00, the constant ought to be equal to 26·50.

(To be continued.)

REPORT ON THE

CHEMICAL LABORATORIES

IN COURSE OF ERECTION IN THE

UNIVERSITIES OF BONN AND BERLIN.

THE CHEMICAL LABORATORIES OF THE RHENISH FREDERICK WILLIAM UNIVERSITY OF BONN.

(*Continued from page* 214.)

To become acquainted with the remainder of the rooms intended to supply the special wants of the three laboratories, we must retrace our steps to the main corridor (*a, a, a*)* between the principal entrance and the director's study, from which at *a′, a′, a′*, we had entered the three laboratories. Along this corridor lies a series of rooms opening upon it, and lighted by windows overlooking the back courts of the institution. Close to the vestibule, immediately to the right and lying between the entrance to the first and second laboratories, is, first of all, the Volumetrical Analysis Room (L), the very name of which implies the purpose for which it is intended. This room, in which are kept the standard solutions, daily increasing in variety, as well as the graduated vessels, burettes, &c., required in volumetric analysis, is open to all the students of the institution, but is more especially used by those of the second and third laboratories.

The Balance Room (M), the next in order, is not only intended for the reception of chemical balances, but also of the more delicate physical instruments made use of in analysis, such as air-pumps, barometers, &c.

Next follows a Room for Fusions and Ignitions (N) capable of being carried out by means of gas. Here are the necessary appliances for the various heating operations occurring in mineral analysis. This room is also fitted up with all the requirements for organic analysis (carbon and nitrogen determination), likewise exclusively conducted by means of gas, and carried on in special "combustion niches" let into the walls, and communicating directly with the outer air by means of wide tubes of glazed earthenware. Lastly, this room contains the ranges of water ovens required for drying the substances to be submitted to analysis. In these ovens, which are heated by the steam of the stills for distilled water in the basement, every student has his own compartment under lock and key. With respect to the uses of these three rooms, they are more especially intended for the workers in the middle laboratory; they are, however, accessible also to the beginners, a greater or less number of whom, advancing more rapidly than their fellow-students, will thus be enabled to participate in the facilities supplied by these apartments. The balance room is purposely situated in the middle, and separated from the laboratories by the volumetric analysis room on the one side, and the room for fusions and ignitions on the other, so as to protect, as

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† *Cosmos*, 1860, xvii. 656.

* For diagram see last number (Fig. 2), p. 211.

effectually as possible, the costly instruments of this room from the fumes, which, in spite of all ventilation, at times escape in a laboratory. The situation of the balance room, between the two others, affords an additional and a by no means trifling advantage. Numerous operations preceding the weighings, such as drying substances in the water bath, heating crucibles, collecting the combustion products in organic analysis, &c., all take place in the immediate neighbourhood of the balance, whilst on the other hand the preliminary weighings, which invariably form the first step in volumetric analysis, can be made in close proximity to the room devoted to the subsequent stages of volumetric observation. The three rooms, therefore, communicate directly with each other.

Between the second laboratory and the third laboratory are, in addition to a small flight of steps leading to a number of attics over the ground floor, three similar rooms (O, P, and Q), accessible from the corridor, and with doors opening into each other. Of these, the one nearest the second laboratory is intended for the Library (O).

The principal results of chemical investigation are duly registered in treatises and manuals, and are therefore easily within the reach of students. But the statements to be found in books of this description cannot be more than abstracts, always very considerably condensed, and often more or less garbled, from the memoirs of the first observers. As soon, therefore, as the student has got beyond the first rudiments, he can no longer dispense with original sources of information. The main bulk of chemical observation is collected in a series of periodicals and journals, the volumes of which are counted by hundreds, and, if all were collected, certainly by thousands. Again, many important investigations have been communicated by their authors to the various academies and learned corporations, and are printed in the transactions of these societies. Thus it happens that the literature of chemistry, though the youngest of sciences, has already attained to very considerable dimensions, and to collect the works which have to be consulted in the prosecution of even limited investigations in most cases far exceeds the power of any single individual. These books could, of course, be readily procured from any public library, but reference to original communications is but too frequently omitted if the work is only to be had by specially sending for it. On this account every chemical school should possess a library, more or less complete, offering to the student a copious collection of original memoirs which he can consult whenever he may require their assistance. The usefulness, it may be said the necessity, of such libraries is so apparent that the students themselves have in a great many instances most materially participated in their foundation and subsequent increase. In this way, from but small beginnings, some most complete collections of chemical works have been formed. The Reporter, when a young student, had the good fortune to take part in the establishment of such a laboratory collection, under the auspices of his illustrious master, Baron Liebig, at Giessen, which is now the oldest and probably the largest chemical library extant. In later times he had the pleasure of assisting in the inauguration of a similar collection for the Royal College of Chemistry in London. Such a library it is of course in contemplation to establish for the Bonn laboratory, and already, long before its opening, a number of books have come in as presents, which are here gratefully acknowledged as examples for imitation. The situation of the room set apart for their reception, between the second and third laboratories, is peculiarly appropriate, because it is more especially to the students of these two laboratories that the library will be of use, whilst its slight distance from that part of the institution where the director carries on his own researches, is likewise a great convenience to him and his assistants.

The two remaining rooms lying between the second and third laboratories are a Balance Room (P) and a Room for Fusions and Ignitions (Q). They hold the same relation to the third laboratory which obtains between the corresponding apartments (M and N) and the middle laboratory, so that, as regards the special appliances provided and the particular position assigned to them, what has been said of the last-mentioned rooms holds good for them also.

With these rooms on the right-hand side of the principal corridor, terminate the ground-floor apartments intended for practical instruction. We have now only to glance at the theatre and adjoining rooms for preparing the lectures and preserving apparatus, models, drawings, and collections of all kinds.

The students attending chemical lectures in the German Universities are always much more numerous than those who work in the laboratories, and, therefore, much more accommodation had to be provided in the lecture hall† than in the laboratories. A lecture room capable of holding two hundred and fifty students appeared likely to meet the requirements of the University of Bonn. An area of forty feet square was found to be sufficient for this purpose, and at the same time to afford ample space for a convenient lecture-table, as well as for the free and easy movement of the lecturer and his assistants.

The approach to the lecture room is likewise in the principal corridor. Just half-way along the latter, opposite the entrance to the middle laboratory, is a Staircase Hall (a″), twenty-six feet in height, and provided with a skylight. This hall is entered from the corridor through an archway resting on columns, and leading by a broad flight of stairs to a Landing (g) eight feet above the ground floor, overlying the thoroughfare between the front courts. Passing the folding doors before us, we enter the Great Lecture Hall (R) on a level with its upper row of seats which are arranged like the tiers of an amphitheatre, and reach the lower area of the room by the steps near the wall on either side. In this lower part just opposite the entrance is placed the lecture-table, forty feet long and three feet four inches wide. In the lower part of the wall, behind the table, are the evaporation and ventilation niches for experiments, whilst on its upper part drawings and diagrams can be exhibited. Here, as on former occasions, the Reporter must forego giving details of the numerous appliances designed for the lecturer, which are still far from being complete; suffice it to mention that the lecture room is lighted from both sides, so that neither professor nor audience is obliged to face the light—an advantage sure to be appreciated by any one who has been either lecturer or hearer in a room of different construction. The fourteen windows which supply the light are arranged at a height of nine feet above the floor of the hall, except the two next the lecturer, which descend to the level of the table, enabling him to exhibit many colour-phenomena by means of transmitted light, and to employ sunlight, under favourable conditions, as an agent in his experimental illustrations.

The theatre communicates with the Laboratory of the Lecture-Assistant (S) by means of two side doors, and a large niche in the centre of the wall. Here everything required for the lecturer is got in readiness, and all the necessary furnaces and benches are provided. In this room larger pieces of apparatus can be fitted up upon a table moving on rails, which may be run through the niche already mentioned into the theatre during the course of the lecture. This laboratory is lighted from two sides, on the north-east by a large window, and on the south-west by a glass door communicating with a Platform (h); whence a staircase leads down to the Front Court (i). These steps also communicate with the rooms of the basement underneath, for the storage of compounds requiring a low temperature, sealed tubes containing condensed gases, &c., and likewise give access to a well-ventilated

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† During the winter session of 1865-6 the University of Bonn was attended by 818 matriculated and 35 non-matriculated students; total number of students, 853.

closet immediately under the lecture-table, containing the large galvanic battery, the wires of which pass through the ceiling into the theatre above. The room, where the experiments for the lectures are prepared, is of course in close connexion with the Store-room for Apparatus, Models, Drawings, Diagrams, &c. (T); this room likewise is lighted from both sides. Farther on we come to the last room of this series, having but one window, which is used for the preservation of the various documents belonging to the lectures, such as printed forms, registered lists of students attending, &c., and where the professor may stay before entering the theatre, and after the lecture receive those students who wish to consult him. This room, called the Lecturers' Waiting Room (U), communicates with the Mineralogical Museum (V), one of the great halls assigned to the scientific collections of the Institution. This hall, as well as the one next to it, which, being profusely lighted by six windows symmetrically disposed on both sides, is intended for the Chemical Museum (W), is in the front block of the building. Close to the mineralogical museum is a small Lecture Room (X) for recapitulations and special lectures to be conducted by the assistants. It is separated from the mineralogical museum by a small room with one window to be used either as a Waiting Room (Y) for the Assistant, or as a preparation room for private courses or special lectures. Students working in the laboratories reach this small lecture room by descending the steps leading from the staircase hall into the thoroughfare between the front courts, crossing the left front court, and ascending, lastly, the Flight of Steps (ζ) to the corridor of the ground-floor on which the small lecture room is situated; whilst those who are not laboratory students have access to it by the left main entrance in the front block of the building.

A glance at the ground-plan shows that all the rooms for apparatus, chemical preparations, &c., used in the lectures are situated between the two rooms (R and X) devoted to oral demonstrations, so that all requisites for the lectures can be conveyed with the greatest ease either to the larger or the smaller theatre, and back to the collections. The museums were purposely somewhat removed from the busier departments of the institution. The experience of the Reporter, which is not unlikely to receive confirmation from others, has taught him that the love of research and zeal for discovery in young chemists, however praiseworthy in themselves, are at times anything but conducive to the increase of scientific collections. But independently of this, it was also desirable to devote this part of the building to museums, and not to laboratories for the use of students, because the floor immediately above is appropriated exclusively to the residence of the director.

The large halls for the mineralogical and chemical collections, together with the smaller theatre and its preparation room, occupy almost the entire ground floor of the front block of the building. In addition to these are still to be mentioned two Vestibules (*m* and *p*), prominently marked in the external architecture of the building, which lead, the one to the Main Staircase (*q*), the other to the Back Staircase (*n*), ascending to the apartments on the first floor; then immediately to the left of the north-east entrance a Lodge (*n*) for the House-porter; and, lastly, close to the south-west entrance, apartments (*o* and *o'*) for one of the Junior Assistants of the institution.

But a few words more, and we have done with the description of the plan of the ground floor. It remains to be explained how the two side wings, uniting the front block with the middle cross-building, have been laid out.

And, first, as regards the side wing stretching out at right angles from the left of the main vestibule in the north-east front: in this wing we have close to the vestibule the Porter's Lodge (*s*), reached by a small Passage (a''''), and communicating with the long Corridor (*t*, *t*), which leads in succession to the Cloak-room (*u*), to two Rooms (*v*, *v*) of the Castellan, and lastly, to two suites of Apartments (*w*, *w*, and *x*, *x*) intended respectively for the First and Second Assistant of the institution. The rooms in this wing are not only accessible from the main vestibule, but likewise by means of a Staircase (*y*) ascending from the front court close to the Carriage Way (*z*).

The other side wing projecting, symmetrically with the one described, from the left of the other end of the main corridor, is entirely devoted to the scientific purposes of the director, with whose study this part of the building is in immediate communication. Among the rooms situated in this wing, mention must first be made of the Private Laboratory of the Director (Z), which is lighted by four windows. On one side of this lies the Director's Waiting Room (α), accessible from the main corridor, and communicating with his study by the short Private Passage (β). Beyond the other end of the private laboratory are two small apartments, one to be used as a Balance Room (γ), the other as a Room (δ) for Ignitions, Fusions, and Combustions. The latter has egress to a little Portico (ε), for experiments requiring to be performed in the open air. This portico communicates, moreover, by means of doors, on one side, with the Passage (*k*, *k*, *k*), which runs along all the rooms in this wing, on the other, with a Prolongation of the Passage (*k'*), whence the director's residence is accessible by means of the Back Staircase (*n*), and the left front court by means of the Flight of Stairs (ζ) already mentioned. The prolongation of the passage likewise establishes communication between the whole side wing and the Main Corridor (*l*) of the front block, thus allowing to the director and his assistants the freest access to the collections, lecture halls with their preparation laboratories, and all the remaining rooms belonging to this department

After this detailed description of the plan of the ground floor, where nearly the whole of the rooms devoted to the special purposes of the institution are situated, a brief comment will suffice to render the remaining drawings intelligible.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 1.

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

At this, the first meeting after the long vacation, there was a full attendance of members. The minutes of proceedings at the last (extraordinary) meeting of the Society were read and confirmed, and a long list of donations to the library were announced. Mr. Edward Purser, jun., was formally admitted a Fellow of the Society, and Messrs. W. Chandler Roberts, Associate of the Royal School of Mines, and Edward P. H. Vaughan, patent agent, 54, Chancery Lane, were duly elected. For the second time were read the names of Mr. Robert Biggs, Deputy Coroner, 17, Charles Street, Bath, and Mr. David Page, Galebeck Powder Mills, near Kendal. The following candidates were proposed:—A. C. Cook, Ph.D., Demonstrator of Chemistry, King's College, London; Mr. Henry Dircks, Civil Engineer, Whitehall Club, and 16, Bucklersbury; Mr. James Forrest, Ashburnham Road, Greenwich; Mr. William Huskisson, manufacturing chemist, Gray's Inn Road; Mr. A. F. Marreco, Newcastle College of Medicine; Mr. J. Hancock Richardson, Newcastle-on-Tyne; Alexander Morrison Thomson, D.Sc. Lond., Sydney, New South Wales.

Dr. Hermann Sprengel exhibited and described an apparatus for taking the sample as a preliminary to determining the specific gravity of heterogeneous liquids. The instrument consists of a cylindrical glass tube about eighteen inches in length, the lower end of which may be temporarily closed by a platinum disc and spring wires, whilst a piston works through an india-rubber cap fitted to the upper extremity. The rod of this piston is composed of a smaller glass tube with a "pinch cock" at the top. To use the instrument for the purpose of taking a sample—say of vitriol from the leaden chambers—the height of the vertical column of liquid is first measured; the piston is then adjusted within the glass tube to a corresponding level, the upper orifice being left open; the whole instrument is then slowly immersed in the acid or other liquid to be tested until the tube has, as it were, cut through a true section of the heterogeneous fluid; the bottom of the tube is closed by exerting slight pressure upon the platinum disc, and the whole withdrawn. The liquid contents of the tube may now be transferred to an ordinary hydrometer glass, thoroughly mixed, and the gravity taken in the usual manner.

Dr. W. De la Rue and Dr. Odling offered some remarks upon the practical use of the instrument, from which the necessity of the vitriol chambers being fixed perfectly level was elicited.

Mr. Ernest T. Chapman then read a paper "*On the Gradual Oxidation of Organic Bodies,*" detailing the results of experiments made by Mr. William Thorp and himself upon the action of chromic acid on several organic compounds. Commencing with alcohol and bodies of the vinic series, the authors found that by heating in the water bath with mixtures of sulphuric acid and bichromate of potash contained in sealed tubes, acetic acid was formed without the escape of any carbon in the form of gas. An intermediate stage was remarked, at which acetic ether was the sole product. Amylic alcohol treated in the same way furnished valerianic acid, thus—

$$\text{I. } C_2H_6O + O_2 = C_2H_4O_2 + H_2O.$$
$$\text{II. } C_5H_{12}O + O_2 = C_5H_{10}O_2 + H_2O.$$

The compound ethers were then experimented upon, and the products were similar; thus, the acetate of ethyl was converted entirely into acetic acid, whilst the acetate of amyl furnished a mixture of acetic and valerianic acids. No further action could be observed upon submitting the products to another treatment with the chromic solution, unless at a much higher temperature, when carbonic acid in variable quantity was produced. Nitric ether gave acetic and nitric acids, and with the iodide of ethyl the change was as follows:—

$$2C_2H_5I + O_5 = 2C_2H_4O + H_2O + I_2.$$

The iodide of isopropyl gave acetic and carbonic acids besides free iodine and water. The ammonia-bases similarly treated furnished acids corresponding to the contained radicals, and a salt of ammonia was produced. Of the olefines, ethylene, amylene, and β hexylene were submitted to experiment, when the following reactions were observed:—

$$\text{I. } C_2H_4 + O_6 = 2CO_2 + 2H_2O.$$
$$\text{II. } C_5H_{10} + O_7 = 2C_2H_4O_2 + CO_2 + H_2O.$$
$$\text{III. } C_6H_{12} + O_7 = C_3H_6O_2 + C_2H_4O_2 + CO_2 + H_2O.$$

By the use of stronger solutions of chromic acid, at 130° C., it was noticed that the acid made from valerian root behaved differently from the ordinary valerianic acid made by oxidation; the first-named quality became converted into carbonic and butyric acids; likewise a difference was noticed in the case of fousel oil, which seems to contain two isomeric amylic alcohols, distinguished by the greater facility with which one of them becomes oxidised, and by the greater amount of carbonic acid produced in a given time. Mr. Chapman concluded by referring to a set of graphic diagrams illustrating the hypothetical constitution of the olefines.

Dr. Frankland regretted that he was under the disadvantage of not having heard the first part of the author's communication. As a rule, he preferred the synthetical method of arriving at the constitution of bodies, but the analytical researches just now described appeared worthy of great confidence, and he applauded the careful manner in which the experimenters had pushed the oxidising action, even to the fresh treatment of first products. The employment of Crum Brown's graphic formulæ helped to set the constitution of bodies in a clearer light.

Professor Williamson asked for an explanation of the observed dissociation of carbon in the case of the iodide of iso-propyl being acted upon by chromic acid, and of the manner in which this substance had been prepared.

Mr. Chapman replied that it was obtained direct from glycerin, and if its constitution be correctly represented by the formula $(CH_2)C_2H_5I$, it was clear that the radicals furnished each its respective product, thus—

$$2CH_2(C_2H_5)I + O_{11} = 2C_2H_4O_2 + 2CO_2 + 3H_2O + I_2.$$

The President moved a vote of thanks to the authors, and announced that at the next meeting of the Society a paper "*On Ozone,*" by Dr. Daubeny, would be read. The meeting was then adjourned until the 15th inst.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, by Dr. Percy, F.R.S.

Lecture No. X.

(Continued from page 209.)

In India we find diamond always in the same kind of rock, or a similar kind—namely, in a breccia of red and yellow jasper, quartz, chalcedony, and hornstone, cemented by siliceous matter. This breccia is overlaid by sandstone, and it passes into a conglomerate of rounded pebbles, which are cemented together by a calcareous or calcareo-argillaceous cement. In this conglomerate the diamonds are generally met with. They are found in several parts of India; but I need not trouble you with details. Diamonds are found in Borneo in a conglomerate of pebbles, diorite, and quartz, along with marl containing marine shells; and here we find diamond associated with magnetite—that is, the magnetic oxide of iron, a mineral we shall very shortly describe and examine in detail. Diamond is not only associated here with the magnetic oxide of iron, but (which is deserving of great attention) with gold, platinum, and other things, sometimes very rare minerals. I would particularly direct your attention to the case in the museum upstairs containing illustrations of the mode of occurrence of diamond.

I have said that in Brazil diamonds are met with accompanying this itacolumite rock. This is a most important point, and we must examine it further. Itacolumite rock is commonly termed quartzite. It is a variety of quartz rock. On a large scale it always presents a more or less distinct slaty structure, thereby indicating its sedimentary origin, or the probability of such an origin. I am perfectly aware that slaty structure does not necessarily imply that, but it may be the result of cleavage; but here, at all events, it seems to indicate sedimentary origin. Itacolumite is sometimes traversed by pyrophyllite. It is sometimes found to be flexible. The flexibility of this sandstone may be easily explained, I think, by the interposition or intermixture of little particles of mica. Now, this sandstone is all thrown down, of course, by deposition gradually. If there be mica present, the rate of deposition is various, and you will get little alternate layers of mica and sand, and these matters may overlap one another, and so tend to combine one with the other. This is one way, at all events, in which the flexibility of sandstone may be accounted for.

Itacolumite is believed by geologists to be a metamorphic rock—that is, a rock which has undergone certain changes subsequent to its deposition. The subject of metamorphism is one of very great importance in geology, and one to which we shall hereafter direct attention. It is stated that no fossils have been found in this rock.

Together with this itacolumite occurs what is called a metamorphic schist—a kind of slate, which is very variable in its character, and contains quartz sometimes associated with chlorite or talc and sometimes with mica. In some cases it is a pure mica schist. It generally forms elevated plains, and it is easily weathered—that is, disintegrated by exposure to the weather. We are told that it frequently passes insensibly into an argillaceous schist, containing talc, and mica, and disthene or cyanite, and also into itacolumite itself; and in one locality fragments of crystalline schist form a conglomerate in the itacolumite itself. Limestone and schistose red iron ore also occur in this metamorphic schist. This variety of red iron ore sometimes forms beds of great extent. This schist is very easily disintegrated, as I said just now, sometimes being weathered and decomposed and softened to a great depth. This softening is the result of the heavy tropical rains which fall there, and which, moreover, are reported to contain nitric acid.

In the products of the disintegration of the schist and the itacolumite numerous rare minerals are found, and this is a subject of importance in connexion with our inquiry. First we have the diamond; then the euclase, a most rare and beautiful gem; and also the topaz, chrysolite, cymophane, transparent andalusite, tourmaline, amethyst, a beautiful variety of anatase, and rutile.

Diamonds are met with in three distinct regions. They are found, first, in what is called gurgulho, which is derived from the itacolumite, and consists of a pure quartzose sand. This sand is washed, and together with the diamond is obtained a residue of anatase, rutile, and magnetite or magnetic oxide of iron. These three minerals more or less constantly accompany the diamond, and are regarded as indications of its presence. Now, as the minerals associated with diamond are also found in the itacolumite, we might have concluded with tolerable certainty that the diamond existed in that rock and was derived from it; and that conclusion has been justified by recent, or comparatively recent, discoveries.

One observer has seen, we are told, four diamonds in the itacolumite in one spot—in the rock itself. Diamonds have actually been obtained by blasting the rock, showing clearly that the diamonds are there, and that the source of them is this rock. Then there is another variety of this weathered stuff derived from the metamorphic schist. As long as this superficial product of weathering, or gurgulho, yielded diamonds, the exploration of the subjacent schist was never thought of; but in 1850, by some chance or other, this schist was washed and produced many diamonds, and ever since it has been worked for the diamond. It appears that no diamonds have yet been discovered in the metamorphic schist itself; but that schist has been very imperfectly worked at present, compared with the itacolumite rock. The great point for us to bear in mind is the occurrence of diamond in this metamorphic schist. It is actually there *in situ*, so that no further doubt can be entertained on that point. In the Brazilian cascalho, Damour, a French observer, has mentioned the occurrence of disthene, felspar, almandine, hydrophosphate of alumina, titaniferous phosphate of yttria, diaspore, tantalite, columite, oxide of tin, cinnabar, and what to my mind is excessively interesting—graphite, another variety of allotropic carbon. Then we find gold diffused in the Brazilian diamond-bearing-schist, and also platinum. The association of gold with diamond is also a point of considerable importance, or, at all events, of interest.

Diamonds have been found, as we all know, in the Ural mountains since Humboldt's visit in 1829. He suggested the probability of their occurrence there from the geological similarity of the district to that of Brazil. You have all heard of the similar suggestion of the occurrence of gold in Australia, or a suggestion rather founded on similar reasoning. The diamonds are found in a stream work in the Ural mountains a foot and a half or two feet thick. Diamonds are said to have been found in a similar rock to itacolumite in North Carolina and Georgia, but I do not know how far that statement is worthy of acceptance. We are also told that diamond has been found in Australia. One has been brought over and presented to this museum by Sir Thomas Mitchell. There was some doubt at the time as to the source of the diamond, but the question has been taken up, and I think there is no doubt now with regard to the occurrence of diamond there. Public attention ought to be directed to the subject, in order that it may be investigated.

I might go on and expatiate for a long time with regard to the mode of the occurrence of diamond, but we have so much which remains to be done, that I must pass over that subject as briefly as possible, and now come to the conclusions and see if they are justified. The question is, if this itacolumite be, as there is no doubt it is, a rock of sedimentary origin, have the diamonds been developed in the rock by some means or other subsequent to its formation, or were they deposited there contemporaneously with it? That is the point, and so far as I know it is a point which has not been clearly made out at present. All attempts, I say, concerning the artificial production of diamond have hitherto proved most signally abortive. All that we are in a condition to say at present, so far as I know, is this—that we have not the slightest clue in the world to the mode in which the diamond has been made in nature. It is evident that the condition or conditions of its formation must be excessively rare, because the quantity of diamond is, comparatively speaking, so small. I cannot help thinking—and it is the opinion of those who have directed attention to this subject—that one day or other we shall be able to crystallise carbon. There can be little doubt about that; but then it does not follow, supposing we should arrive at that, that we should be able to crystallise diamonds of any value. It may be that the crystallisation of diamonds of a large size is a work of time—such a work as only nature can accomplish in a satisfactory way. No doubt fluorine, or some similar element, has played a part in the production of the diamond. It is a suggestion worthy of attention. Compounds of that element are very imperfectly known at present.

(To be continued.)

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 16, 1866.

Edward Schunk, *Ph.D., F.R.S., &c., President, in the Chair.*

A paper was read "*On the Isomorphism of Thallium-perchlorate with the potassium and Ammonium-perchlorates*," by Prof. H. E. Roscoe, F.R.S., &c. (See page 217.)

"*Catalogue of Binary Stars, with Introductory Remarks*," by A. Brothers, F.R.A.S.

PHYSICAL AND MATHEMATICAL SECTION.

October 11, 1866.

Joseph Baxendell, *F.R.A.S., Vice-President of the Section, in the Chair.*

"*Observation of the Eclipse of the Sun, October 8, 1866, at Mr. Worthington's Observatory, Crumpsall*," by Joseph Baxendell, F.R.A.S.

The first contact was observed at 4h. 20m. 6·0s. Greenwich mean time. Owing to the low altitude of the sun, its limb was very tremulous, but the error arising from this cause was estimated not to exceed one second. The telescope used was the equatorially-mounted achromatic, of 5 inches aperture and 70 inches focal length, with a positive eyepiece magnifying 68 times. The position of the observatory is, latitude 53° 30′ 50·0″ N., longitude 8′ 56·16″ W.

"*Results of a Comparison of the Magnitudes of the Bedford Catalogue with those of Sir John Herschel*," by George Knott, F.R.A.S. Communicated by Mr. Baxendell.

"*Note on the Combined Magnitude of two Stars in close Proximity*," by George Knott, F.R.A.S. Communicated by Mr. Baxendell.

ACADEMY OF SCIENCES.

October 29.

An elaborate paper on the "*Functions of Leaves*," by M. Boussingault, was the first read at the sitting on this day. This is a continuation of a paper by the same author, which appeared in the *Comptes Rendus*, vol. lxi., p. 657. It is devoted to a discussion of the comparative action of light on the opposite surfaces of a leaf placed in a mixture of air and carbonic acid. This appears to have been a debated question for nearly a century, for we find that Ingen-Housz, in 1780, fancied that the leaves of plants furnished a purer air if the sun shone upon their upper surface than when their lower surface received the direct influence of the sun. This conclusion was, however, premature, as the conditions of the experiment were not such as to admit of a decision one way or the other. The author proceeds to explain the conditions under which his experiments have now been tried, in order to obviate all possible source of error. He finds that in each experiment the under-surface of the leaf decomposed considerably more carbonic acid than the upper surface; in some instances the amount being nearly four times as much.

"*On a General Mode of crystallising Insoluble Compounds*," by M. E. Fremy. It occurred to the author that if he could effect, in a very slow manner, the precipitations and decompositions which in laboratories produce amorphous bodies, owing to the instantaneity of their formation, he might succeed in obtaining them in the crystalline form. In some experiments the two bodies were introduced into liquids of different density, containing gum, sugar, gelatine, &c.; in others the phenomenon of endosmose was had recourse to; in other trials wood or unglazed vessels were employed: tho result in almost all cases being that he obtained in the crystalline form such insoluble bodies as sulphate of baryta, sulphate of strontia, carbonate of baryta, carbonate of lead, sulphate of lead, oxalate of lime, borate of baryta, chromate of baryta, magnesia, and several sulphides. Quartz was attempted to be crystallised in a similar manner by the reaction of alkaline silicates on certain acids, but the author only succeeded in obtaining cystals which certainly would scratch glass, but contained 5 per cent. of soda and 27 per cent. of water.

"*On a Disengagement of Gas under Remarkable Circumstances*," by M. Babinet. When cold water is poured upon roasted and ground coffee, a considerable disengagement of gas takes place; this is probably air which has been absorbed after the manner of porous bodies, and is driven out by the water. The author finds that if a bottle is half filled with powdered coffee, then filled up with water and tightly corked, an explosion takes place. We don't quite see where the "remarkable circumstances" are, unless it be in the fact of such a trivial paper being brought before the French Academy.

"*Experimental Researches on the Development of Wheat*," by M. J. Isidore Pierre.

"*Remarks on a Recent Communication of M. Angström on certain Facts in Spectrum Analysis*," by M. Janssen. Our readers will remember that at the meeting of October 15 (Chemical News, p. 203) Angström corrected some of Janssen's statements. The latter now says that Angström's opinions entirely coincide with his own.

"*On the Cause and Nature of Tuberculosis*," by M. J. A. Villemin. The author finds that tuberculosis is a specific disease which is capable of being communicated from one animal to another by inoculation.

"*On the Habits of a Young Gorilla*," by M. de Langle.

NOTICES OF BOOKS.

The Student's Text-book of Electricity. By Henry M. Noad, Ph.D., F.R.S., F.C.S., Lecturer on Chemistry at St. George's Hospital. London: Lockwood and Co.

So rapidly is our knowledge of the science of electricity increasing, that books written on the subject a few years ago have now become insufficient, and a want has been felt for some work that should correctly represent the present state of the science. This want the book before us is intended to supply. Much of the matter has been taken from the author's "Manual of Electricity" and arranged in a more condensed form for the use of students, but many additions have been made throughout, and copious extracts have been taken from the "Cantor Lectures" which were delivered in the spring of the present year by Mr. Fleeming Jenkin, F.R.S. The whole is arranged in a very convenient manner, giving first the theory and laws of electricity and magnetism, and afterwards their application to telegraphy and other practical uses; the author has also adopted the plan of giving the principal facts and rules in large type, followed by illustrations and quotations bearing on the subject in smaller print, by which means much space is gained without any sacrifice of clearness.

The work is divided into ten parts, the headings of which are as follows:—Frictional Electricity—Magnetism — Electro-Physiology — Voltaic Electricity — Electro-Magnetism — Diamagnetism — Magneto-Electricity — Thermo-Electricity—Electric Telegraphy—and Miscellaneous Practical Applications of Electricity. As might be supposed, by far the greater number of the recent discoveries have been made in the two latter parts, and we therefore find allotted to them a much larger proportion of space than has usually been the case hitherto in treatises on electricity. The subject of electric telegraphy is divided into two chapters—Land Telegraphs, and Submarine Telegraphy. The former traces the history of all attempts to communicate by electricity down to the present time, giving a short description of all the early forms of apparatus designed for that purpose, and a full account of the various instruments that are now in practical use. The Morse instrument and its modifications are stated to be the most generally used of any, and a very complete description is therefore given of it, together with the alphabet; the latter, however, is certainly not the one that is commonly used at the present time. The chapter concludes with a long account of Professor Wheatstone's ingenious dial and automatic telegraphs. The description of the latter is chiefly taken from the Jurors' Report, International Exhibition of 1862; and this is, we believe, the first time an account of it has appeared in any manual of electricity. The chapter on Submarine Telegraphy commences with a list of all the principal cables yet made, their construction being illustrated by numerous diagrams. The Atlantic cable of last year is very completely described, both as to its mechanical and its electrical qualities, and an account given of the progress of the laying down to the loss of the cable on August 2, a note being inserted at the commencement of the book stating the facts of its successful recovery and the completion of this year's cable, with a short description of the latter. The subjects of induction and the retardation of signals are illustrated by numerous extracts from the valuable experiments of Mr. Latimer Clark (described in the Report of the Submarine Telegraph Committee), and frequent reference is made to Mr. Fleeming Jenkin's "Cantor Lectures" as to the best methods of testing cables for faults. Mr. Jenkin has also contributed an account of Sir W. Thomson's portable electrometer, which is accompanied by diagrams of the different parts of the instrument, numbered for reference. The book concludes with a short notice of Mr. Wilde's new magneto-electric machine.

This work, we believe, will be found sufficient fully to enable the student of electricity to understand the later developments of the science, while the numerous diagrams will familiarise him with the construction and appearance of the principal instruments in practical use among electricians.

The Ophthalmic Review. Edited by J. Z. Laurence and T. Windsor. London: Hardwicke.

Our duty as reviewers is almost necessarily confined to announcing the punctual appearance of the October number of this excellent periodical. The present number opens with a good article on the necessity for a better provision for teaching ophthalmology in England, in the course of which there is given an anecdote from Trousseau's admirable Lectures on Quackery, which we are tempted to transcribe in full:—

"Quacks, it is sad to say, are often patronised by men of genius. I had the honour, for many years, to be the intimate friend and physician of Béranger. In 1848 he had a slight attack of ophthalmia, for which M. Bretonneau prescribed a lotion; the ophthalmia was cured, but as Béranger read and wrote a good deal, and as his skin was irritable, it returned. He consulted a Polish priest, who treated diseases of the eye by some secret remedy. At that time I was President of the Board charged with the examination of *officiers de santé*. The police had a crow to pluck with the Pole, on account of certain eyes that he had extinguished; and he, wishing to render himself safe, called upon Béranger and asked him to use his influence to get him passed at the examination, in order that he might go on treating eyes, and putting them out at his pleasure. Béranger came to me. 'My friend,' he said, 'will you do me a great favour? Try to get this poor devil licensed as an *officier de santé*. He only treats eye diseases; and, as your examinations embrace all branches of the healing art, have a little indulgence and show him favour. He is a refugee; and besides, he has cured me, which is the best of reasons.'

"I told him to send me his man. The Pole came. 'You are recommended to me,' said I, 'by one whom I should be very glad to oblige, one of my best friends, in fact by Béranger; which indeed says everything. Two of my colleagues, to whom I have spoken, agree with me to do what we can in your case. But, as our examinations are public, we must be careful. I will myself take the examination in anatomy; and, in order that it may not be difficult for you to know as much as I do myself, I will only question you upon the eye.'

"The man appeared disconcerted.

"I continued, 'You know what the eye is?'—'Of course I do.'

"'You know that there is an eyelid?'—'Certainly.'

"'You know what the pupil is?'—'Oh yes, I know it well.'

"'You have an idea which is the cornea?'—He hesitated.

"'Do you know the crystalline lens, the vitreous humour, or the retina?'—'No, Sir. Of what use would such knowledge be to me, who only occupy myself about diseases of the eye?'

"'It would be of some use, I assure you; and indeed it is almost necessary that you should have no doubt that there is a crystalline lens, especially if you mean to operate for cataract.'—'But I never operate.'

"'Still, if the fancy took you to extract one?'

"I could go no farther. The poor fellow wished to practise as an oculist without the slightest knowledge of the structure of the eye. I went to Béranger, and told him. He interrupted me by exclaiming—'But the poor man!'

"I continued, 'My dear Béranger, I have been your physician for eight years, and now I am going to ask for a fee.'—'What fee?'

"'You must write a song, and dedicate it to me; and I will furnish the subject.'—'Certainly, and the subject is?'

"'What fools are men of genius!'

"The affair was understood at once, and he said no more about the Polish priest."

We almost think that it would be possible to cap the above with an anecdote drawn from our own profession, in which the Polish priest might be replaced by the letters F.C.S.

CONTEMPORARY SCIENTIFIC PRESS.

[Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted.]

Bulletin de l' Académie des Sciences de Belgique. No. 5. May.

"*List of Prize Questions proposed by the Academy for 1867.*"

"*On some Derivatives of Paroxybenzoic Acid,*" by Ladenburg and Fitz.

No. 6. June.

"*On the Derivatives of Itaconic Acid and of Acids Isomeric with the same,*" by P. Swartz.

"*On the Organised Bodies found in the 'Terrain Ardennais'* (Dumont)," by C. Malaise.

"*On the New Variable Star discovered in Corona Borealis,*" by E. Quetelet.

No. 7. June.

"*On the Vision of Fish and the Amphibia,*" by F. Plateau.

"*On a Meteor observed in Belgium on the 20th of June, 1866,*" by A. Quetelet.

"*Note on the Mutual Action of Soluble Salts as compared with their Effect upon the Animal Economy,*" by L. H. Melsens.

No. 8. August.

"*On Coloured Glass Shades for lessening the Intensity of the Electric Light,*" by A. Brachet.

Sitzungsberichte der kaiserlichen Akademie der Wissenschaften zu Wien. No. 3. March.

"*On Electro-Magnetism as a Motive Power,*" by J. P. Wagner.

"*On the Radiant Heat which accompanies Fluorescence,*" by V. Pierre.

"*On the Colour of Daylight, and of some Sources of Artificial Illumination,*" by Memorsky.

"*Analyses of the Mineral Springs of Austria,*" by S. Streit and W. Holecek.

"*An Analysis of the Johannisbad Spring at Baden, near Vienna,*" by C. Hidegh.

"*On Sulphide of Allyl,*" by M. Ludwig.

No. 4. April.

"*On a New Method of measuring the Length of Waves of Light,*" by J. Stepan.

"*On the Influence of the Molecular Friction of Air on the Velocity of Sound,*" by the same author.

"*Experiments on Inflammation of the Stomach,*" by S. Stricker and Kocslakoff.

"*Experiments on the Interference of Light,*" by J. Stefan.

"*On some of the Dust Showers observed during the last few Years,*" by C. Jelinek.

Chemisches Central Blatt. Nos. 47, 48, 49, 50, 51, and 52.

Nos. 48 and 49 contain:—"*On the Determination of the Absorptive Power of Solid Bodies for Gases*," by Dr. E. Reichardt. No. 49 contains:—"*Notice of the Nitrogenised Food of Plants*," by Dr. W. Wolf and Professor W. Knop; "*On the Absorptive Properties of Arable Land*," by W. Knop. Nos. 50, 51, and 52 contain a very long article on "*Researches on the Basic Carbonates*," by A. Geuther and Dr. Brandes. No. 52 contains, besides, "*On the Corrosion of Lead in Water*," by M. Stahlmann; "*On the Variations of Ash in different Potatoes*," by Dr. A. Vogel.

NOTICES OF PATENTS.

No. 483. *Preparing Meat for Food.* Arthur Hill Hassall, M.D., Wimpole Street. Dated February 15, 1866.

This invention has for its object improvements in the preparation of meat for food. For this purpose the inventor selects the leanest joints or parts of beef or of any other kind of meat; these he first deprives of all bone, tendon, and visible fat, and the red part or flesh is then cut into pieces of about an inch or so in diameter. These are then passed through a sausage or mincing machine, by the knives of which they are cut into small pieces and minced. The minced meat is then spread in very thin layers upon perforated trays, by preference of galvanised iron; this spreading is effected either by hand labour, or it may be by a spreading apparatus attached to the mouth of the sausage machine. The trays when spread are transferred either to a drying closet heated by means of steam or to a hot-air room or chamber (heated by flues passing through it), in either of which the meat becomes deprived of the greater portion of its water and assumes a crisp and friable condition. Special care is taken that the meat is dried at a temperature below the coagulating point of albumen. The meat thus dried is then ground in a mill or under mill stones of suitable construction, after which it is passed either through sieves or a flour-dressing machine, a very fine "flour of meat" being thus obtained. This powder is now subjected to a further drying process, whereby the whole or nearly the whole of the water of the meat is dissipated. By preference, dry the greater portion, say about two-thirds of the powder, at a temperature below the coagulating point of albumen, and dry the remainder at a high temperature, say at about 160° Fahrenheit; the two portions are subsequently mixed together. By thus drying a portion of the powder at a higher temperature a superior flavour is imparted to the powder than if the whole of the powder were dried at a low temperature. For some purposes, however, the whole of the powder may at the second drying be dried at the low or high temperature; when intended to be used for biscuits at the low temperature, and when for lozenges at the high. Part of the ground meat will not after the first grinding be passed through the sieves or dressing machines. This has to be ground a second and even a third time, whereby other quantities of the flour are obtained, but there is still a residue which remains in the sieve. This is of a fibrous character, and consists for the most part of gelatine, and is derived from the membranous or gelatinous portions of the meat. This is ground in a mill suitably adapted for reducing fibre, or is subjected to a temperature much above the coagulating point of albumen, whereby it is rendered more friable, so that it admits of being ground and sieved, the powder being added to the flour of meat previously obtained. Finally, the bones are crushed, and these as well as the tendons are boiled and digested, so as to remove the gelatine contained in them, and which is subsequently recovered in the manner usually practised by gelatine manufacturers, and which, when reduced by grinding and sieving to a fine powder, is added to the flour of meat. Vegetables, such as turnips, carrots, celery, onions, and herbs, are dried also at low temperatures, and for the most part below the coagulating point of albumen, and they are then, like the meat powder itself, ground and passed through fine sieves, a "flour of vegetables" being thus obtained. If the flour of meat is intended to be used for the preparation of beef tea, add to it a little salt; if intended for soups, add all the requisite vegetables and flavourings prepared as above, and reduced to a fine powder similar to that of the meat itself, so that the cook has nothing more to do but to add the requisite quantity of water and simmer for a few minutes, when the soup is ready for use. The flour of meat is also suitable for being used in the preparation of a meat cocoa, also in the manufacture of meat biscuits, and also, when mixed with a farinaceous matter, for a food for invalids.

By the above-described method of preparing meat there is obtained a material capable of prolonged preservation; it utilises the beef or other meat which is usually thrown away in the preparation by the ordinary method of beef-tea, broths, and soups; it also reduces the meat to such a condition that the beef-teas and soups made with it are infinitely more nourishing than those made in the usual manner; and, lastly, it reduces the meat to such a state as that no mastication is required, and it can be readily consumed by persons with defective teeth and by invalids generally.

No. 580. *Liquid and Plastic Cement.* William Welch, Southsea. February 24, 1866.

A person, judging from many of the patents now in existence, would scarcely credit the possibility of any "invention" being too absurd to have protection granted it. Here, however, is an instance to the contrary, and we quote it as a warning to intending patentees that their discoveries must still contain a slight amount of sense and intelligibility.

The "invention has for its object the manufacture of liquid and plastic cement compositions, and relates also to the method of applying the same for ornamental and other uses. The cements are compounded from varied geological stratas made subsidiary by mechanical and other means, or from substances artificially compacted in lieu thereof. The metallic or other substances thus produced are, by the aid of mineral acids, liquids, and salts, agglutinated into a plastic or fluid consistency, according to the purposes for which it is intended, and may be applied in the usual forms of ordinary paints or cements. The properties of the components are permanent and literally indestructible, and firmly adhering to metals, stone, wood, or other surfaces without being displaced by concussive or vibratory action (as is the case with ordinary cements when applied to non-absorbent bodies). The compositions are intended to be used for general, building, and other purposes, as also for imitations of stones, metals, &c., and for plastic ornamental purposes, also for the coating and preservation of iron and other substances exposed to marine uses, whereby a waterproof insulatory protective surface is obtained, and, where necessary, coated with a granulated or fluid metallic compound (pure or mixed), whereby a system of galvanism, active, passive, or otherwise, is produced for anti-fouling or other purposes."

After perusing this remarkable composition, our readers will hardly be surprised to learn that provisional protection was refused.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

2625. E. B. Wilson, Edinburgh, "Improvements in furnaces."

2627. G. Hadfield, Lancaster, "Improvements in furnaces and cupolas."—Petition recorded Oct. 11, 1866.

2645. E. Beanes, Priory Road, Kilburn, "Improvements in refining or decolorising sugar and syrup."—Oct. 12, 1866.

2066. W. Clark, Chancery Lane, "Improvement in the utilisation of chloride of manganese (residue of the manufacture of chlorine) in the manufacture of peroxide of manganese, chlorine, and hydrochloric acid, and in apparatus for the same." A communication from E. A. Cotelle, 29, Boulevart St. Martin, Paris.—August 11, 1866.

2606. G. W. Skinner, Strand, "Improvements in the means of and apparatus for utilising sewage matters and liquids."

2612. G. H. Benson, Staleybridge, Cheshire, and W. G. Valentin, Royal College of Chemistry, "Improvements in the melting and casting of steel, and in the apparatus employed therein."

2614. G. H. Benson, Staleybridge, Cheshire, and W. G. Valentin, Royal College of Chemistry, "Improvements in the manufacture of malleable iron and steel, and in the apparatus employed in such manufacture."

2616. G. H. Benson, Staleybridge, Cheshire, and W. G. Valentin, Royal College of Chemistry, "Improvements in the manufacture of iron and steel, and in the apparatus employed therein."—October 9, 1866.

2669. G. T. Bousfield, Loughborough Park, Brixton, Surrey, "Improvements in the manufacture of green and blue colouring matters." A communication from A. Poirrier and C. Chappat, Rue d'Hauteville, Paris.

2671. A. Swan, Kirkcaldy, Fifeshire, "Improvements in, and in apparatus for, evaporating or recovering lees." October 16, 1866.

2681. J. Slessor, Glasgow, N.B., "Improvements in distilling alcoholic spirits."

2683. J. Hamilton, Glasgow, N.B., "A new and improved fuel."

2685. A. V. Newton, Chancery Lane, "Improvements in the process of distilling petroleum and other oils or substances." A communication from P. Lugo and T. O. L. Schrader, New York, U.S.A.—October 17, 1866.

2691.—A. R. F. N. Darbel, M.D., Rue d'Enghien, Paris, "Improvements in the manufacture of caustic soda."—October 18, 1866.

2707. E. L. Simpson, Bridgeport, Fairfield, Con., U.S.A., "An improved process for the preparation of india-rubber and kindred gums."—October 19, 1866.

Inventions Protected by the Deposit of Complete Specifications.

2759. G. T. Bousfield, Loughborough Park, Brixton, Surrey, "Improvements in the manufacture of gases for the purpose of producing heat, and the application thereof to metallurgical operations." A communication from W. Elmer, M.D., New York, U.S.A.—Petition recorded October 25, 1866.

2810. G. T. Bousfield, Loughborough Park, Brixton, Surrey, "Improvements in treating sheet-iron plates for the purpose of preparing the same for being coated with zinc, for producing the so-called 'galvanised iron,' and also for manufacturing such plate in imitation of Russia iron."—A communication from C. H. Perkins, Rhode Island, U.S.A.—October 30, 1866.

Notices to Proceed.

1654. D. A. Fyffe, Glammis, Forfarshire, N.B., "Improvements in the manufacture of pulp."

1658. J. Abbot, Dockhead, Surrey, "The better combustion of fuel in steam boilers and other furnaces."—Petition recorded June 20, 1866.

1667. E. Hunt, Glasgow, N.B., "Improvements in dissolving or treating rubber, gutta percha, copal, and similar gums or resins and their compounds."—June 22, 1866.

2418. C. Crump, Paignton, Devon, "Improvements in solvents for resins or resinous substances, caoutchouc, gutta percha, oils, and fats."—September 20, 1866.

CORRESPONDENCE.

Fires of Spontaneous Origin.

To the Editor of the Chemical News.

Sir,—Since the destruction by fire of the Standard Theatre on Sunday, October 21, I have not seen any reference made in the public prints to the probable cause of this accident, which forms one of a large series of similar disasters with which the British public is already familiar. Taking into consideration the known circumstances of the case—namely, the character of the theatrical performance, a burlesque of *Der Freischütz*, the time of outbreak, 6 a.m., and the unusual heat and closeness of the weather for some days previously, I conceive that the origin of the fire may with some degree of probability be attributed to the spontaneous inflammation of the pyrotechnic composition ordinarily used in the production of red fire. Several instances are already on record, and I was myself some five years ago witness to a spontaneous ignition of the substance in question. There cannot be a doubt regarding its highly dangerous character, and its liability to ignite spontaneously is specially noticed in Fownes's "Manual of Chemistry" (eighth edition, foot-note, page 284).

The red-fire composition ordinarily consists of nitrate of strontia, sulphur, chlorate of potash, and lamp-black, all in the state of fine powder, and intimately mixed; it is usually stored in metal canisters, but in the event of ignition occurring the vast quantity of gases evolved would at once rip open the cylinders and spread fire in all directions. I imagine that the tendency to become inflamed would be augmented by the heat of the weather, which from the *Times*' meteorological reports appears to have risen in London as much as thirteen degrees during the two days immediately preceding the conflagration. Large quantities of the "red fire" would no doubt be procured for a continuous representation of *Der Freischütz*, and inasmuch as similar performances are now going on at two other theatres in London, and the pantomime season is also fast approaching, it would seem desirable to call attention to the treacherous qualities of a pyrotechnic composition so largely employed. I am, &c. John Spiller.

Woolwich, November 5.

Process for the Estimation of Resin in Soap.

To the Editor of the Chemical News.

Sir,—As I happen, like your correspondent S. H. J., of last week's Chemical News, to have a text-book at my elbow, I was quite aware of the action of nitric acid on the fatty acids and the nine or ten acids of the acetic series, not to mention about half as many of the succinic, produced by that action; and when I made my first experiment for the estimation of resin, I was quite prepared to find that the process would not be satisfactory, on account of the action of the nitric acid on the fatty acids, as mentioned in Turner, Taylor and Brande, &c., but was agreeably surprised to find the result as near as a rough preliminary experiment could be expected to be. I then repeated the operation, and found my result to coincide exactly with the amount of fatty acid known to be present. I have made several experiments since, and in almost every case obtained a fair approximation to the relative proportions of the fatty and resinous acids. The reason of this I believe to be that nitric acid attacks the resinous much more readily than it does the fatty acids, producing almost at once a solution of the former as terebic acid, while the latter are comparatively unacted upon. That these fatty acids are but little acted on by the nitric acid during the operation is seen from the characteristic crystalline appearance of the cake obtained at the end of the process, and more especially from the high melting point exhibited, and which I found to be 118° F. This is, as near as may be, the correct melting point of such a mixture of fatty acids as is usually obtained from mixed animal fats, and shows plainly that they have undergone but little alteration by the short continued action of the nitric acid. Had the results suggested by our friend S. H. J. been produced, the melting point of the resulting mixture of oily acids would have been depressed to at least 40° C., as several of those acids specified by him have melting points below zero; while the highest melting point is that of capric acid, the furthest down in the series, and which stands 86°. Moreover, in almost every instance I have found the resulting fatty acid to come up to the quantity actually present.

I never for a moment fancied that such a process as that given by me would, under all circumstances, give perfectly accurate results, but after a few experiments it is capable of giving results sufficiently correct for the purposes of the soap-maker, or even for the analyst, when required to give an idea of the relative proportions of fatty and resinous acids. The process is, I believe, capable of being elaborated into one giving thoroughly scientific results—say, by the precipitation of the terebic acid, or its collection in some other suitable manner—but this I leave to some one having better opportunities of scientific research.—I am, &c.

Jno. Sutherland.

Soap Works, Sydney Street, Glasgow.

To the Editor of the Chemical News.

Sir,—In reference to the process proposed for the above by Mr. Sutherland, in your number for October 19, I beg to say, as a practical soap-maker, that a process of this kind is one of the great desiderata in soap analysis, but, as one who has had a laboratory training in London, and since then constantly engaged in analysing soaps for several years, I am bound to say that, having given the process several fair trials, under conditions slightly varied so as to afford greater chances of success, I fear there is no reliance to be placed on the process as thus described. I will not trouble you with the details of my experiments, which I should be happy to communicate to the author of the process, but will at once subscribe myself

Yours, &c. B.A., B.Sc. Lond.

The Smoke Question.

To the Editor of the Chemical News.

Sir,—I have read a paper in your journal by P. Spence, Esq., F.C.S., in which are the following statements:—

1st. That well-known gas nitrogen is "thoroughly poisonous to animal life."

2nd. That fresh charcoal is newly-*precipitated* carbon.

3rd. That when 50,000 tons of coal containing 80 per cent. of carbon are burnt, 183,000 tons of CO_2 are formed, whereas with the above data most persons would calculate 146,666 tons; thus:—

$$\frac{50000 \times 80 \times 22}{100 \times 6} = \frac{88000000}{600} = 146666$$

Mr. Spence, however, obtains a different result, and this 183,000 happens to represent in round numbers the weight in tons of the CO_2 which would be produced by the combustion of 50,000 tons of pure carbon; thus:—

$$\frac{50000 \times 22}{6} = \frac{1100000}{6} = 183333.$$

4th. That "at present we get not much, if anything, over half the available heat" of coal Now, in your report of Dr. Frankland's lecture on the source of muscular power, it is stated (and I have seen it proved at length elsewhere) that "in the best constructed steam-engine only one-tenth of the actual energy developed by the burning fuel can be obtained in the form of mechanical power" (Chemical News, vol. xiv., page 150).

I am, &c. W. T.

November 3 1866.

MISCELLANEOUS.

Chemical Society.—The next meeting of the Society will be held on Thursday evening, at 8 o'clock, when the following papers will be read:—"*On Ozone*," by Dr. Daubeny; "*On a Chlorosulphide of Carbon*," by Mr. W. N. Hartley.

Carminic Acid, according to MM. Hlasiwetz and Grabowsky, is a glucoside, decomposing by boiling with diluted sulphuric acid, the products being glucose and *carmine red*. Melted with hydrate of potash, the latter gives a new compound, crystallisable in yellow plates, which the author calls coccinine. It is remarkable for the beautiful coloration it produces with different reagents.—*Zeitschr. Chem.*, 1866, p. 373.

Physiological Action of Nitrate of Methyl-Strychnine.—M. Schroff has confirmed the curious fact noticed by M. Stahlsmidt of the perfect harmlessness of methyl-strychnine when introduced into the blood; but he finds that its action is different when this base is put into direct communication with the blood by subcutaneous injection; for in this case it recovers the poisonous properties which characterise strychnine. This reminds the author of the action of curara, which is similarly digested without danger, and he asks whether this Indian arrow poison may not be of an analogous nature. The experiments have been made on rabbits and frogs.—*Neu. Repertor.*, xv. 196.

Permanganate of Potash, in solutions, spread upon pear or cherry wood for a few minutes, leaves a permanent dark brown colour, which, after washing, drying, and oiling, assumes a reddish tint upon being polished.—*Am. Drug. Circ.*

ANSWERS TO CORRESPONDENTS.

General Index to the First Fourteen Volumes of the Chemical News.—We have had an inquiry for such an index. Its compilation will be attended with considerable trouble and expense; if, however, we find our readers generally wish for one, it shall be commenced as soon as the present volume is completed. Intending subscribers will please notify their wishes to the publisher without delay.

⁂ 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. XIII. 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., II., and VII. are out of print. All the others are kept in stock. Vol. XIV. commenced on July 6, and will be complete in 26 numbers.

J. Israel.—The metric ton of 1000 kilogrammes is equal to 19 cwt. 2 qrs. 20 lbs. 10 oz. For rough commercial purposes you may therefore consider it as equal to our ton.

Dyer.—You can obtain toluidine at the same place where you get aniline.

Amber Mouthpiece.—Baudrimont certainly found sulphur in all specimens of amber which he examined, but we see no apparent connexion between this sulphur and the sore lips you complain of. We should rather blame the tobacco.

Q. R. S.—We suggested the employment of silico-tungstate of soda for fluid prisms in our number for May 14, 1864, but we do not know whether the suggestion has ever been adopted.

Photo.—Add sulphide of sodium to your silver solution, and the whole of the metal will be precipitated as sulphide. You will get no precipitate on the addition of salt, as chloride of silver is soluble in hyposulphite of soda.

A Consumer will find a method of detecting picrotoxine (the poisonous principle of Cocculus indicus) in beer in the Chemical News, vol. ix., p. 122.

Received with thanks.—J. M. M.; Prof. How, D.C.L.

Books Received.—Temperature in Acute Disease, by Thomas A. Compton, M.D., &c.; Calendar of the Pharmaceutical Society of Great Britain; A Popular Description of the Small Induction Coil.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

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

Part III.

Connexion between Organic and Inorganic Chemistry.

Section V.—*Inorganic and Organic Nitrides.*

(Continued from page 218.)

Oxygenised groups, inorganic and organic, may replace the hydrogen of ammonia to form compound ammonias or amines. I have shown the existence of oxyethylenic bases, which may be looked upon as ammonia, in which 1, 2, or 3 atoms of hydrogen are replaced by 1, 2, or 3 oxyethylic groups $\text{Ꞓ}_2\text{H}_5\Theta$. This group acts the part of a monatomic radical; it may be looked upon as formed of an ethylene group joined to the residue $(\text{H}\Theta)'$.*

$$[(\text{Ꞓ}_2\text{H}_4)''(\text{H}\Theta)]'.$$

The atomicity of the ethylene group is lowered one degree by the addition of the monatomic group $(\text{H}\Theta)'$.

The following formulæ express the relations of these bases with ammonia:—

$$\left.\begin{array}{r}\text{Ꞓ}_2\text{H}_5\Theta\\ \text{H}\\ \text{H}\end{array}\right\}\text{N},\qquad \left.\begin{array}{r}\text{Ꞓ}_2\text{H}_5\Theta\\ \text{Ꞓ}_2\text{H}_5\Theta\\ \text{H}\end{array}\right\}\text{N},\qquad \left.\begin{array}{r}\text{Ꞓ}_2\text{H}_5\Theta\\ \text{Ꞓ}_2\text{H}_5\Theta\\ \text{Ꞓ}_2\text{H}_5\Theta\end{array}\right\}\text{N}.$$

Oxethylenamine. Dioxethylenamine. Trioxethylenamine.

There are oxycobaltic, oxymercuric, and oxyplatinic bases.

We know that the ammoniacal solutions of the salts of cobaltosonium absorb the oxygen of the air and change into ammoniacal bases corresponding to cobaltic oxide. These bases have been studied (within the last few years) by M. Fremy and by MM. Gibbs and Genth. M. H. Schiff rightly admits the existence in them of a group $[\text{Ꞓo}\Theta]'$. He considers this group as monatomic, and formed by the combination of diatomic oxygen with cobalt $(\text{Ꞓo} = 59)$, which is triatomic in the cobaltic salts (cobalticum). Here we see the atomicity of the triatomic metal lowered two degrees by the addition of oxygen, which saturates 2 affinities:—

$$[\text{Ꞓo}'''\Theta'']'.$$

We know that there are oxygenised salts corresponding to the combinations of chloroplatammonium and of amichloroplatammonium. These are formed when the chlorised combinations are boiled with an excess of nitrate of silver (Gerhardt, Kolbe). The chlorine of the chloroplatinum radical is then replaced by oxygen.

$$\left.\begin{array}{r}[\text{ᵽtCl}_2]''\\ \text{H}_2\\ \text{H}_2\\ \text{H}_2\end{array}\right\}\text{N}_2\qquad \left.\begin{array}{r}(\text{Ᵽt}\Theta)''\\ \text{H}_2\\ \text{H}_2\\ \text{H}_2\end{array}\right\}\text{N}_2$$

Chloroplatammonium. Oxyplatammonium (Gerhardt).

$$\left.\begin{array}{r}(\text{ᵽtCl}_2)''\\ \text{Am}_2\\ \text{H}_2\\ \text{H}_2\end{array}\right\}\text{N}_2\qquad \left.\begin{array}{r}(\text{Ᵽt}\Theta)''\\ \text{Am}_2\\ \text{H}_2\\ \text{H}_2\end{array}\right\}\text{N}.$$

Amichloroplatammonium. Amoxyplatammonium (Kolbe).

In these bases the group

$$\text{Ᵽt}\Theta$$

acts as a diatomic radical formed by the combination of diatomic oxygen with tetratomic platinum.

M. Millon some years ago discovered a remarkable base, to which he gave the name of *ammonio-mercuric oxide*. This body is formed by the action of ammonia upon oxide of mercury. Its composition is usually represented by the formula

$$3\text{HgO},\text{HgH}_2\text{N} + 3\text{HO}.$$

When anhydrous it contains—

$$3\text{HgO},\text{HgNH}_2.$$

In our notation this formula becomes

$$3\text{Ħg}\Theta,\text{ĦgN}_2\text{H}_4.$$

The base itself may be looked upon as the oxide of an ammonium—

$$\left[\left.\begin{array}{r}(\text{Ħg.H}\Theta)\\ \text{Ħg}''\\ \text{H}\end{array}\right\}\text{N}\right]_2\Theta$$

in which the diatomic mercury would be joined to the $\text{Ħ}\Theta$ group, as, in the oxyethylammoniums, ethylene is joined to the same group.

(To be continued.)

New Researches on the Law of Chemical Proportions, and on Atomic Weights and their Mutual Relations, by J. S. Stas.*

(Continued from page 219.)

In my third memoir, entitled "*Researches made for the purpose of determining and controlling the Atomic Weights of Nitrogen, Bromine, Chlorine, Silver, Lithium, Potassium, and Sodium*," are recorded all the labours to which I have devoted myself in order to solve these different questions. This memoir consists of fifteen notices; it is useless to quote them all here. The principal are entitled—5th. *Of chloride of potassium employed in the determinations and determination of the proportional relation between chloride and nitrate of potassium;* 7th. *Of chloride of sodium used in the determinations and determination of the proportional relation between this chloride and nitrate of sodium;* 9th. *Of chloride of lithium employed in the determinations;* 11th. *Of the means employed for the determination of the proportional relation between chloride of lithium and silver;* 13th. *Of the means employed for the determination of the proportional relation between chloride and nitrate of lithium;* 14th. *New syntheses of nitrate of silver.*

The remarkably concordant results to which the labours mentioned in these notices lead me, show that, taking for the atomic weight of potassium 39·00, or 39·125, or 39·250; of sodium 23·00; of lithium 7·00; of silver 108·00, the difference between the weight of a molecule of the chloride of one of these metals and the nitrate which corresponds to it is not a *constant*, as it ought to be, according to the law of chemical proportions, and further that it is not equal to 26·50.

Indeed, for potassium, according as K is taken at 39·00 or 39·125, or 39·250, this difference is comprised between . . .	26·553	and	26·640
For sodium this difference is .			26·561
For lithium			26·603
For silver			26·607
Instead			26·500

These researches prove, on the contrary, that the difference becomes a constant from the moment when (in order to calculate the results) *those deduced directly from the experiment*, and not the hypothetical ciphers, are taken for atomic weights.

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* The group $[\text{Ꞓ}_2\text{H}_4.\text{H}\Theta]'$ represents glycol. $\text{Ꞓ}_2\text{H}_4.2\text{H}\Theta$ minus $(\text{H}\Theta)'$.

* *Memoirs of the Royal Academy of Belgium.*

In this case, chlorine being 35·457, and

K = 39·130, the difference is equal to	.	26·586
Na = 23·043 " " "	.	26·591
Li = 7·022 " " "	.	26·589
Ag = 107·930 " " "	.	26·587
This constant is then equal to a mean of	.	26·588

There is, then, a difference of $\frac{1}{265}$th over the total weight of the constant, or nearly $\frac{1}{10}$th of an atom of hydrogen, which serves as the unit, between the calculation and the result of the concordant experiments, in which, nevertheless, *four* distinct metals are interposed, three of which are the best known of all existing elements. This difference constitutes an error *sixteen* times greater than the mean deviation which I have observed in my experiments on chloride of potassium; it is *twelve* times greater than the mean deviation proved in the experiments on chloride of sodium, a determination of which has been made in collaboration with M. Kekulé; it shows an error *forty* times greater than the mean deviation of the proportional relation between chloride and nitrate of lithium which my determinations present; lastly, this difference constitutes an error *forty* times greater than the mean deviation offered by my new synthesis of nitrate of silver.

The magnitude of the difference between the calculation, according to Prout's hypothesis, and the experiment, proceeds from this—that, in this method of control, the deviation existing between the atomic weights of chlorine and nitrogen, calculated according to this hypothesis, and the atomic weights deduced from experimental determinations, and which is in an opposite direction, is added, instead of taken off, as is often the case in other modes of investigation. Relatively slight as is the difference for each of these two bodies, it becomes so great when added, that it is absolutely impossible to attribute it to a constant error of observation. The sum of the mean deviation which exists, for chlorine and nitrogen, between the figures of the hypothesis and those which proceed from the experiments recorded in my "*Researches on the Reciprocal Relation of Atomic Weights*," is from 0·084 to 0·086, or nearly $\frac{1}{10}$th of an atom of hydrogen, a sum which, within the limits of accuracy of the experiment, is equal to the overplus observed in the transformation of chlorides into nitrates. I confess this was the motive that induced me to undertake those *four series* of researches in which (as I anticipated) I had to struggle with such considerable difficulties of every kind, that several times I was on the point of giving them up. As for the rest, I explain myself at length on this subject in the exposition of these researches.

The atomic weight of nitrogen which is derived from these labours is, according to the relation of weight—

From chloride of potassium to nitrate	.	= 14·043
From chloride of sodium to nitrate .	.	= 14·048
From chloride of lithium to nitrate .	.	= 14·046
From chloride of silver to nitrate .	.	= 14·044
Mean . .	.	14·045

There is, then, a mean deviation which does not exceed $\frac{1}{4000}$th part.

My *new* syntheses of nitrate of silver lead to	.	14·042
My *old* syntheses, contained in my "*Researches on the Reciprocal Relation of Atomic Weights*," give as a mean	.	14·041
General mean .	.	14·044

These labours, then, completely confirm the conclusion which I have drawn from the synthesis of nitrate of silver; they establish on sufficient proof that the atomic weight of nitrogen is not represented by 14·00, oxygen being 16·00, and that the hypothesis on which this number is based is not founded on experience.

These labours prove equally that—

1st. The atomic weight of potassium is comprised between .	39·130	and	39·135
2nd. The atomic weight of sodium is between . . .	23·042	"	23·045
3rd. The atomic weight of lithium is between	7·020	"	7·024
4th. The atomic weight of silver is between	107·925	"	107·930
5th. The atomic weight of chlorine is between . . .	35·455	"	35·460

Before the publication of my "*Researches on the Reciprocal Relation of Atomic Weights*," I had many times determined the proportional relation between bromide of potassium and silver. The labours which I effected in order to obtain pure bromine designed for the synthesis of bromide of silver, and those which I undertook for the purpose of proving the purity of the bromine produced, compelled me to procure very considerable quantities of bromate and bromide of potassium. I took advantage of this circumstance to control the atomic weights of potassium and bromine. The *ensemble* of the researches which I have made on this subject is recorded in the notice which closes the third memoir, and which is entitled, "*Determination of the Proportional Relation between Bromide of Potassium and Silver.*"

From the relations proved between bromine, potassium, and silver, it follows that silver being .			107·93
The atomic weight of potassium is comprised between . . .	39·130	and	39·144
The atomic weight of bromine between	79·945	"	79·965

The researches made by M. Marignac in 1843 lead to precisely the same numerical proportions.

(To be continued.)

PHARMACY, TOXICOLOGY, &c.

Report on Amyl,* *by Dr.* B. W. RICHARDSON.

THE author commenced by stating that, in accordance with the desire of the Section, as expressed at the last meeting at Birmingham, he had in this, his third report, enlarged the report by introducing a comparison between certain of the compounds of ethyl and those of amyl. After recapitulating his reports of previous years, the author narrated experiments to ascertain whether nitrite of amyl could, by being injected into the blood-vessels, recall the heart into action when that organ had ceased to beat from various causes of sudden death, such as death by drowning or by suffocation from poisonous vapours and the like: the results were, so far, negative, but this probably arose from the want of some advance in experiment rather than from an error in principle.

In the next step of his Report Dr. Richardson explained that the extreme stimulation and action of the heart which follows on the inhalation of nitrite of amyl is brought about by the direct action upon the heart through the nervous system. The experience of everyday life tells us that the heart may be thrown into similar activity by the mere agency of force communicated from the external world to the senses, and through

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* British Association, Nottingham Meeting, Section D.

them to the heart. The influence of sounds harsh or melodious, of sights appalling or fascinating, are well known. From the manner in which these influences come upon us, from their invisibility of action—if such an expression be allowed—we are prone to look upon them as immaterial agencies; they are not so; thoroughly understood, they are as material as a physical blow, or the impress of a liquid or gaseous substance. Nitrite of amyl is one of those substances which enable us to realise this connexion between the really material and seemingly immaterial influences which surround us; for, by refining experiment so as to diffuse vapour of amyl through the air, an invisible and, as it would seem to the unlearned, an immaterial agency acts, by known rules and in obedience to the human will. He (the author) could, for instance, make every person's heart in the room quicken ten beats per minute as easily as he could quicken the action of a steam-engine if his hand were on the lever.

The third point dwelt upon had reference to the antiseptic properties of the amyl compounds. It was shown on this point that the acetate of amyl (essence of pears) was an excellent and cheap antiseptic, that it might be applied to the preservation of animal substances used as food, and even for the transmission of whole carcases of animals from one part of the world to the other.

The fourth point dwelt upon related to the physiological action of pure ether, acetic ether, hydrochloric ether, and nitrite of ethyl. The inferences drawn from the author's researches were strongly in favour of pure ether, as a means of destroying pain generally, over chloroform and all other similar bodies.

Respecting nitrite of ethyl, specimens of which were shown, it was reported that this substance, like nitrite of amyl, was one of the most powerful of excitants upon the heart. It also suspended the animation of cold-blooded, and, to a certain limited extent, of warm-blooded animals.

The author concluded with the statement of the three following conclusions:—

1. That the oxide of ethyl, when used as a pure chemical, is the safest and most effective general means for producing insensibility to pain.

2. That amylene and ether produce their effects by virtue of two acts: by suppressing oxidation of blood in the lungs and by the extraction of caloric from the blood. This latter point was advanced as a new and more simple explanation of the action of the substances named than had before been suggested.

3. That the modification of symptoms produced by the change of form of a simple amyl or ethyl compound into a nitrite, turned in the introduction of nitrogen, into the composition; by this introduction the anæsthetic action is destroyed, and is replaced by disturbance of muscular action, especially of the heart. In this respect the nitrite compounds represent immediately in an exaggerated degree the action of strychnine, theine, nicotine, and analogous alkaloidal substances, of which nitrogen forms an elementary constituent.

Cafetannic Acid, according to M. Hlasiwetz, is a glucoside resembling tannin, and may be transformed into glucose and a crystallisable acid $C_{18}H_{16}O_8$, which the author calls *cafeic* acid. This new acid is allied to *ferulic* acid, previously discovered in assafœtida by M. Hlasiwetz, as well as to protocatechucic acid.—*Zeitschr. Chem.*, ix. 373.

REPORT ON THE

CHEMICAL LABORATORIES

IN COURSE OF ERECTION IN THE

UNIVERSITIES OF BONN AND BERLIN.

The Chemical Laboratories of the Rhenish Frederick William University of Bonn.

(Continued from page 221.)

The Basement.

We will take but a hasty survey of the plan of the basement (Fig. 3, page 232). This is, to all intents and purposes, a repetition of the ground floor, the greater thickness of the walls, however, lessening the amount of space to some extent. The rooms in this part of the building are twelve feet in height from the floor to the top of the arch, and are sufficiently lighted throughout by numerous windows of comparatively large dimensions. As yet, only part of the basement has been assigned to special purposes.

In the plan of the basement the various parts are again denoted by letters, enabling the reader to trace the several rooms in the synopsis, in which full particulars of their destination and of their dimensions are given.

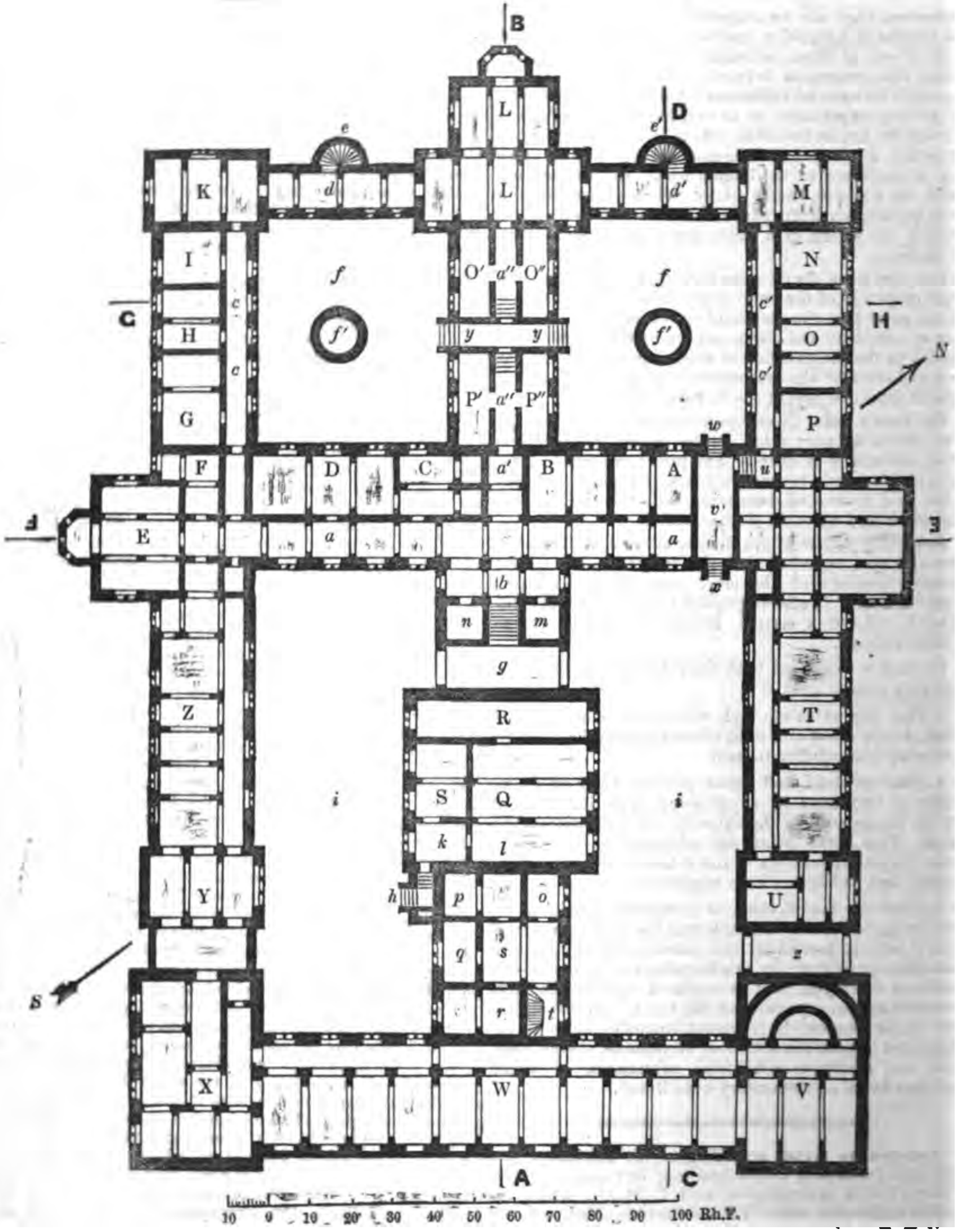
For further elucidation the following remarks may still find a place.

The various rooms are connected with one another by means of the principal transverse Corridor (*a*, *a*), running along the whole length of the middle cross building, and lying immediately under the corresponding corridor of the ground floor. These two corridors communicate with one another by means of a Staircase (*b*), the bottom flight of which lies directly under that leading from the ground floor to the great theatre, whilst the two side wings, into which it divides at the mid-story, lead, close beside the theatre staircase, to the ground-floor corridor, affording, at the same time, communication between the two stories and the front courts by means of an additional flight descending from the mid story into the thoroughfare (*g*).

Along the main corridor of the basement are two spacious Rooms (A and B), of which the first (A) is intended for the Storage of Solid, the other (B) for that of Liquid Reagents. In the first of these rooms (A) are cupboards and drawers for preserving dry substances, together with shelves for earthenware jars containing moist and deliquescent salts; whilst the second room (B) is fitted for storing away carboys, and stone jars wherein acids, soda solution, ammonia, and liquid reagents generally are kept. Both store rooms are close to the flight of stairs leading on one side into the courts, on the other to the ground floor, whereby the carriage of chemicals to the store rooms and thence to the main body of the institution is greatly facilitated. The same accessibility to the floor above pertains to the other two rooms (C and D) along this corridor, and has determined their especial uses. In the one nearest to the staircase a steam boiler will be set up; while directly communicating with the Steam Boiler Room (C), and at the same time accessible from the corridor, is a large and well-lighted Apartment (D) intended for rougher kinds of work, and especially to be used as a general Wash Room, where glass and porcelain apparatus of all kinds can be readily collected from the various parts of the institution and cleaned. For all these purposes the close proximity of the steam boiler is of particular advantage, inasmuch as it places steam and hot water at the immediate disposal of those engaged in the adjoining room. In this room, moreover, a large press will be fitted up, in the use of which for hot-pressing purposes, the steam, close at hand, may likewise be turned to account. At the extreme end of the corridor is a fine well-lighted Room (E), corresponding in form and size with the director's study on the floor above; this is a Store Room for the large stock of Glass and Porcelain,

FIG. 3.

ROOMS ON BASEMENT.



under the charge of the castellan. In the Lumber Room (F) immediately adjoining, boxes and packages in which glass and porcelain as well as other supplies for the institution have arrived, can be temporarily stowed away.

SYNOPSIS OF ROOMS ON BASEMENT.

	Name of Room.	Length. ft.	in.	Breadth. ft.	in.	Height to top of arch ft.	in.
A	Store-room for solid reagents	19	4	15	11	12	0
B	Store-room for liquid reagents	18	11	15	11		
C	Steam boiler and press-room	18	11	15	11		
D	Wash-room for glass and porcelain	33	1	15	11		
E	Store-room for glass and porcelain	26	5	19	1		
F	Lumber-room for temporary storage of boxes and packages	8	9¾	15	11		
		7	0	4	10		
G	Coal-cellar for steam boiler and hot-water apparatus	21	5½	15	5½		
H	Room for hot-water apparatus	16	8	15	5½		
I	Hospital for animals under chemico-physiological treatment	12	5½	15	5½		
K	Laboratory of physiological chemistry	25	6	14	11		
L, L	Furnace-rooms of second and third laboratory	37	7	14	11		
		21	11	15	7		
M	Furnace room of first laboratory	25	6	14	11		
N	Room for hot-water apparatus	12	5½	15	5½		
O	Coal-cellar	25	8	15	5½		
P	Ditto	12	5½	15	5½		
O′ O″ P′ P″	Ditto Ditto Ditto Ditto	21	3	7	1½		
Q	Workshop	29	8	25	8		
R	Room for medico-legal investigations	39	11	8	11½		
S	Cellar for explosive compounds, condensed gases, &c.	19	4	12	10		
T, U, V, W, X, Y, Z	Cellarage provided for future use	...		...		...	
a, a	Main corridor through middle cross building	122	5½	8	9	12	0
a′	Middle widening of corridor (*a, a*)	15	11	9	0		
a″	Passage connecting the widening (*a′*) of main corridor with great furnace-room	21	3	5	0		
b	Staircase from basement to ground floor	...		...		...	
c, c	Side passage leading to laboratory of physiological chemistry	53	3	4	8½	12	0
c′, c′	Side passage leading to small furnace-room	53	3	4	8½		
d	Passage between laboratory of physiological chemistry and furnace-room of second and third laboratories	36	5	10	0		
d′	Passage between the furnace room of second and third laboratories and that of first laboratory	36	5	10	0		
e	Winding staircase of passage (*d*) to open hall above	...		...		...	
e′	Winding staircase of passage (*d′*) to open hall above	...		...		...	
f, f	Back courts of the institution	56	1	46	10		
f′, f′	Open reservoirs in back courts	...		...		...	
g	Thoroughfare between front courts of institution	29	2	9	0	...	
h	Steps leading from basement to front court, and thence to platform outside lecture preparation room	...		...		...	
i, i	Front courts of institution	115	6	45	0	...	
k	Approach to rooms under the lecture hall	12	10	8	11½	12	0
l	Ventilation niche for galvanic battery	...		...		...	
m, n	Coal-cellars	11	10	6	11½	12	0
o *p* *q* *r*	Director's household cellars	11	4	7	8½		
		16	11½	11	4		
		13	2½	7	3½		
		16	11½	11	7½		
s	Approach to director's household cellars	16	11½	13	2½		
t	Servants' staircase from front court to director's residence	...		...		...	
u	Staircase from side passage (*c′, c′*) to thoroughfare (*v*)	...		...		...	
v	Thoroughfare between front court (*i*) and back court (*f*)	26	5	9	0	12	0
w	Steps from thoroughfare (*v*) to back court	...		...		...	
x	Steps from thoroughfare (*v*) to front courts	...		...		...	
y, y	Thoroughfare between back courts	22	0	7	3	12	0
z	Carriage-way to courts	25	6	11	0		

From the main corridor (*a, a*), between the lumber room and the wash room, a Side Passage (*c, c*) branches out, communicating on its left side with three small Rooms (G, H, I), and forming at the end an approach to a larger Room (K). The first of the small rooms, the one lying nearest to the main corridor, is a Coal-cellar (G) for supplying the steam boiler as well as the hot water apparatus in the adjoining room (H). The two rooms next in succession are provided for chemico-physiological researches; the large well-lighted room at the end being the Laboratory for Physiological Chemistry (K), whilst the adjoining room is fitted up as a Stable (I) for the housing and feeding of animals required for experiment. The chief entrance to this laboratory, however, is not from that side by which we have come upon it in our wanderings through the basement. It is likewise approached from the other side by a Passage (*d*) communicating with the open hall overhead by means of the Spiral Staircase (*e*), so that any one working in the second or third laboratory need only pass through the adjoining operation room to reach in this way the laboratory for chemico-physiological researches.

In addition to this laboratory, the basement of the back block of the building contains two Furnace Rooms (L, L, and M) for smelting operations, carried on by means of coal and coke. The larger of these, that situated in the middle (L, L), is for students of the second and third laboratories; while the smaller one (M) is for the beginners. These furnace rooms are purposely located in the basement, since the greater height of the chimneys of this flat insures a considerable increase of draught. Being, moreover, far less frequently used than the rooms on the ground-floor, their slight distance from the principal laboratories appeared of but little importance. Lastly, the dust and dirt invariably attending the use of coal are thus almost entirely excluded from the rooms in the flat above. The furnaces and appliances set up in these laboratories are of a varied nature; among them protected niches for operations carried on under great pressure, such as digestion of substances in sealed tubes, &c., deserve particular notice.

The larger furnace-room is readily accessible from all the laboratories on the ground-floor, first by the corridor leading to the laboratory for physiological chemistry, and the spiral staircase connected therewith, and secondly by the Passage (*d′*) leading to the small furnace-room, from which a Spiral Staircase (*e′*) likewise ascends to the open hall above. By the same route, the beginners working in the first laboratory get to the smaller furnace-room allotted to their use. The large furnace-room communicates, moreover, by a special Passage (*a″*, *a′*) with the Widening (*a′*) of the principal corridor of the basement, and thence with the various store-rooms. For the storage of the fuel required for the furnace operations, four Coal Cellars (O′, O″, P′, P″) have been provided in the immediate neighbourhood of, and communicating with, the passage (*a″*, *a′*). Lastly, the Back Courts (*f*) of the building are also made accessible from this part by means of a Thoroughfare (*y*, *y*) connecting the two courts by intersecting the passage (*a″*, *a″*) in the mid-length.

The furnace-room for beginners has in like manner its own Passage (*c′*, *c′*) communicating with the basement rooms of the middle cross building. The Rooms (N, O, P) lying along the passage are for Hot-water Apparatus (N) and for Storage of Coal (O, P), which is thrown in here from the outer and consequently most accessible side of the building. The end of the passage (*c′*, *c′*) opposite the entrance to the small furnace-room opens, on the one hand, into the cellars which, having as yet no special purpose assigned to them, have been left unfinished, and leads, on the other hand, by a small Flight of Steps (*u*) down into the Thoroughfare (*v*), from which by means of two other Flights (*w* and *x*) we ascend to the left front and back courts.

With regard to the courts themselves, it deserves to be mentioned that the two Front Courts (*i*, *i*) communicate by means of a Thoroughfare (*y*) cutting the front wing of the cross building immediately under the landing of the theatre staircase; in this manner any one of the four courts can be reached through the Carriage-way (*z*) facing the town, without entering the interior of the building. Such a disposition is of great use for the preservation of cleanliness throughout, and of absolute necessity for rendering all parts of the building accessible in case of fire.

Attention must still be directed to some of the rooms situated on the basement of the front part of the middle wing.

The Staircase (*h*), already mentioned when describing the room for preparing the lectures on the ground floor, has the double office of uniting the two floors and furnishing to the lecture assistant a ready exit into the front court. On descending from the ground floor to the basement, we pass through the Vestibule (*k*) into a large Workshop (Q) lighted by three windows. Here the rougher work required for the lectures is performed; here liquid carbonic acid would be prepared, and here, in a well-ventilated Niche (*l*), stands the large galvanic battery already mentioned, the wires of which, passing through the floor of the theatre above, communicate with the electric lamp, now rapidly becoming an indispensable appliance of the lecture table. Further on is a small Laboratory (R) for Medico-legal investigations; it is lighted from both sides, and, being accessible only to the director and the lecture assistant, is effectually protected from all intrusion. Beside the room for the rougher lecture work there is a small Cellar (S), communicating with the vestibule, in which compounds requiring a low temperature, explosive bodies, such as gases condensed in hermetically sealed tubes, like sulphurous acid, chlorine, &c., are preserved. Substances readily undergoing decomposition, generating corrosive vapours, or in any way dangerous, can thus be conveniently excluded from the general collection.

Besides the rooms enumerated there are no other rooms devoted to the purposes of the institution. The architect, with his accustomed foresight, has not, however, forgotten to assign the necessary cellarage to the director's household. These Cellars (*o*, *p*, *q*, *r*), completely shut off from the institution, surround a Vestibule (*s*) which by means of a special Back Staircase (*t*) is connected with the residence in the upper floor.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, by Dr. Percy, F.R.S.

Lecture No. X.

(Continued from page 223.)

The next variety of carbon with which we shall deal is graphite. Graphite derives its name from a Greek word signifying *to write*. You all know graphite under the familiar term of plumbago or black lead. It is an elementary body—pure carbon, in fact. It crystallises in the rhombohedral system, whereas the diamond, the other variety of carbon, crystallises in the cubical system. Graphite is perfectly opaque, and exceedingly difficult of combustion compared with ordinary charcoal. It is characterised by giving that well-known stain to paper—a stain, however, which it alone does not give. It is very similar to specular iron ore, and I have seen a quantity of that stuff sold at works as plumbago for lubricating purposes, and the mistake was not found out. We make graphite artificially to a great extent, and it is made every day in our iron furnaces on a large scale. The condition is this: If we heat iron in contact with carbonaceous matter to a very high temperature, and let there be an excess of carbon, we always get graphite formed. That graphite may separate to a certain extent in the crucible in which you make the experiment; if not, you will always find it more or less diffused through the iron itself, if the experiment be properly conducted, and you get it by acting on the iron (grey pig iron) by hydrochloric acid, and then treating the residue by various other reagents. At length you obtain scales of pure graphite. This graphite is separated from its combination with iron, or from its solution in iron, on the solidification of the metal, just as any other crystal would separate from a solution during solidification or cooling. Iron certainly has the power of dissolving carbon, and when the carbon separates, if it separates at all, it is always in the crystalline form of graphite. You may take that as a general—nay, universal rule. I think the solubility of graphite in iron is proportionate, to a certain extent, to the temperature. Hence we find in certain kinds of iron—pig iron from the blast furnaces smelted under conditions favourable to the formation of graphite—that the separation takes places as it runs from the furnace, a true separation by solidification. I think I mentioned to you on a former occasion that, as carbon in the form of graphite so separates from iron, silicon may also separate from iron in exactly the same way. We can form graphite, then, without difficulty, and it is the result of a very high temperature.

In nature, graphite occurs in granite, gneiss, mica-slate, and also in crystalline limestone; it occurs in greenstone and in nests. At Borrowdale, in Cumberland, it is met with in trap rock. There you have an igneous action. It occurs in Davis' Straits and in Russia, and also in many other places. Now, how far the information we possess concerning the artificial production of graphite will apply to the solution of that question which relates to its formation in nature, I am not prepared to state. I do not think there is any evidence for supposing that in nature we have had this element, iron, at work. There must be some other condition under which graphite has been formed in nature, and at present further experiments are required to enable us to settle this point satisfactorily. I think there is no doubt, however, that a high temperature has in every case been concerned.

The subject I have next to bring before you is that of iron, and a great subject truly it is. I have already spoken of iron pyrites, and I need not repeat what I said concerning it.

Iron is one of the most abundantly diffused elements; it exists everywhere—not only in this world, but apparently throughout the universe. It is detected even in the atmosphere of the sun.

Probably the most remarkable state of iron is the meteoric, in which it occurs in those bodies called meteorites—small stars, or planets, or asteroids, which frequently fall to the earth when they come within the sphere of its attraction. These bodies, or some of them at all events, consist almost wholly of iron, but never, so far as I know, of pure iron. They are associated with other metallic bodies, especially nickel and cobalt, and we find some of these meteoric irons including also various other compounds. There is a particular quality of iron pyrites, for example, and a great many other things have been found in them. One of the most remarkable is that which I called your attention to on a former occasion—chrysolite, of which I showed you a specimen. Here is a cellular mass of meteoric iron, the cells of which are filled in with this chrysolite or silicate of magnesia. To enter into the details of this meteoric iron would occupy a whole lecture, so I can only deal with mere generalities. All this meteoric iron, or, if not all, the greater part of it, presents a singular appearance when treated by acids under certain conditions. If you take the best of it that occurs, and polish it, and etch the surface by means of nitric acid, certain figures known as the Widmanstätian figures will come out. These figures are different in structure, and it is remarkable how they should occur upon a mass consisting of the same crystals. Why should one part be attacked more than another? Different faces of the same crystal are acted upon in different degrees by the same acid. There is a peculiarity about these figures which was mentioned to me by Professor Widmanstät, of Berlin. He says the same faces of the crystals are acted upon with different intensities by hydrochloric acid, and different parts are acted upon with different degrees of intensity, even in the same crystal. That is a fact which easily explains how we get these figures when acting upon the surface of a piece of polished meteoric iron by an acid. I am indebted to my friend Mr. Tennant for some of the specimens of meteoric iron now on the table. A very large meteorite—I suppose one of the largest in the world—has recently arrived from Australia in this country, and is now in the British Museum. The structure of some of these meteorites is excessively interesting, but, as I hinted, time forbids my doing justice to this part of our subject. There are some points in connexion with these meteorites interesting to us in a geological point of view—namely, the presence of nickel and cobalt, nickel especially. The association of these three metals in nature—iron, nickel, and cobalt—is worthy of our serious attention. It has not received so much attention hitherto as I think it deserves. The fact is, it is only recently—within the last few years, comparatively, at all events—that very careful attention has been attracted to the subject of the composition of different kinds of iron. We have found, from the analysis of iron produced in different localities in this country, decided indications of both nickel and cobalt in almost every case when we have sought for them. I mention this particularly in order to excite further inquiry. It is really a point deserving of serious and continuous observation. It seems to indicate a connexion between these three metals much more general than one has supposed. We find a singular connexion between lead and silver, or lead, silver, and gold; and it would appear from this meteoric iron, and also from specimens of iron from different localities, that a similar relation exists between the three metals iron, nickel, and cobalt.

What the source of these meteorites is, is, of course, entirely unknown at present. Various conjectures have been put forth, such as the consolidation, the result of the aggregation of cosmical dust. Cosmical dust is supposed to be floating everywhere throughout the universe. This is rather an old notion. Berzelius very properly inquired, if this cosmical dust, by its aggregation, can produce these meteorites, how is it that we do not find them on the tops of our highest mountains? With regard to these meteorites I may add that they seem to have fallen at different times on the earth in different parts of the world, and sometimes in great abundance, and I think we ought to find more extensive remains of them than we have hitherto found in ancient geological formations, if, indeed, we have found any. A short time ago a paper was published in *Poggendorff's Annalen* giving an account of the remains of a meteorite being found deep in the sandstone at Oldenburg.

Of the pure chemistry of iron it does not become me to say anything on the present occasion. I must give you credit for knowledge on that topic.

It has been supposed that metallic iron occurs native not only in meteoric stones or meteoric masses, but in certain trap rocks. Experiments were made a great many years ago by Professor Andrews, of Belfast, upon certain trap rocks which, he says, when immersed in a solution of copper, caused the deposition of metallic copper, and he thence inferred that these rocks contained metallic iron diffused throughout. But I do not think the evidence is quite conclusive, or sufficient to justify that conclusion. I think there is another way of accounting for that deposition, short of supposing the presence of metallic iron.

(To be continued.)

BRITISH ASSOCIATION, NOTTINGHAM MEETING.

Friday, August 24.

A Lecture "On the Results of Spectrum Analysis, as applied to the Heavenly Bodies," by WILLIAM HUGGINS, *F.R.S.*

(Concluded from page 210.)

THE most remarkable, and possibly the nearest to our system, of the nebulæ presenting a ring formation, is the well-known annular nebula in Lyra. The spectrum consists of one bright line only. When the slit of the instrument crosses the nebula, the line consists of two brighter portions corresponding to the sections of the ring. A much fainter line joins them, which shows that the faint central portion of the nebula has a similar constitution.

A nebula remarkable for its large extent and peculiar form, is that known as the dumb-bell nebula. The spectrum of this nebula consists of one line only. A prismatic examination of the light from different parts of this object, showed that it is throughout of a similar constitution.

The most widely known, perhaps, of all the nebulæ is that remarkable cloud-like object in the sword-handle of Orion.

This object is also gaseous. Its spectrum consists of three bright lines. Lord Rosse informs me that the bluish-green matter of the nebula has not been resolved by his telescope. In some parts, however, he sees a large number of very minute red stars, which, though apparently connected with the irresolvable matter of the nebula, are yet doubtless distinct from it. These stars would be too faint to furnish a visible spectrum.

I now pass to some examples of the other great group of nebulæ and clusters.

All the true clusters, which are resolved by the telescope into distinct bright points, give a spectrum which does not consist of separate bright lines, but is apparently continuous in its light. There are many nebulæ which furnish a similar spectrum.

I take as an example of these nebulæ the great nebula in Andromeda, which is visible to the naked eye, and is not seldom mistaken for a comet. The spectrum of this nebula, though apparently continuous, has some suggestive peculiarities. The whole of the red and part of the orange are wanting. Besides this character, the brighter parts of the spectrum have a very unequal and mottled appearance.

It is remarkable that the easily resolved cluster in Hercules has a spectrum precisely similar. The prismatic connexion of this cluster with the nebula in Andromeda is confirmed by telescopic observation. Lord Rosse has discovered in this cluster dark streaks or lines similar to those which are seen in the nebula in Andromeda.

In connexion with these observations, it was of great interest to ascertain whether this broad classification afforded by the prism of the nebula and clusters would correspond with the indications of resolvability furnished by the telescope. Would it be found that all the unresolved nebulæ are gaseous, and that those which give a continuous spectrum are clusters of stars?

Lord Oxmantown has examined all the observations of the 60 nebulæ and clusters in my list, which have been made with the great reflecting telescope erected by his father, the Earl of Rosse.

The results are given in this table:—

	Continuous Spectrum.	Gaseous Spectrum.
Clusters	10	0
Resolved, or Resolved? . .	5	0
Resolvable, or Resolvable? .	10	6
Blue or Green, no resolvability, no resolvability seen	0	4
	6	5
	31	15
Not observed by Lord Rosse	10	4
	41	19

Considering the great difficulty of successful telescopic observation of these objects, the correspondence between the results of prismatic and telescopic observation may be regarded as close and suggestive.

Half of the nebulæ which give a continuous spectrum have been resolved, and about one-third more are probably resolvable; while of the gaseous nebulæ none have been certainly resolved, according to Lord Rosse.

The inquiry now presses itself upon us—What superstructure of interpretation have we a right to raise upon the new facts with which the prism has furnished us?

Is the existence of the gaseous nebulæ an evidence of the reality of that primordial nebulous matter required by the theories of Sir William Herschel and Laplace?

Again, if we do not accept the view that these nebulæ are composed of portions of the original elementary matter out of which suns and planets have been elaborated, what is the cosmical rank and relation which we ought to assign to them? As aids to a future determination of these great questions, I will refer in a few words to some other observations.

COMETS.

There are objects in the heavens which occasionally, and under some conditions, resemble closely some of the nebulæ. In certain positions in their orbits, some of the comets appear as round vaporous masses, and, except by their motion, cannot be distinguished from nebulæ. Does this occasional general resemblance indicate a similarity of nature? If such be the case—if the material of the comets is similar to that of the nebulæ, then the study of the wonderful changes which comets undergo in the neighbourhood of the sun may furnish useful information for a more correct interpretation of the structure and condition of the nebulæ. In 1864, Donati found that the spectrum of a comet visible in that year consisted of bright lines.

Last January a small telescopic comet was visible. It was a nearly circular, very faint vaporous mass. Nearly in the centre, a small and rather dim nucleus was seen. When this object was viewed in the spectroscope, two spectra were distinguished. A very faint continuous spectrum of the coma, showing that it was visible by reflecting solar light, and about the middle of this faint spectrum a bright point was seen. This bright point is the spectrum of the nucleus, and shows that its light is different from that of the coma. This short bright line indicates that the nucleus of this comet was self-luminous; and, further, the position of this line of the spectrum suggests that the material of the comet was similar to the matter of which the gaseous nebulæ consist.

MEASURES OF THE INTRINSIC BRIGHTNESS OF THE NEBULÆ.

It appeared to me that some information of the nature of the nebulæ might be obtained from observations of another order. If physical changes of the magnitude necessary for the conversion of these gaseous bodies into suns are now in progress in the nebulæ, surely this process of development would be accompanied by marked changes in the intrinsic brightness of their light, and in their size.

Now, since the spectroscope shows these bodies to be continuous masses of gas, it is possible to obtain an approximate measure of their real brightness. It is known that as long as a distant object remains of sensible size, its brightness remains unaltered. By a new photometric method I found the intrinsic intensity of the light of three of the gaseous nebulæ in terms of a sperm candle burning at the rate of 158 grains per hour.

Nebula, No. 4628, $\frac{1}{1680}$th part of the intensity of the candle.
Annular Nebula
in Lyra . . $\frac{1}{6032}$nd " " " "
Dumb-bell Nebula $\frac{1}{19604}$th " " " "

These numbers represent not the apparent brightness only, but the true brightness of these luminous masses, except so far as it may have been diminished by a possible power of extinction existing in cosmical space, and by the absorption of our atmosphere. It is obvious that similar observations made at considerable intervals of time may show whether the light of these objects is undergoing increase or diminution, or is subject to a periodic variation. If the dumb-bell nebula, the feeble light of which is not more than one twenty-thousandth part of that of a candle, be in accordance with popular theory a sun-germ, then it is scarcely possible to put in an intelligible form the enormous number of times by which its light must increase before this faint nebula, feebler now in its glimmering than a rushlight, can rival the dazzling splendour of our sun.

MEASURES OF THE NEBULÆ.

Some of the nebulæ are sufficiently defined in outline to admit of accurate measurement. By means of a series of micrometric observations, it will be possible to ascertain whether any considerable alteration in size takes place in nebulæ.

Mr. Alexander Herschel has recently succeeded in subjecting another order of the heavenly bodies to prismatic analysis. He has obtained the spectrum of a bright meteor, and also the spectra of some of the trains which meteors leave behind them. A remarkable result of his observations appears to be that sodium, in the state of luminous vapour, is present in the trains of most meteors.

CONCLUSION.

In conclusion, the new knowledge that has been gained from these observations with the prism may be summed up as follows:—

1. All the brighter stars, at least, have a structure analogous to that of the sun.

2. The stars contain material elements common to the sun and earth.

3. The colours of the stars have their origin in the chemical constitution of the atmospheres which surround them.

4. The changes in brightness of some of the variable stars are attended with changes in the lines of absorption of their spectra.

5. The phenomena of the star in Corona appear to show that in this object at least great physical changes are in operation.

6. There exist in the heavens true nebulæ. These objects consist of luminous gas.

7. The material of comets is very similar to the matter of the gaseous nebulæ, and may be identical with it.

8. The bright points of the star clusters may not be in all cases stars of the same order as the separate bright stars.

It may be asked what cosmical theory of the origin and relations of the heavenly bodies do these new facts suggest? It would be easy to speculate, but it appears to me that it would not be philosophical to dogmatise at present on a subject of which we know so very little. Our views of the universe are undergoing important changes. Let us wait for more facts, with minds unfettered by any dogmatic theory, and therefore free to receive the obvious teaching, whatever it may be, of new observations.

ACADEMY OF SCIENCES.

November 5.

The approach of the busy season is shown by the numerous communications which are now being sent in to the Academy from all parts of the kingdom. The first communication was from Maréchal Vaillant, who announced the discovery of an aerolite weighing 780 kilogrammes, found in Mexico. This, like everything else, is to appear in the Exhibition next year. The conclusion of the paper "*On the Functions of Leaves,*" by M. Boussingault, was then read. The results obtained by the author are confirmatory of those we gave last week. He finds the thickness of the leaf and its consequent transparency to light influence the results in a marked degree.

"*On the Principal Causes of the Rapid Passage of Rain Water into Rivers and their Feeders during Floods,*" by M. Becquerel.

"*On the New Planet* (91)," by M. Leverrier.

"*On the Blue Coloration of Glasses and Slags,*" by M. J. Fournet. The author, who has had this subject under notice for upwards of five and twenty years, has come to the conclusion that the blue coloration of slags, as well as of bottle glass, is the pure and simple result of molecular grouping, of which opacity—that is to say, white enamel—is the final product. By polishing pieces of this blue glass, varying in thickness, a decided dichroism is observed—blue by reflection, and orange by transparency. Generalising the result of these observations, the author shows that this dichroism belongs to many substances met with in nature; corundum, phosphate of iron, pure water, and clouds, all show it under certain circumstances.

"*On a Method of realising Pneumatic Occlusion on the Surface of the Human Body,*" by M. J. Guérin.

"*A New Electric Generator or Continuous Electrophorus,*" by M. Bertsch. This is an improvement on the somewhat celebrated electric machine of Holtz. The machine is too complicated to allow of description in abstract. With a disc of vulcanite 50 centimetres diameter, sparks of about 15 centimetres long can be obtained at the rate of from five to ten a second, and having sufficient tension to pierce a glass one centimetre thick, and to illuminate continuously a tube of rarefied gas one metre long. In thirty or forty seconds it will charge a battery having an interior surface of two square metres, which will burn up a thick iron wire one metre in length.

"*On the Action of Heat on Benzol and analogous Hydrocarbons,*" by M. Berthelot. When passed through a red-hot porcelain tube, benzol decomposes with condensation into several definite hydrocarbons, the principal being phenyl $C_{24}H_{10}$. This is identical with the phenyl which Fittig obtained by the action of sodium on bromo-benzol; it fuses at 70°, boils at 250°, and crystallises very definitely. Another product, obtained in smaller quantity, is chrysen $C_{36}H_{12}$, and after this a solid resinous hydrocarbon is produced, but naphthalin and anthracen. When toluol is passed through a red-hot tube, it furnishes a considerable quantity of benzol, naphthalin, a small quantity of a crystallised carbide boiling at 270°, anthracen $C_{28}H_{10}$, and several other hydrocarbons analogous to chrysen and the last derivatives of benzol. When a mixture of benzol and ethylene is passed through a red-hot tube, there are formed—styrol, $C_{16}H_8$; naphthalin, $C_{20}H_8$, the principal product; a crystallised hydrocarbon, boiling at 260°, analogous to phenyl, but distinguished from it by the formation of a characteristic compound of picric acid and anthracen. As a *résumé* of all his experiments, the author gives the following formulæ as expressing the parentage and generation of the pyrogenous hydrocarbons from benzol and acetylene:—

Benzol . . .	$C_4H_2[C_4H_2(C_4H_2)]$
Styrol . . .	$C_{12}H_4[C_4H_2(H_2)]$
Naphthalin . .	$C_{12}H_4[C_4H_2(C_4H_2)]$
Phenyl . . .	$C_{12}H_4[C_{12}H_4(H_2)]$
Anthracen . . .	$C_{12}H_4[C_{12}H_4(C_4H_2)]$
Chrysen . . .	$C_{12}H_4[C_{12}H_4(C_{12}H_4)]$

"*On Blue Slags,*" by M. Mène. The author concludes that the blue colour is due to a mixture of proto- and peroxide of iron.

"*On some New Notions respecting the Action of Acids on Saccharine Juice,*" by M. Kessler-Desvignes.

"*On the Poisonous Properties of Boundon, the Ordeal Poison of the Gabonese,*" by MM. Pécholier and Saintpierre.

NOTICES OF BOOKS.

Lecture Notes for Chemical Subjects: embracing Mineral and Organic Chemistry. By E. Frankland, F.R.S. London: J. Van Voorst. 1866.

We welcome the appearance of this most interesting book with real pleasure. At first sight, indeed, the dashes, the thick letters, the strange formulæ, and the multitudes of curious diagrams, reminding us of the Greek trees of our early days, gave us the idea of a new science, which would surely prove hard to master. But Dr. Frankland has demonstrated, in the opening chapters of this volume, that he can write with equal success for the young student and for the advanced chemist. The lingering fondness of the old school for the half truths and downright errors of most of our text-books, must give way before the clearness, the accuracy, and, we will say also, the simplicity of the views unfolded in the pages now under review.

This volume of lecture notes is not a manual of chemistry in the ordinary sense of the words. It says but little of the manufacture of chemical compounds; it scarcely alludes to their outward and sensible properties, but it gives many instructive glimpses of their interior constitution. It offers, as it were, a sketch of the structure and leading features of the chemical edifice, leaving us to add afterwards, from other sources, the minuter details. Yet, notwithstanding the breadth of view which thus characterises the work, there is no lack of precision. It is evident that no pains have been spared to secure and use the most accurate data, and to look upon doubtful questions from all sides. We do not, however, mean to affirm that the book is, in our opinion, faultless; in fact, the author himself states in his preface that he is "aware that the atomicity which is assigned to many of the elements may be called in question." But we may safely say that the author's thorough scheme of the combining powers of the atoms, and his methods and examples of symbolic and graphic expression, will prove a great boon to the student of chemistry, and will aid materially in furthering the development of the science.

In the quotation made in the preceding paragraph from the author's preface, we meet with one of the very few features in his book which we deem open to criticism. We refer to what we cannot but think, with due deference be it said, the confused and confusing use of the words *atomic* and *atomicity*. Dr. Hofmann, in his "Introduction to Modern Chemistry," page 168, has so clearly pointed out the illogical employment of the term atomic to signify two totally distinct facts, that we prefer to use his language, and to cite his authority in speaking of this subject. He says:—"We are in want of a good appellation to denote the atom-fixing power of the elements. The vague and rather barbarous expression, atomicity, has drifted into use for this purpose, and the elements have been called *mon*atomic, *di*atomic, *tri*atomic, and *tetr*atomic, accordingly as their respective molecule-forming minimum weights are capable of saturating one, two, three, or four standard atoms. These expressions are faulty, because they are open to misinterpretation, as if intended to denote the atomic structure of the respective elementary molecules themselves—a sort of confusion, the possibility of which should always be sedulously avoided in scientific nomenclature. We shall escape this evil by substituting the expression *quantivalence* for *atomicity*, and designating the elements *uni*valent, *bi*valent, *tri*valent, and *quadri*valent, according to their respective atom-fixing values." We need add nothing to these remarks save to point out that Dr. Frankland uses the word atomic in two senses. It is used, accompanied by a prefix, to indicate, in the case of a molecule, the number of atoms in that molecule; when applied to an atom, it shows the number of "bonds" in that atom, each bond being satisfied by, or capable of attaching, one atom of hydrogen. We are bound to confess, however, that our author is careful to use the words monad, dyad, triad, &c., in lieu of monatomic, diatomic, triatomic, &c., when atoms of elements are referred to, and thus these latter special terms are confined to their proper use, although two meanings are attached to the general expressions *atomic* and *atomicity*.

We may now proceed to point out some of the special characteristics which distinguish these Lecture Notes for Students from the ordinary handbooks of chemistry. The formulæ first demand attention.

We find the *bracket* used for one purpose only—namely, to indicate chemical union between elements placed perpendicularly to each other, and next the bracket in a formula; thus—

$$\overset{1.}{\left\{\begin{array}{l} CH_3 \\ CH_2Cl \end{array}\right.} \qquad \overset{2.}{\left\{\begin{array}{l} CH_3 \\ O \\ CH_3 \end{array}\right.} \qquad \overset{3.}{\left.\begin{array}{r} COO \\ Ba \\ COO \end{array}\right\}}$$

In formula 1, the bracket shows that the two atoms of carbon are directly united with each other; in formula 2, that the two atoms of carbon are linked to each other by the atom of oxygen; whilst in formula 3, we perceive that one atom of oxygen in the upper line is united to an atom of oxygen in the lowest line by the mediation of the atom of barium.

The use of thick letters in formulæ is another characteristic of importance. These are used to indicate the central or chief element of a compound. In the symbolic formulæ, this element is generally placed first, and to it all the active bonds of the other elements or compound radicals following on the same line are supposed to be linked. Thus the formula for microcosmic salt becomes

$$\mathbf{P}OHoAmoNao.$$

Here the pentad element phosphorus is combined with the dyad element oxygen, and the three monad radicals which follow. (We should mention that Ho = HO or hydroxyl, and that in the other radicals also o has the same value as O.) Other examples of the use of thick letters follow:—

Sulphuric acid . . .	$\mathbf{S}O_2HO_2$
Water	$\mathbf{O}H_2$
Nitric acid	$\mathbf{N}O_2Ho$
Ferrous sulphate . . .	$\mathbf{S}OHo_2Feo''$
Phosphoric iodide . .	$\mathbf{P}H_4I$.

The marks of atomicity (or, as we should prefer to say, "quantivalence") are employed for the most part in the usual manner by Dr. Frankland; but in some instances their position with regard to the symbol is varied. Thus, when the pentad element nitrogen becomes a triad, as in ammonia, and a monad, as in nitrous oxide, the symbols will undergo the following modifications:—

$N^{v}_2O''_5$ Nitric anhydride.
$''N'''H_3$ Ammonia.
$^{iv}N'_2O$ Nitrous oxide.

In the first formula the pentad character of the element is preserved; in the second, a pair of bonds, indicated by the two dashes to the left of the symbols, have united or saturated each other; and in the third formula two pairs of bonds have been thus affected. This kind of union is also called *latent atomicity*, the absolute atomicity being the maximum number of bonds of an element. We think, with Dr. Hofmann, that a slight increase of clearness in these marks of atomicity would be obtained by the consistent use of Roman numerals instead of dashes and numerals; or, perhaps better still, of ordinary dashes for the lower values and of crossed dashes for the higher. And we would further suggest that, as proposed in this journal some years ago, the basylous or chlorous character of the constituents of a body may often be advantageously indicated by the *inclination* of the marks of quantivalence. The ordinary marks of basylous quantivalence may slant, as usual, to the left, those of chlorous quantivalence to the right, and those which indicate suppressed or self-saturated bonds may be represented by vertical dashes. In pyrites, for instance, the basylous quantivalence of the Fe is shown by two left-handed dashes; the chlorous quantivalence of the S_2 by one right-handed dash, and the neutral quantivalence of these sulphur atoms by one vertical dash, this last sign indicating that one bond of one sulphur atom saturates one bond of the other sulphur atom. The same fact is expressed graphically thus:—

Little Experiments for Little Chemists. By William Henry Walenn, F.C.S. London: T. J. Allman.

This little book is intended for the junior classes at schools where chemistry is taught, or as a recreation for the young student in his holidays. Great attention is paid to enforcing the necessity of cleanliness in all chemical manipulations, and care is taken to limit the apparatus required to the simplest articles, while strong acids and poisons are, where possible, avoided. The subjects treated of are:—The action of chemical solutions upon each other; the phenomena of crystallisation; and the precipitation of metals from their solutions. The experiments are arranged in series, each of which is headed by a list of the articles required, and concludes with a paragraph entitled "Results or Uses," which shows the applications of the phenomena just produced. The experiments are selected so as to be of a striking character, and we can recommend this work as one calculated to amuse, while it instructs, the young chemist.

CONTEMPORARY SCIENTIFIC PRESS.

[Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted.]

Dingler's Polytechnisches Journal. No. 4. August.

"*On the Detection of the Presence of Air in Carbonic Acid and other Gases,*" by GRAEGER.

"*On the Commercial Preparation of Azaleine, Rubine, or Mercury-Fuchsine,*" by T. OPPLER. (Extract from *Theorie und praktische Anwendung von Anilin, &c.*")

"*On the Composition of certain Sugars, and of some Products obtained during their Manufacture,*" by J. L. KLEINSCHMIDT.

"*On Tanning;*" 2. "*On Tanning Kid Leather,*" by F. KNAPP.

"*On the Behaviour of Copper and Silver in Solutions of Arsenious, Sulphurous, Selenious, and Phosphorous Acids,*" by H. REINSCH.

"*On the Manufacture of Caramel for Colouring Spirit,*" by E. ASSMUSS.

"*On the Preparation of Coloured Inks with Aniline,*" by J. FUCHS.

No. 5. September.

"*On the Recovery of Peroxide of Manganese from the Chloride of Manganese formed during the Manufacture of Chlorine,*" by P. W. HOFMANN.

"*On the Manufacture of Borax,*" by G. LUNGE.

"*On Testing Mineral Oils,*" by J. SALLERON and V. URBAIN.

"*On the Preparation of Commercial Formic Ether,*" by J. STINDE.

"*On Obtaining Uric Acid from Peruvian Guano,*" by J. LOWE.

"*On the Quantity of Juice contained in Beetroot,*" by C. STAMMER.

"*On a New Explosive Compound,*" by C. LESIMPLE.

"*On the Presence of Sulphates in Filter Paper,*" by KRUGER.

"*On the Preparation of Peroxide of Barium and Peroxide of Hydrogen.*"

"*On Bleaching Palm Oil,*" by A. ENGELHARDT.

"*On the Organic Constituents of Beet Juice,*" by C. SCHEIBLER.

Annales de Chimie et de Physique. September.

"*Researches on Silicic Ethers and on the Atomic Weight of Silicium,*" by C. FRIEDEL and J. M. CRAFTS.—"*On the Cultivation of Tobacco in Alsace,*" by J. B. BOUSSINGAULT.—"*On the Cultivation of Tobacco in the Department of the Bas Rhin,*" by E. OPPERMANN.—"*Experiments on Churning, followed by an Analytical Investigation of the Influence of the Food of the Cow on the Quantity of Butter contained in Milk,*" by J. B. BOUSSINGAULT.

October.

"*Notes on the History of the Phosphorus Compounds of Zinc,*" by B. RENAULT.—"*Memoir on Supersaturation,*" by LECOQ DE BOISBAUDRAN.

NOTICES OF PATENTS.

No. 525. *Improved Dye.* JAMES BARRY, Ballyclough, in the County of Cork, J. P. Dated February 20, 1866.

THIS invention has reference to an improved dye prepared from the lichen grown parasitically upon apple or crab trees.

To extract the colouring matter from the lichen and employ it for the purposes of dyeing, the patentee causes the lichen in its raw or unprepared state (procured from the apple or crab trees aforesaid) to be first cleansed from foreign matters, dried, reduced to powder, and subsequently macerated as may be found desirable. The lichen thus treated is then placed within closed vessels charged with water, proportionately to the concentration or varied shades of colour required. It is then submitted to the operation of boiling, until the colouring extract or matter is produced, which when strained, or chemically treated, and the whole of the insoluble matters removed, is rendered clear and fit for use. By this process any or all of the various descriptions of earths, alkalies, acids, salts, metallic oxides, or other reagents which may be found necessary for combining with and improving the body or colour of the dye, may be employed, either separately or in conjunction with suitable mordants for fixing the said dye and rendering the same permanent. In conclusion to the foregoing description, the patentee briefly notes that the process of applying or imparting the colouring matter to the various articles to be dyed, either in union with mordants or otherwise, may be varied as may be found necessary; thus the simple solution, independently of other chemical matters, may be applied directly to the cloth by steeping, or otherwise saturating the same through the medium of suitable apparatus or machinery as at present, admitting at the same time of the surface being dyed, woven, or ornamented, as may be found desirable.

No. 540. *Refrigerating or Freezing Liquids.* (Provisional protection). B. W. RICHARDSON, Doctor of Medicine. Dated February 21, 1866.

THIS invention relates to certain improvements in the means of refrigerating or freezing liquids, and for producing ice, and also in apparatus to be employed therein.

The agents which the patentee proposes to use are ethers or volatile hydrocarbons, or other volatile fluids of low boiling point which produce intense cold when volatilised or distributed in the form of spray or dew in a pulverised state. He also proposes to use the hydrocarbon products from gas works which boil at a low temperature.

The liquid to be refrigerated is contained in a metallic vessel in the form of an inverted cone. This vessel contains a false perforated small cone attached to a rod or handle, or to two rods, in order that it may be lifted out or removed from the exterior cone, and withdraw the frozen particles of the liquid.

The conical receptacle is contained in a cylinder or outer casing, at the bottom of which is a reservoir for containing the volatile fluid, which is withdrawn therefrom and pumped through a series of tubes or apertures on and around the circumference of the conical chamber. The pump to be used consists of an india-rubber hand bellows or pump actuated by compression, or by bellows, or cylinder and piston pump, and controlled by suitable valves for inlet and exit of the volatile fluid, which is thereby impelled in the form of dew or spray (or as if it were pulverised) upon the surface of the cone, thereby creating an intense degree of cold. According to this invention, therefore, the cold is produced by the contact of pulverised spray of volatile fluid, which becomes condensed and falls into a receiver underneath the cone wherein it is collected, and may be withdrawn for further use over and over again.

The apparatus may be made of any size, but the chief object of the invention is to supply a portable apparatus for the purpose of refrigerating or freezing small quantities of liquid. The patentee prefers to use a conical vessel, since by such a form he can freeze liquid most rapidly.

For refrigerating wine he employs a cylinder of either metal or earthenware, in which the bottle is placed, and the volatile fluid is impelled thereon by the process before described. Similar methods of collecting the volatile fluid for further application may be adopted.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

2454. J. Gamgee, Bayswater, Middlesex, and A. Gamgee, M.D., "Improvements in the slaughtering of animals with a view to the preservation of their bodies as articles of food, and in the method of preserving animal and vegetable substances."—Petition recorded Sept. 24, 1866.

2733. J. Greenshields, Glasgow, N.B., "Improvements in making gas and coke."—October 23, 1866.

2745. H. D. Plimsoll, Great Ormond Street, Middlesex, J. B. Davies, Gresham Street, London, and W. R. Dawson, Homerton, Middlesex, "Improvements in extracting metals from titaniferous iron, sand, or minerals containing metals."

2749. J. C. Stevenson, South Shields, "Improvements in furnaces for the manufacture of alkali."—Oct. 24, 1866.

2755. C. E. Brooman, Fleet Street, "Improvements in apparatus for lighting and heating." A communication from J. B. M. A. Bourreiff, Paris.—October 25, 1866.

2773. J. Wagener, Wellclose Square, and G. J. Firmin, Millwall, "Improvements in sugar refining."—October 26, 1866.

Notices to Proceed.

1703. W. R. Lake, Southampton Buildings, Chancery Lane, "Improvements in the manufacture of white lead." A communication from W. Bell, T. M. Fell, and A. G. Fell, New York, U.S.A.—Petition recorded June 26, 1866.

1726. C. E. Brooman, Fleet Street, "Improvements in obtaining alkaline permanganates." A communication from C. M. T. du Motay, and C. R. Marechal, Metz, France.—June 28, 1866.

CORRESPONDENCE.

The Smoke Question.

To the Editor of the Chemical News.

Sir,—Your correspondent, "W. S.," merits respectful treatment from the evidence his letter affords of the careful perusal he has given my paper published in your last number. I must also allow that there is some justice in several of his criticisms.

1st. My statement that nitrogen is poisonous to animal life is probably not a happy expression. That pure nitrogen gas would be destructive of animal life surrounded by it only, "W. S." will not deny, and this should have been the form in which it should have been presented.

2nd. That fresh charcoal is newly precipitated carbon is, I think, substantially true; in ligneous fibre carbon only exists in combination, and when the other elements are eliminated, and the carbon left, it is at least a change analogous to precipitation.

3rd. The amount of carbonic acid gas. 146,666 tons was correctly stated in the first copy of my paper, but in transcribing it the calculation was again hastily gone over, taking 50,000 tons as the basis, and not 80 per cent of this, as should have been done.

4th. In the last criticism of "W. S." we differ only by looking at different objects. As my paper chiefly dealt with combustion, perfect and imperfect, my statement as to our practically getting not more than half the available heat went only so far as the evaporation of water. Perfect combustion of average Lancashire coal, and perfect application of the heat evolved to the evaporation of water, would give 13 lbs. water converted into steam for 1 lb. of coal used, while our practice gives only 5 to 7 lbs.

The obtaining of the theoretical heat-power or force was not in any sense in my mind.

Thanking your correspondent for the courteous tone of his remarks,

I am, &c. Peter Spence.

Manchester, November 12.

Process for the Estimation of Resin in Soaps.

To the Editor of the Chemical News.

Sir,—As one who has had more than a mere book knowledge of the reaction of nitric acid on oleic and margaric acids, I would respectfully remind Mr. Sutherland that a "distinctly appreciable quantity of nitrous acid is given off" during the reaction, and that, when we use "strong nitric acid," there is even a copious evolution of nitrous fumes, and also that these fumes are evolved until the reaction I have alluded to is completed; so that Mr. Sutherland, I am sure, will grant that, in the absence of his subsequent explanation, I was justified in taking objection to the process.

From the facts that Mr. Sutherland has adduced, there is no doubt but that he has obtained good results; and as the process seems to be an important one, perhaps he would favour us with the strength of the nitric acid he employed when he obtained his best estimations.

Apologising for again trespassing on your space,

I am, &c. S. H. J.

Wolverhampton.

MISCELLANEOUS.

Composition and Quality of the Metropolitan Waters in October, 1866.—The following are the Returns of the Metropolitan Association of Medical Officers of Health:—

Names of Water Companies.	Total solid matter per gallon.	Loss by ignition.*	Oxidisable organic matter.†	Hardness.	
				Before boiling.	After boiling.
Thames Water Companies.	Grains.	Grns.	Grains.	Degs.	Degs.
Grand Junction	21·00	1·00	0·81	15·0	5·0
West Middlesex	20·98	1·01	0·98	16·0	6·5
Southwark & Vauxhall	21·65	1·14	1·00	15·0	6·0
Chelsea	20·33	0·66	0·59	14·0	6·0
Lambeth	21·34	0·75	0·80	16·0	5·0
Other Companies.					
Kent	27·19	1·98	0·15	18·5	8·0
New River	18·87	0·75	0·31	15·0	4·5
East London	18·59	0·80	0·68	16·0	5·0

* The loss by ignition represents a variety of volatile matters, as well as organic matter, as ammoniacal salts, moisture, and the volatile constituents of nitrates and nitrites.

† The oxidisable organic matter is determined by a standard solution of permanganate of potash, the available oxygen of which is to the organic matter as 1 : 8; and the results are controlled by the examination of the colour of the water when seen through a glass tube two feet in length and two inches in diameter.

H. Letheby.

ANSWERS TO CORRESPONDENTS.

Dr. Roessler's request shall be attended to.

M. O. P.—The salt is acetate of lime.

A. C. S.—Commercial carbonate of bismuth frequently contains basic nitrate. This will explain the effect noticed.

M. L. B.—Moisten the portion of the linen which has the fruit stain on it, and then expose it to the fumes of burning sulphur. This will generally be found effectual.

T. Williams asks if there is a translation from German to English of Professor Will's table of qualitative chemical analysis. Can any correspondent favour us with the information?

Dialysis, F. A.—This beautiful discovery has been utilised by Mr. Whitelaw, of Glasgow, for separating the salt from meat brine. We do not, however, know whether the process is now in operation anywhere.

Blowpipeist.—The cause of the green colour communicated to the flame by the iron wire is the presence of a minute trace of phosphorus in the metal. See Mr. Chapman's letter in the Chemical News, vol. ix., p. 180.

Fitzetienne.—We do not know any text-book of natural philosophy that treats its subjects so fully in respect to the conservation of energy as you require. Tyndall's "Heat as a Mode of Motion" will doubtless satisfy your requirements as far as that science is concerned, and there are several other works on special branches of science, recently reviewed in our columns, which you might consult with advantage.

Dr. Roscoe, E. J. Chapman, W. Chisholm, T. Clarke, W. L. R., S. R.—Received, but deferred till next week owing to press of matter.

Books Received.—"On Pulmonary Consumption," by Dr. Henry Bennet, M.D., &c.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

New Researches on the Law of Chemical Proportions, and on Atomic Weights and their Mutual Relations, by J. S. Stas.*

(Concluded from page 230.)

Such is the abridged indication of the new researches which I have undertaken or completed in the last five years, in order to assure myself by experiment whether or not a simple relation exists between the weights of the bodies which unite to form chemical combinations.

With a view of satisfying the wish expressed by most of the chemists who have had occasion to examine my means of investigation, I have added to each of these memoirs figures, designed to render the operations and apparatus there described more easily intelligible. I have also explained my researches with a fulness which I hope will be found sufficient.

I do not disguise that the compilation of these memoirs leaves much to be desired with respect to unity. I even confess that it might be singularly simplified. The imperfections presented by these works proceed from this—that they have been written at very different periods, and that I have only had in view the facts related in each of them, without being preoccupied with what goes before or may follow; but on attentive consideration I thought that in their revision I ought to pass over these defects, because they strictly express the facts observed, and the conclusions which result separately from each of them.

It now remains for me to recapitulate and conclude. I have sought to discover whether the law of chemical proportions is an absolutely exact one; I think I have proved that it is the expression of a mathematical relation. I believe I have also demonstrated that the atomic weight of a like body, determined by the aid of different elements and of independent methods—a weight which *ought* to be identical—is in *reality* so, within the limits of accuracy at which it is possible to arrive by our present means of investigation.

The values of the atomic weights which proceed from all these researches are the following:—

Oxygen being taken by hypothesis . =	16·000
Silver is	107·930
Nitrogen	14·044
Bromine	79·952
Chlorine	35·457
Iodine	126·850
Lithium	7·022
Potassium	39·137
Sodium	23·043

These atomic weights are necessarily *means;* but as the values result from determinations which have, for the most part, undergone numerous controls, obtained by the aid of independent methods, I think that the first and very probably the second decimal of nearly, if not quite, all these atomic weights, may be considered as certain.

When we wish to confine ourselves to a *unit,* with which experience may correspond, it is easy to prove that no simple relation exists between these different atomic weights. I have expressly said that all these values are determined by reference to oxygen, taken *hypothetically* equal to 16. If referred to hydrogen taken as the unit, they must necessarily be corrected, from the fact of the difference which exists between the atomic weight of oxygen, deduced from experiment, and that admitted by hypothesis.

But the relation of hydrogen to oxygen is not known with certainty. From the *ensemble* of all the labours performed on the composition of water, on the specific gravity of hydrogen and oxygen, and on the proportional relation between chloride of ammonium and silver, I am led to believe that, hydrogen being 1, the atomic weight of oxygen cannot far exceed 15·96. If I proportionally reduce all the above-mentioned values, for the difference existing between 15·96 and 16·00—that is to say, $\frac{1}{400}$—I arrive at the following results:—

Hydrogen being	1
Oxygen is.	15·960
Silver	107·600
Nitrogen	14·009
Bromine	79·750
Chlorine	35·368
Iodine	126·533
Lithium	7·004
Potassium	39·040
Sodium	22·980

In this case the atomic weights of nitrogen and lithium are obviously represented by whole numbers; but those of oxygen, silver, chlorine, iodine, and potassium are so far removed from whole numbers or simple fractions, that it seems to me difficult, if not impossible, to discover in them a simple relation.

It follows, from all that goes before, that I have no reason to alter the conclusions with which I have ended my "*Researches on the Reciprocal Relation of Atomic Weights.*" The simplicity of ~~relation of~~ weight which Prout's hypothesis presupposes between the masses which intervene in chemical action, is not, then, observed in experience; *it does not exist in reality.* Indeed, *these relations, as they present themselves to us, are incommensurable.* Besides, M. Dumas, in the works on which the partisans of Prout's hypothesis build, now admits that the ciphers, deduced from experiment, with those which the English chemist's hypothesis presupposes, offer a more considerable deviation than can rightfully be attributed to an inevitable error of the observation. However, convinced as he is that this hypothesis is the expression of a *philosophical truth,* he considers Prout's law as a limited one analogous with those of Mariotte and Gay-Lussac. Reduced to these terms, the English chemist's hypothesis escapes the investigations of those who believe they ought to rely only on experience in searching out and establishing the laws which govern matter; it re-enters the domain of pure speculation, which can have nothing in common with the proceedings, the exigencies, and the principles of exact sciences.

One word more, and I have finished. Prout's law not being verified by experiment, is it conformable to the true principles of science, to inscribe, in any works, atomic weights represented by *entire numbers or followed by simple fractions,* taking hydrogen for the unit? This is done by a great many chemists in the present day. In ordinary usage is it possible, without inconvenience, to make use of entire numbers, or those followed by simple fractions? The greater part of carefully determined atomic weights come so near to calculated ciphers, that it has been necessary to have recourse to all the arts and refinements of analysis, to prove that they are not absolutely exact. It is evident from this that in ordinary calculations they may be used. It is certain that the error committed will always be as little as or less than that which results, in the majority of cases,

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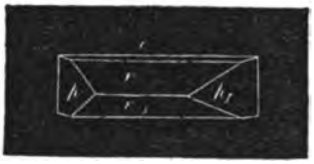
* *Memoirs of the Royal Academy of Belgium.*

from the operation by which the calculation is intended to be verified. Besides, it naturally follows that in calculations the use of atomic weights brought more or less near to the truth, is correlative to the degree of exactitude desired. It ought to be, in the use of atomic weights, as with weights and measures themselves; although standard weights and measures are required, there is no utility or necessity in employing them where such a degree of accuracy as is presupposed by their use is not required. If I agree on this point with most chemists, I do not in that which relates to the substitution in some works of calculated or approximative atomic weights for those determined by experience. When the end in view is to instruct or to ascertain what is the reality of natural phenomena, it is no more allowable to substitute error for truth than it is possible to agree with a principle known to be untrue.

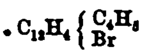
On the Isomorphism of Thallium-perchlorate with the Potassium and Ammonium-perchlorates, by Prof. H. E. Roscoe, *F.R.S., &c.*

The crystalline form of thallium-perchlorate is that of a right rhombic prism (pp_1), in which the faces of the rhombic octahedron (rr_1) and the basal faces of the prism (c) generally appear; the crystals being lengthened, as is the case with the alkaline-perchlorates, sometimes in the direction of the prismatic and sometimes in the direction of the octahedral faces. A careful measurement of the crystals gave the mean value of 102° 50′ for the angle pp_1, and that of 102° 6′ for the angle rr_1 on c. Hence the relation of the axes is 0·7978 : 1 : 0·6449.



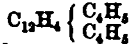
The angles observed by Mitscherlich,* in the case of potassium- and ammonium-perchlorates, agree exactly with the above. For the first of these salts, pp_1 = 103° 58′, rr_1 on c = 101° 19′; and for the second, pp_1 = 103° 11′, and rr_1 on c = 102° 4′, giving the relation of the axes to be (1) 0·7817 : 1 : 0·6408, and (2) 0·7926 : 1 : 0·6410.

Ethylated Benzol,† by M. Fittig.—From monobromated benzol, and by the process already described, the author has obtained *ethylated benzol*, $C_{12}H_5,C_4H_5$. Boiling point 135°. By the gradual addition, at a low temperature, of its equivalent of bromine, it forms a bromated compound



$$C_{12}H_4\left\{\begin{matrix}C_4H_5\\Br\end{matrix}\right.$$

which can be isolated by washing in soda, dehydrating with chloride of calcium, and fractionally distilling. It boils without decomposition at 199°. With equal equivalents of the latter and hydrobromic ether, diluted with anhydrous ether, *diethylated benzol* is obtained



$$C_{12}H_4\left\{\begin{matrix}C_4H_5\\C_4H_5\end{matrix}\right.$$

For this purpose the above mixture is treated with sodium in a well-cooled vessel. The new compound has an agreeable odour distinct from that of benzol. Boiling point 178°. With oxidising agents, such as fuming nitric acid and chromic acid, it forms derivatives, among which are acetic and terephtalic acids.

PHYSICAL SCIENCE.

Thermo-Electricity.

In the *Annales de Chimie et de Physique* for August last there is an article by M. Becquerel on the thermo-electric powers of different substances, and the construction of thermo-electric batteries. We give some of his results, which will doubtless prove interesting to our readers, as they comprise all that is yet known in this branch of electricity. To insure the accuracy of the results, great care had to be taken to keep each end of the bar to be experimented on at a constant temperature, usually 0° and 100° Centigrade. To effect this, two tin boxes were constructed, into the sides of which test-tubes were inserted, so that the ends of the bar could each be placed in one of the tubes, and the mouth then closed with plaster of Paris; one of the boxes was then heated by the vapour of boiling water, and the other filled with ice. To ascertain the comparative values of each experiment, a standard couple of bismuth and copper was constructed with which all the rest were compared, and as copper was one of the metals in every experiment, it was sufficient to fasten a copper wire to each extremity of a metal bar to convert it into a thermo-element. In order to have the same electrical conductivity in each comparison, the couple to be tested was placed in the same circuit with the standard bismuth-copper couple, and the intensity of the current observed first when the two couples were acting together, and next when they were opposing each other; then, by Ohm's law, half the sum of the intensities represents the proportional electromotive force of the experimental couple, and half the difference that of the normal couple. The standard pair was carefully compared with a Daniell's cell, and their points of junction being at 0° and 100° it was found that 207·2 of the former gave a tension equal to 1 of the latter; by these means the value of every couple could readily be obtained in terms of a Daniell's cell. The most remarkable of the results thus arrived at are given in the following table:—

Metal forming with copper a thermo-electric couple, the points of junction being at 0° and 100° Centigrade.	Electromotive force, that of one Daniell's cell being 1000.
Tellurium	+39·949
Fused sulphide of copper } Maximum	+32·762
} Mean	+18·130
Equal chemical equivalents of antimony and cadmium	+21·410
Ditto with one-tenth its weight of bismuth	+13·000
Equal chemical equivalents of antimony and zinc	+ 9·020
Ditto with one-tenth its weight of bismuth	+ 7·750
Antimony	+ 1·409
Iron wire	+ 0·950
Silver	+ 0·026
Copper	0
German silver wire	− 1·260
Nickel wire	− 1·630
Cobalt wire	− 2·140
Bismuth	− 3·909
10 parts of bismuth to 1 of antimony	− 6·197

The above table gives the electromotive force observed between each metal and copper, but to compare any two metals together it is only necessary to subtract the one value from the other, attention being paid to their respective signs; thus the action between tellurium and bismuth would be 39·949 − (−3·909) = 43·858. The reciprocals of these numbers, multiplied by 1000, give the number of couples required to equal the tension of a Daniell's cell.

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[*] *Pogg. Ann.*, xxv. (1832), p. 301.

[†] *Zeitschr. Chem.* ix. 358 (1866).

It is seen that the greatest electromotive force is possessed by tellurium, but its high price would prevent its being of any practical use in the construction of thermo batteries. Next to it stands sulphide of copper, the action of which will be further described. We then come to an alloy of antimony and cadmium (806 of the former to 696 of the latter); this is, however, like the similar alloy of antimony and zinc, too brittle to be used, and a mixture of a small quantity of bismuth is found necessary to give it consistency. This addition has the effect of considerably lowering the electromotive force, but as the latter still remains tolerably high, it is this mixture which M. Becquerel recommends as the positive element in cases where sulphide of copper would give too much resistance. The addition of a small quantity of antimony to bismuth renders it much more strongly negative, and also improves its mechanical condition, which it makes more consistent and homogeneous; for these reasons this is strongly recommended as the negative metal where a temperature of over 100° is not required. Where a much greater heat is to be applied, German silver will be found the most convenient, as it is easily procurable, and its force is not much inferior to that of pure nickel. In almost all cases, M. Becquerel has found that annealing the metals for some hours at a temperature of from 200° to 400° increases their power sometimes as much as 13 per cent.

Experiments were tried upon the sulphides of the metals, but especially upon that of copper, the action of which was found to be the most energetic of any. This sulphide is easily prepared by placing fragments of sulphur in a crucible which is heated over a fire. When the sulphur boils, plunge into the crucible a red-hot bar of copper; the action at once takes place, and when the sulphur is exhausted the sulphide is to be scraped off the bar, and the operation repeated. When sufficient has been obtained, it may be melted and cast into a bar; its melting-point is about the same as that of gold, or between 1030° and 1040° Centigrade. The bars should then be placed in a sand-bath and exposed to a dull red heat for several hours, after which they are allowed to cool slowly; by this operation their electromotive force is often increased ten times: this increase is far greater than is ever observed in the case of metallic bars.

Where a current of great quantity is required, the resistance of sulphide of copper may be found to be too great, and it is then better to use an alloy of antimony and cadmium, or antimony and zinc, with German silver as the negative metal when much heat is to be used. The numbers given in the former table are for a difference of 100° between the junctions; for any other temperatures the electromotive force may be roughly taken as proportional to the difference, but will usually increase rather more rapidly than the latter. The following is taken for a difference of temperature between the two junctions of about 400° Cent.:—

Elements of couple.	Number of couples required to give an electromotive force equal to that of one Daniell's cell.
Sulphide of copper and German silver . .	Between 8 and 9 couples.
Equal equivalents of antimony and cadmium plus one-tenth the weight of bismuth, and German silver .	Between 10 and 15 couples.
Equal equivalents of antimony and zinc plus one-tenth the weight of bismuth, and German silver .	Between 15 and 20 couples.

The following are the conclusions arrived at by M. Becquerel:—

For piles to be used at low temperatures, such as those employed for measuring radiant heat, the negative metal should consist of 10 parts of bismuth to 1 of antimony; the positive metal should be as follows:—

Antimony . . .	806	Equal equivalents.
Cadmium . . .	696	
Bismuth . . .	$\frac{1}{10}$th the weight of the above.	

For piles of a high tension the negative metal should be German silver, and the positive may be either the above mixture or sulphide of copper; the latter stands the greatest heat, but gives also the highest resistance. The sulphide should be used in bars of about 10 centimetres in length, 12 millimetres thick, and 18 wide; the ends should be coated with German silver, and wires of the same material screwed on, so as to unite the ends of each bar with the opposite ends of the next bars. A jet of gas is allowed to play upon a small plate of German silver, which is left projecting from one end for that purpose. As sulphide of copper is a very bad conductor of heat, it will scarcely be found necessary to cool the other ends; but this should be done when a metal is used, and the length of the bar should, in that case, be increased.

Thermo-electric piles, on account of their low tension, cannot yet replace hydro-electric batteries; but for special purposes, and particularly for the study of radiant heat, the piles here described offer new facilities, and are therefore worthy of attention.

Quinic Acid,* by M. Graebe.—This acid, which is by many of its properties allied to citric acid (see *Ann. Chem. Pharm.* xxxviii. 229), in others resembles the group of aromatic acids; for with hydriodic acid it gives *benzoic* acid; with bromine, *carbohydroquinonic* acid; with peroxide of lead, *hydroquinon*: the latter is also produced with heat; it is accompanied by *benzoic* and *phenic* acids. M. Graebe has himself transformed it into chlorinetted chloride of benzoyle by treating it with pentachloride of phosphorus. He has transformed it into carbohydroquinonic acid by melting it with three times its weight of caustic potash. Under these circumstances potash behaves in exactly the same way as bromine.

$$\underbrace{C_{14}H_{12}O_6}_{\text{Quinic acid.}} + 2HO = \underbrace{C_{14}H_{12}O_8}_{\text{Carbohydroquinonic acid.}} + H_2.$$

In constitution the author believes this acid to resemble hydrate of amylene.

On the Analysis of Alkaline Silicates,† by M. de Fellenberg.—According to the author, the best and most successful process for attacking alkaline silicates consists in using chloride of calcium pure, or with the addition of quicklime. For this a high temperature is necessary. The operation may, without fear, be performed in platinum. First melt the chloride of calcium, and incline the crucible so that the sides may be covered with it; after it has cooled, add the silicate, previously reduced to a fine powder; heat again, and keep the mass in fusion for at least ten minutes. After cooling, the product of the fusion may be easily detached from the sides of the platinum crucible; then extract with hot water, filter, and wash until the liquid is no longer rendered turbid by nitrate of silver. The solution will contain only lime and the alkalies, for the alumina, iron, magnesia, &c., displaced by the lime, will remain on the filter. Precipitate the liquid by carbonate and oxalate of ammonia, which removes the lime, leaving only the alkalies in solution.

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* *Ann. Chem. Pharm.* cxxxviii. 198.

† *Zeitschr. Chem.* 1866 p. 179.

REPORT ON THE

CHEMICAL LABORATORIES

IN COURSE OF ERECTION IN THE

UNIVERSITIES OF BONN AND BERLIN.

THE CHEMICAL LABORATORIES OF THE RHENISH FREDERICK WILLIAM UNIVERSITY OF BONN.

(Continued from page 234.)

THE UPPER FLOOR.

It has already been stated that only the front block of the building has a second story; this contains a splendid suite of apartments provided for the director of the institution. It would be superfluous to describe more fully its various parts, since a mere inspection of the ground plan (Fig. 4), and of the synopsis which accompanies it, will suffice to show everything that could be of interest.

It may still be mentioned, that there are a number of servants' rooms over the domestic offices, and a suite of inferior rooms over the upper floor of the left corner, intended for household purposes.

The drawing-room (*b*) in the right corner of the building is, as stated in the synopsis, considerably higher than the remaining rooms.

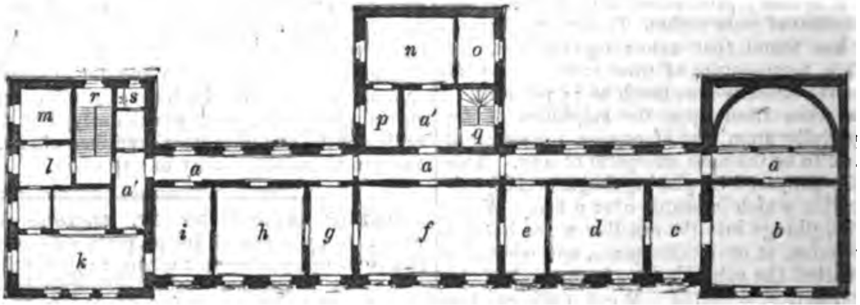
The slated roof overlying the front block of the building contains abundance of well-lighted storage-room.

The drawings which still remain to be described are partly sections, partly views, and although with the help of the ground plans they are readily intelligible, a few explanatory remarks may not be superfluous.

Fig. 5 represents a section along the longer axis of the building—that is, the line A B in the ground plans. In examining this very instructive drawing, we shall commence, as we shall with all the other sections, from the left side. We observe in succession the Mineralogical Museum with the door leading into it from the corridor; the Waiting Room for the Lecturer; the Apparatus Room, with the windows; and the Preparation Room for the Lectures, with the doors opening into the left front court.

FIG. 4.

ROOMS ON FIRST FLOOR.



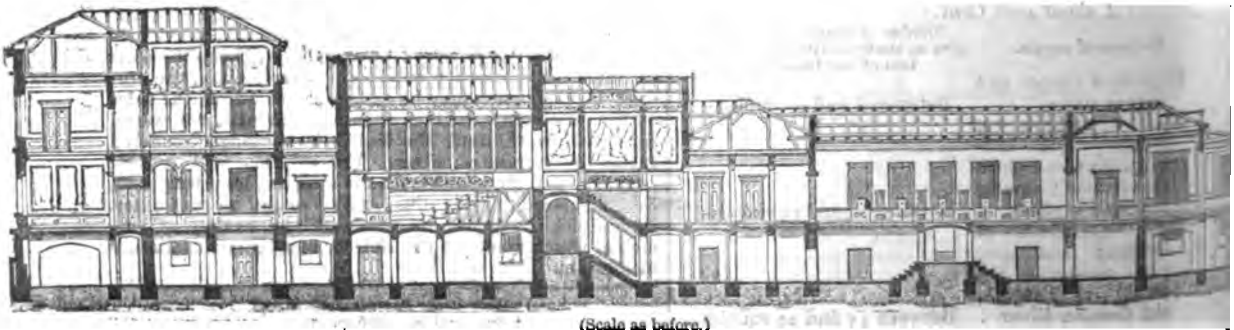
(Scale as before.)

SYNOPSIS.

	Name of Room.	Length. ft.	in.	Breadth. ft.	in.	Height. ft.	in.
a, a, a	Main corridor and staircase	116	2	6	5	15	0
a', a'	Side-passages . . .	...		...		...	
b	Ball-room	28	0	21	3	19	0
c	Sitting-rooms and bedrooms	18	1	11	3½	15	0
d	Ditto ditto .	19	2	18	1		
e	Ditto ditto .	18	1	9	9		
f	Ditto ditto .	29	5	18	1		
g	Ditto ditto .	18	1	8	11		
h	Ditto ditto .	19	2	18	1		
i	Ditto ditto .	18	1	12	1½		
k	Ditto ditto	28 (13	0 0)	11 (8	1 7)	14	0
l	Ditto ditto .	11	8	9	2½	14	0
m	Sitting-rooms and bedrooms	11	11	11	8	14	0
n	Kitchen	17	0	13	10	11	0
o	Small side rooms attached to kitchen . .	13	10	8	6		
p		12	6	7	6		
q	Servants' staircase leading up to servants' rooms over main suite, and down to court and household cellars	...		...		...	
r	Back staircase leading from ground floor to roof, and small rooms in left corner of front block . . .	...		...		...	
s	Closet	14	2	6	2	14	0

FIG. 5.

SECTION ALONG THE LINE A B IN THE PLANS OF THE GROUND FLOOR AND BASEMENT.



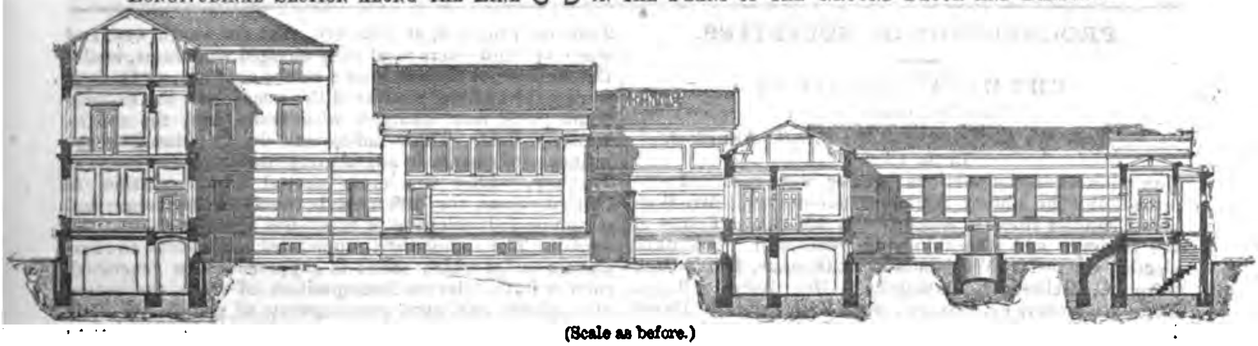
(Scale as before.)

Next come the Great Lecture Theatre, with its seats rising in tiers, and the range of elevated windows, only the first on the left descending to the level of the lecture-table; the elegant Staircase Hall, lighted by a skylight, and the landing by which students, having ascended the flight of steps, enter the lecture-hall; the Main Corridor of the middle cross building, with the door of the director's study in the background; the Side Passage leading to the middle laboratory, with the door to the attic staircase; the Middle Laboratory itself, with its five windows looking into the back court; the evaporation niches fitted up in the intervening piers, and the double working benches in front of the window recesses; the Passage to the laboratory for gas analysis, with the door of the ante-room; and lastly, the Gas-analysis Room itself, with part of its bay-window. This section shows, moreover, with great distinctness, the unequal height of the different apartments of the institution intersected by the middle axis.

Fig. 6 shows a section of the building parallel to the previous one, but lying to the right of it, along the line C D. In this drawing we see, on the ground-floor, beginning again from the left, first, in section, the Chemical Museum, with its door opening into the Mineralogical Museum; in elevation, the Waiting Room for the Lecturer, the Apparatus Room, the Preparation Room, and the Great Lecture Theatre; lastly, the Staircase Hall, with the Thoroughfare under the landing, which affords communication between the two forecourts. After this we have, again in section, the Main Corridor of the middle Cross building, with the door of the director's study in the background; and, farther, the balance room with the door leading to the room for fusions and ignitions; then follow, once more in elevation, the Middle Laboratory, with its five windows opening into the right back-court, and the thoroughfare running underneath it, and (in section) the Reservoir in the middle of the court. The Colonnade for open-air work with the steps leading up to it from the back court, and the door of the operation room of the middle laboratory, appear again in section. Finally we have an opportunity of glancing into the interior of the semicircular structure projecting from the building, and encasing the winding stairs which lead down to the basement passage between the two furnace-rooms.

Fig. 6.

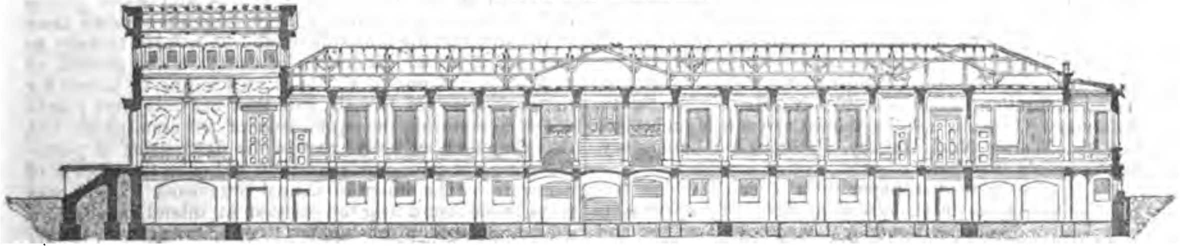
Longitudinal Section along the Line C D in the Plans of the Ground Floor and Basement.



(Scale as before.)

Fig. 7.

Section of the Middle Cross Building along the Line E F in the Plans of the Ground Floor and Basement.



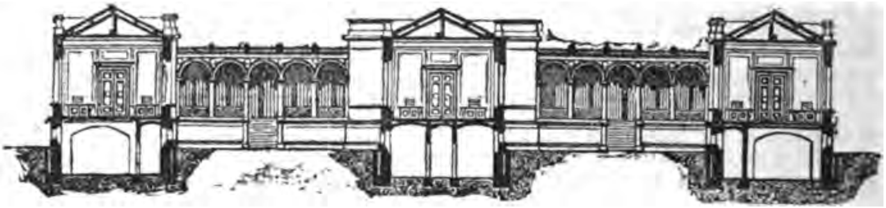
(Scale as before.)

This section (Fig. 7) cuts the corridor of the middle cross building, the main artery of the institution, the observer looking from north-west to south-east—that is to say, in the direction from the laboratories towards the front block. Beginning, as before, from the left, we first find the outside flight of steps, leading through the principal entrance into the magnificent vestibule, the imposing style and tasteful decorations of which are visible from this sketch; the drawing exhibits also the elegant suite of windows running round the upper part of the walls, by which the vestibule is profusely lighted. The large door, seen just beyond the second column in the vestibule, leads to the corridor of the side wing containing the apartments of the assistants and the castellan. The vestibule passed, we have the main corridor in its full length lying before us. In addition to the light obtained from the eight windows shown in the drawing, this corridor also derives a good deal of light from the staircase. The walls opposite the windows and behind the spectator are ornamented with the busts of celebrated chemists, which, fully lighted as they are in this position, produce a particularly striking effect. This section also gives us a very clear insight into the position and construction of the staircase. The stairs, starting from an archway on two columns, lead to the landing repeatedly mentioned, and up to the theatre door, the lower part of which, in the drawing, is seen between the columns; on either side of these columns the ornamental balustrades which protect the landing are visible. Of the stairs, leading to the basement, the top of two side wings is seen in part only and from below; whilst the central flight, lying parallel to and immediately under the staircase to the lecture-room, is given in full. At the end of the main corridor we perceive the folding-doors of the side corridor, which, leading by the director's laboratory, communicates with the front block of the building. Lastly, on the extreme right we find the director's study, with the door to the private laboratory, the side window facing the south-east, and part of the bay-window for microscopic investigation.

A few words will suffice for the description of this drawing (Fig. 8). Here the three laboratories are shown in section, and between them, in elevation, the colonnades for open-air work, with the flight of stairs leading down into the back courts. In the laboratories themselves the working benches, with their cupboards and shelves for reagents, are indicated. Lastly, between the benches are seen the three doors leading respectively to the operation-room of the third laboratory, to the passage communicating with the gas-analysis room, and, on the right, to the operation-room of the first laboratory.

Fig. 8.

Section along the Line G H in the Plans of the Ground Floor and Basement.



(Scale as before.)

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 15.

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 library donations announced. Mr. William Chandler Roberts was formally admitted a Fellow of the Society, and the following gentlemen were duly elected, viz.:—Mr. William Herbert Gossage, Foot's Cray Soapery, Melbourne, Australia; Mr. Robert Biggs, Deputy-Coroner, 17, Charles Street, Bath; and Mr. David Page, Galebeck Powder Works, near Kendal. For the second time were read the names of the undermentioned candidates:—A. C. Cook, Ph.D., King's College, London; Henry Dircks, C.E., Whitehall Club and Bucklersbury; James Forrest, Ashburnham Road, Greenwich; William Huskisson, Gray's Inn Road; A. F. Marreco, Newcastle-on-Tyne, and J. Hancock Richardson, of the same place; Alexander M. Thomson, D.Sc., Sydney, New South Wales. The following candidates were proposed, viz.:—John Broughton, B.Sc., Chemist to the Government Cinchona Plantation, Madras Presidency; Mr. Watson Smith, Analytical Chemist, 26, Portland Crescent, Manchester; and Mr. Walter Noel Hartley, Pathological Laboratory, St. Thomas's Hospital.

Dr. Daubeny read a paper "*On Ozone*," which embodied the results of an extensive series of experiments and meteorological observations made at Torquay and Oxford. The tests employed to indicate the presence of ozone were the iodide of potassium and starch paper of Schönbein, and the moistened sulphate of manganese paper. The first, if protected from the light, was considered as furnishing the most reliable indications, although it was known to assume a blue tint by the action of free acids, chlorine, &c.; the second reagent indicated the ozone by the formation of brown hydrated peroxide of manganese. The apparatus employed consisted of a glass U tube screened from the light and connected with a Johnson's aspirator, and also with an intermediate wash bottle and gas meter. The volume of air drawn over the paper in the U tube was registered, and the resulting tint compared with a standard scale of coloration to indicate the amount of ozone. Thus measured, Dr. Daubeny found in the three winter months, commencing with January, 1864-5-6, at Torquay, that the south-west and westerly winds were most fully charged with ozone, whilst the north wind showed least; on the contrary, at Oxford, during the summer months of the same years, the easterly winds were most charged with ozone, and the north-westerly least. These indications clearly pointed to the influence of the sea in augmenting the amount of ozone at Torquay, whilst the more central inland position of Oxford caused the difference between the maximum and minimum indications to be much less apparent than at the seaside. The author then enumerated the various circumstances under which ozone is supposed to be generated, such as in the electro-decomposition of water, the action of sulphuric acid upon permanganate of potash, &c. His own experiments coincided with those of Dr. Gilbert in pronouncing the absence of ozone from the oxygen given off from plants exposed to sunshine whilst immersed in water. Dr. Daubeny then recounted the results of an examination of the air exhaled by growing plants, and found, in thirty-two instances out of fifty-seven plants experimented upon, sensibly larger amounts of ozone than in the surrounding atmosphere, and he was led thereby to consider that the generation of ozone in the process of vegetation was one of the appointed means of nature for the purification of the air, and that not only were plants useful in restoring the equilibrium of the atmosphere, but that they took an active part in the destruction of pernicious organic compounds given off either in the process of decay or by the waste of animal organisms. There was more ozone found near the sea than at inland localities, a greater amount in the country than in towns, and, lastly, more outside a building than in its inhabited rooms. The author referred to his previous researches (*Phil. Trans.*, 1834) as indicating the now commonly received view in reference to the part played by oxygen in the grand economy of nature, and now urged the necessity of seeking for more accurate tests and wider information before making specific statements or recording observations in the form of meteorological tables.

Dr. Williamson inquired whether any precautions had been taken in order to exclude the influence of volatile hydrocarbons and aromatic substances, some of which, like the oil of turpentine, seemed to unite loosely with oxygen, and then furnish the indications of ozone. He agreed with the author in feeling the importance of rightly estimating the action of ozone in the economy of nature.

The President desired to know whether Dr. Daubeny had extended his observations to a full trial of the sulphate of manganese test for ozone. And, with regard to the influence of light in determining the oxidation of hydrocarbons, there were parallel instances in the cases of gutta-percha and india-rubber.

Dr. Frankland was anxious to learn whether or not ozone had the property of oxidising and destroying the vitality of the simplest forms of animal and vegetable organisms known as spores.

Dr. Daubeny replied that the outbreak of epidemics was often ascribed to a deficiency of ozone, but he had no evidence on the point. The action of hydrocarbons had, in his experiments, been guarded against by removing the test-paper to a greater distance in the case of plants exhaling aromatic odours, some of which had been examined, and he found it necessary to discard altogether the use of caoutchouc tubes for connecting the parts of the apparatus, since it quickly destroyed every trace of ozone. The action of light upon the test-papers was a matter of considerable importance, and he had been obliged for the present to omit the mention of some astounding results communicated by the Prior of the Monastery of St. Bernard, since he had no information as to whether the papers were exposed to the sun or shaded from its influence. The sulphate of manganese test was, he thought, inferior to Schönbein's paper; it likewise assumed a dark colour by the action of direct sunlight. In the case of the starch and iodide of potassium reaction, some of the iodine was no doubt dissipated without leaving its mark, and the observed effect was only the difference in the ratio of the action which sets the iodine free and the tension which causes it to evaporate into space. The speaker exhibited some pieces of dark blue fluor spar which when rubbed together gave an odour similar to ozone, but he found it possible to obtain from it some of the reactions of peroxide of hydrogen, particularly in its effecting the conversion of red chromic acid into the blue perchromic acid, so that he preferred giving this explanation, although it did not coincide with an opinion expressed by Liebig.

Dr. Gilbert referred to the published statements relating to the generation of ozone by plants, mentioned some anomalous results observed in the growth of fungi, and stated his belief that further evidence was wanting in order to establish the identity of the ozone-like emanations from growing plants and the odorous substance produced during the slow combustion of phosphorus in moist air.

Dr. Odling expected the manganese papers would have possessed an accumulating action for ozone, and served better than the iodide as a quantitative test. With respect to the odour evolved upon mixing permanganate of potash with an acid, he found that some of the properties of ozone were wanting; thus, heat had no effect upon it, potash absorbed it, litmus was coloured red, and some manganese appeared to be volatilised.

In answer to Mr. Newlands, the lecturer stated that it would be advisable to ascertain the degree and make allowance for the action of excessive heat upon the test-papers in hot climates.

The President, in moving a vote of thanks to Dr. Daubeny, pointed out the necessity of seeking for better means of indicating and registering the presence of ozone in the air; no one doubted the existence of this body, but the proof was as yet very imperfect.

Mr. W. N. Hartley then gave a short account of a new substance called "chlor-sulphoform," $C_2Cl_2S_3$, which he had prepared by the action of sulphydrates of potassium upon the chlorides of carbon. Its vapour density had not yet been ascertained. The author considered he had obtained evidence of the existence of a body having the formula $C_2Cl_4SO_2$.

The next paper, by Messrs. Chapman and Thorp, was a continuation of the one read at the previous meeting of the Society, entitled, "*The Relation between the Products of Gradual Oxidation, and the Molecular Constitution of the Bodies Oxidised.*" The substances operated upon in this instance were mannite and glycerine. The authors confirmed the statement that mannite, when heated with caustic potash, yields formic, acetic, and propionic acids, and observed that these acids were the same as those obtained by them in their oxidation of β hexylene. In the same way glycerine yields acetic and formic acids when treated with caustic potash. These acids are the same as those obtained by oxidising propyleue—the olefine from glycerine. Both mannite and glycerine yielded nothing but formic acid, when oxidised with bichromate of potash and sulphuric acid. Permanganic acid produces the same effect. It was also observed that mannite decolorised an amount of permanganate solution sufficient to convert it entirely into formic acid and water, thus—$C_6H_{14}O_6 + 7O = 6CH_2O_2 + H_2O$.

Dr. Williamson did not consider the foregoing statement to be in harmony with the general view presented by the author on a former occasion. The method of oxidation was said to afford a means of splitting up organic bodies into a number of carbon groups; for his own part he thought Mr. Chapman had been fortunate in isolating from his products so many bodies of definite character, but the results must vary with the temperature and degree of concentration of the chromic solution.

Mr. Chapman was not prepared to admit a discrepancy between his present and former results. Acetic acid and some of the other products named would withstand for hours the action of the chromic solution at the temperature of boiling water, and he had specified the strength of the oxidising agent employed, which was chromate of potash with excess of sulphuric acid made so dilute that no oxygen was evolved from the mixture upon heating.

Mr. Chapman then read a paper, "*On the Synthesis of Butylene.*" The author alluded to Wurts's synthesis of amylene by the action of zinc ethyl upon iodide of allyl. He then stated that he had succeeded in forming butylene by the action of zinc ethyl on mono-brom-ethylene, thus: —$Zn(C_2H_5)_2 + 2C_2H_3Br = ZnBr_2 + 2C_4H_8$. The butylene so obtained is a very mobile liquid, boiling between 12° and 14° C., and of sp. gr. ·739 at 0° C. It unites readily with bromine, and it was by the examination of the bromine compound that it was identified.

The meeting was then adjourned until Thursday, December 6, when the following papers will be read—viz., "*On the Alloys of Magnesium,*" by Mr. Parkinson; and "*On the Synthetical Formation of Formic Acid,*" by Mr. Chapman.

With reference to our report of the previous meeting of the Society, Mr. Chapman wishes it to be stated that the title of his paper then read is identical with the first of those now reported, and was not correctly described in the notice suspended in the hall of Burlington House. Since reading the former paper the authors have ascertained that the abnormal variety of valerianic acid (which gave butyric and carbonic acids upon oxidation) was *not* prepared, as at first supposed, from valerian root. It was an article of commerce of which they could not learn the history. The anomalous fousel oil which seems to contain two isomeric amyl alcohols is a rare variety believed to have been produced from grain with a certain quantity of rice in admixture. The conclusion deduced from the authors' results was "that by gradual oxidation of complicated carbon groups simpler ones are produced; that these simpler ones are capable of resisting the action of the oxidising agents which gave rise to them; and, finally, that these simpler groups are the representatives of the radicals entering into the composition of the bodies oxidised."

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, by Dr. Percy, F.R.S.

Lecture No. X.

(Continued from page 235.)

We will now consider the oxides of iron. Iron has, as you know, a very strong affinity for oxygen. When heated it will burn in oxygen gas, producing certain oxides of iron. When exposed to the action of moist air, it becomes rusty, or, in other words, combines with oxygen at the ordinary temperature, rust being only an oxide of iron.

The first oxide is the protoxide of iron. Of this compound in its isolated state nothing is known. It exists only in combination. There is a process described by a French observer for its production in a separate state, and we are told that the protoxide of iron is a very definite body; but still I do not think that these statements are very well sustained—at all events, they are not received by chemists generally. I have never seen a specimen of protoxide of iron, nor met with a chemist who had.

Perhaps the oxide most important for us in a geological point of view is the sesquioxide of iron—the common red oxide. Protoxide of iron has this formula—FeO. It contains one equivalent or twenty-eight parts by weight of iron, and one equivalent or eight parts by weight of oxygen. Sesquioxide is composed of two equivalents of iron and three of oxygen. It is analogous to alumina in that respect. It is a most beautiful mineral. You have two or three specimens of it on the table before you. It crystallises in the rhombohedral system, and forms that splendid mineral called specular iron ore. I may call your attention especially to one specimen in the museum above—one of the finest specimens, I suppose, in the world, of specular iron ore. It occurs in mirror-like laminæ—hence its name. It might be used as a looking-glass. Generally it is steel-grey in colour, and sometimes there is a beautiful iridescence, as there is in this Elba specimen. Elba has been known for some years as a source of this iron. On looking at this specimen, you would never take that to be red oxide of iron, but if you reduce it to powder, you will find that powder to have the characteristic red colour. In the mass it has a steel-grey metallic lustre. Every mineral composed of sesquioxide of iron gives a red powder, and the way to test it is to take a piece of broken pottery, and draw the mineral across the broken part; if the mineral is sesquioxide of iron, you will see a red streak on the broken edge of the piece of pottery. It cannot fail to produce it. We may obtain sesquioxide of iron by heating metallic iron for a sufficient length of time, exposed to the air, or by sundry indirect methods. If we heated sulphate of protoxide of iron (common green copperas) to a good red heat for a sufficient time, we should get sesquioxide of iron. It would then be in the state of what is called Calcutta rouge. It is the material used for polishing silver. It has to be prepared for that purpose with extreme care, or it would scratch the silver article. Much of the rouge which is sold by chemists is adulterated with mercury. This saves the time of the servant in cleaning the plate, but it soon causes its destruction. It is also used for the polishing of looking-glasses. Here is a beautiful micaceous variety, which we make by an indirect method, by heating together common salt or chloride of sodium, and sulphate of protoxide of iron, and then washing the product. It is not quite so steel-grey in point of lustre as the natural variety, but if you take a little of this between your fingers you will find it has the same kind of unctuosity as the variety we meet with in nature. We may form it also by heating anhydrous sesquioxide of iron in a slow current of hydrochloric acid, when it occurs crystallised. Or we may form it by heating a solution of chloride of iron with carbonate of soda and lime at 200° or 300° Centigrade. We here get double decomposition, and the sesquioxide of iron separated in the crystalline form.

Much of this specular iron ore is volcanic. It is found in the products of even modern eruptions of volcanoes. There is no doubt that that magnificent specimen in the museum, to which I have referred, is a volcanic product. Its formation may be accounted for easily by a method proposed long ago by Gustave Rose. Chloride of iron is a product of volcanic emanations. It is found in volcanic products undoubtedly. Sesquichloride of iron is, in fact, the perchloride of iron, and consists of three atoms of chlorine and two of iron. If we bring the vapour of water, which is oxygen and hydrogen, at a high temperature, in contact with this perchloride of iron, we get a double decomposition. The oxygen of the water passes to the iron, and we get sesquioxide of iron, which separates in a crystalline form. The hydrogen of the water goes to the chlorine of the perchloride of iron, forming hydrochloric acid; and thus we get hydrochloric acid, and this beautiful mineral sesquioxide of iron. I have here the result of a small experiment of this sort. It is not very satisfactory; but still there are indications of this crystalline sesquioxide of iron. Though the crystals are microscopic, they are there. There is no doubt that Gustave Rose's conclusion is the true one with regard to this specular iron one. We find sesquioxide of iron in nature which is not specular, and which does not require this hypothesis for its formation. It occurs abundantly in nature, sometimes filling lodes or veins—that is, great cracks or fissures in the earth. It occurs sometimes in great masses, and sometimes in regular beds. In Lancashire and Cumberland, for example, it is found on a very large scale. The Cumberland hæmatite, as it is called, and the Lancashire hæmatite are very well known. At Brixham, near Torquay, there is a large quarry of brown iron ore; but a little further on, at Sharkham Point, there is one of red iron ore. Then you may see it at Swansea, near the Mumbles, and it occurs in different parts of England, and largely in different parts of the world—Sweden, North America, and elsewhere. It sometimes occurs in great masses—kidney-shaped mammillated masses, having a beautiful fibrous or radiated structure. Here are some highly characteristic samples. It is associated frequently with quartz, sometimes with sulphate of baryta, and occasionally with both together—quartz and sulphate of baryta. The presence of free silica is a matter of great importance to the iron smelter; but I need not dwell upon that point. Sometimes it occasions great inconvenience. Some of the finest crystallised specimens of sesquioxide of iron occur in Elba and in Sweden. In Sweden, it not unfrequently accompanies magnetite. It occurs abundantly in Canada, and it occurs pseudo morphous after magnetic oxide of iron at Lake Superior and in Siberia. It is sometimes found pseudomorphous after iron pyrites—that is to say, the iron pyrites or bisulphide of iron has been subject to decomposition; and you will find the crystals to a certain depth transformed into red oxide of iron. I have here very characteristic specimens showing that conversion. Here you have it intermingled with the hydrated red oxide of iron—brown iron ore.

There is, I think, no difficulty whatever in understanding how iron pyrites should, by weathering action—the conjoint action of air and moisture—be converted into a hydrated peroxide of iron; but there is considerable difficulty in understanding how it should be converted into *anhydrous*, or waterless, peroxide of iron. This would seem to imply a comparatively high temperature. Whenever iron pyrites is weathered, the product always is brown iron ore—hydrated peroxide of iron—and never directly this red iron ore; and yet it is true that in certain exceptional cases we find upon the pyrites crystals of red iron ore instead of brown iron ore. That is a point which I do not think has been explained yet. It can only be accounted for, I think, by exposure to a certain increase of temperature. I mention it particularly in order to excite attention to it. I have thought a great deal about this formation of the peroxide of iron in nature, and I must say that so far my conclusions are very unsatisfactory indeed concerning it. It is quite certain there are several conditions which must have concurred in its formation with which we are at present unacquainted, and I cannot help thinking one of the most prominent of these conditions is temperature—hot water, say, at a tolerably high temperature; but that is a point which I speak on with considerable reserve.

The next oxide we shall examine is this brown iron ore. It is nothing more, as I said, than red oxide of iron in combination with water. It exists abundantly in different parts of the world, and we have it largely in this country—in the Forest of Dean, for example, and also at Brixham. It occurs sometimes in Corwall, forming beautiful specimens highly prized by all mineralogists. There are several well-known varieties of it. The well-known mineral getite is nothing more than a beautifully crystallised specimen of it. The brown iron ores are all decomposed by a red heat, without exception. They lose their water and become converted into red oxide of iron. We can produce brown oxide of iron in the laboratory without difficulty. We have only to throw it down from solution by means of an alkali, or we can form it by the action of a current of air upon water containing bicarbonate of iron in solution. Perhaps this is one of the most important points for us to consider in connexion with the geological bearing of the question. The bicarbonate of iron dissolves to a large extent in water, but to a much larger extent in water containing carbonic acid, just as is the case with regard to carbonate of lime. Well, when that bicarbonate of iron is exposed to the action of the air—suppose it to trickle through cavities or fissures in a mine where air can get access—the first thing would be a deposition of carbonate of iron by the separation of carbonic acid, the carbonate of iron becoming insoluble upon the carbonic acid escaping. Then the air would act upon that carbonate of iron, and we should immediately get brown peroxide of iron. I have brought down this morning a beautiful stalactite showing this mode of formation perfectly; it consists of brown iron ore, having a beautiful concentric structure of thin concentric laminæ formed by the action of water in the usual way in which stalactites are formed. Those of you who have been at Hastings, I have no doubt, have seen the brown iron ore in the East Cliff there. It frequently occurs in lumps. It is carbonate of iron which has been exposed to air and moisture, and been converted on the surface into brown iron ore. Here is a specimen. It is carbonate of iron in the interior, but on the surface it has been converted into brown iron ore. Some of our recently discovered deposits of iron show this conversion beautifully. Here is an example in some of these pieces of iron pyrites, of which you may gather tons under the cliffs of Beachy Head. The pieces roll out of the cliffs, and are converted superficially into peroxide of iron. It is one of these singular things which, not many years ago, was mistaken for a thunderbolt, or meteorite. It is well to know this. A gentleman, a sailor of some distinction, was one day standing on the shore when a storm occurred. A flash of lightning struck a rock near at hand, and the result was, as he believed, the fall of a thunderbolt. He went forward and collected what he thought he saw fall, and, as he says, it felt hot and emitted the odour of sulphur. He went away and drew up what the French call a *procès verbal*, and forwarded it, together with the substance he picked up, enclosed in a mahogany box, to the government, stating that it was a true meteorite which he had seen fall. Well, on examination it turned out to be nothing more than one of these specimens which had fallen from the cliff. They are found in abundance at Beachy Head, and they occur also at the Isle of Wight. This story shows how careful people ought to be in such matters, and how necessary is a little knowledge of general facts to enable one to observe correctly. This man was, no doubt, perfectly honest, but he was grievously mistaken. To *see* is one thing; to *observe* is another and totally different thing. You cannot observe without a previous training of the mind.

An immense amount of this brown iron ore is now found in Northampton and in Oxfordshire. It consists essentially of brown oxide of iron—hydrated oxide. It is this ore which supplies the greater portion of the iron produced in France and Belgium, and it is now used as a source of iron in England. It is only a few years ago—since the Great Exhibition of 1851—that the ore was discovered in this country.

ACADEMY OF SCIENCES.

November 12.

The sitting this day was very short; and, with the exception of M. Berthelot's papers, little of general interest was brought forward. After some geographical and mathematical papers, one was read "*On a Method of Diminishing the Waste in Compressing Instruments, owing to the Heating of the Air,*" by M. A. de Caligny.

"*New Details on the Ancient Monuments discovered in the Islands in the Bay of Santorin, and on the Actual Condition of the Eruptive Phenomena,*" by M. de Cigalla.

"*On the Action of Heat on Benzol and Analogous Hydrocarbons,*" by M. Berthelot. (Second Part.) The author has continued the examinations which we noticed last week. When pure styrol is heated to redness, it decomposes with formation of benzol and acetylene; and reciprocally, when benzol is heated with acetylene, it produces a certain quantity of styrol. When styrol and hydrogen are heated together, the products are partly benzol and ethylene. When a mixture of styrol and ethylene are heated, the products are benzol and naphthalin, both in great abundance. When styrol and benzol are passed together through a redhot tube, an abundant formation of anthracen takes place, together with some naphthalin and a hydrocarbon analogous to phenyl. Benzol and naphthalin at a red heat exert no reciprocal action. At a white heat there is an abundant formation of anthracen. Phenyl, $C_{24}H_{10}$, heated to redness in a sealed glass tube full of hydrogen, splits up with formation of benzol and chrysen,

$$3C_{24}H_{10} = 3C_{12}H_6 + C_{36}H_{12}.$$

"*On the Action of Potassium on Hydrocarbons,*" by M. Berthelot. It is generally admitted that potassium and sodium are not attacked by the alkali metals; and indeed these have been employed to purify the hydrocarbons. The author, however, has recently observed that acetylene is energetically attacked by potassium and sodium, with formation of alkaline acetylides. Following up this reaction, M. Berthelot finds that a great many pyrogenous hydrocarbons, rich in carbon, are attacked by potassium, such as cumol from coal-tar, a liquid hydrocarbon of the same origin boiling between cumol and naphthalin, naphthalin, phenyl, anthracen, reten, &c. Styrol gives rise to special phenomena. The naphthalic compound, which may be taken as the type of the rest, is prepared and purified as follows:—Introduce naphthalin and a fragment of potassium into a tube, and heat to fusion. The potassium becomes covered with a black crust, and by breaking this off from time to time with a glass rod the whole may be transformed; no hydrogen is evolved. After dissolving the excess of naphthalin out with benzol, the result is a black powder, which, after removal of the excess of potassium, has a formula approaching $C_{20}H_8K_4$. Water decomposes it violently with formation of potash and a hydrocarbon much more fusible than naphthalin. These compounds appear to be explosive. The author points out their relations with the blue compounds which are formed in the reaction of alkaline metals on chloro and bromo bodies.

"*On Diffusion and Endosmose,*" by M. Dubrunfaut. The author draws attention to the fact that in 1854 he discovered a method of purifying saccharine liquids by a process somewhat similar to dialysis.

"*Chemical and Industrial Memoir on Buckthorn Seeds,*" by M. J. Lefort. Chemists have already found in these seeds bodies which are known by the name of rhamnine, chrysorhamnine, xanthorhamnine, oxyrhamnine, and hydrate of rhamnine. The author has now added to the confusion by discovering, in "large quantity," rhamnegine and rhamnine. *Rhamnegine* is obtained by allowing to remain at a low temperature a concentrated alcoholic tincture of Persian or Avignon seeds. When purified, it forms cauliflower masses of yellow and translucent prismatic crystals. It is very soluble in hot water and alcohol. Sulphuric, nitric, and hydrochloric acids convert it into rhamnine. It unites with bases, and its formula is $C_{12}H_8O_8+2HO$. *Rhamnine* is obtained by boiling the seeds with water. The filtered solution abandons rhamnine under the form of a lively citron-yellow precipitate. With the exception of it being a little darker yellow, and being insoluble in water, rhamnine has the same properties and composition as rhamnegine.

"*On the Separation of Left-handed and Right-handed Tartrates by means of Supersaturated Solutions,*" by M. Gerney. A supersaturated solution of left-handed double tartrate of soda and ammonia does not crystallise in contact with a fragment of the same salt right-handed, and *vice versâ*. From an inactive supersaturated solution of double racemate of soda and ammonia, a fragment of right-handed crystal determines only the precipitation of right-handed crystals; whilst a portion of the same liquid in contact with a left-handed crystal produces a deposit of the left-handed salt. This supplies a simple means of separating at will from the double racemate of soda and ammonia either of its two constituent salts.

CONTEMPORARY SCIENTIFIC PRESS.

[Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted.]

Dingler's Polytechnisches Journal. September.

"*On the Composition of a Deposit from a Steam Condenser,*" by E. Reichardt.—"*On the Manufacture of Uranium Yellow at Joachimsthal, Bohemia,*" by E. Vysoky.—"*On J. Young's Paraffin Oil Manufactory,*" by G. Lunge.—"*On the Detection of Minute Traces of Fatty Substances by their Action in checking the Motion of Camphor on Water,*" by J. Nicklès.—"*Zymotechnical Miscellanies: 7. On Frozen Beer,*" by J. C. Lermer.—"*On the Manufacture of Albumen from Blood,*" by B. Richter.—"*On Disinfection as a Precautionary Measure against the Spread of Cholera,*" by M. Von Pettenkofer.—"*Researches on Graphite,*" by A. W. Hofmann.—"*A Solution for Etching Copper,*" by C. Puscher.—"*Semi-Transparent Glass for Greenhouses and Forcing Pits,*" by J. A. Heckert.—"*A New Glaze Free from Lead for Common Pottery Ware,*" by E. Wiederhold.—"*On the Manufacture of a Certain Kind of Blue Paper,*" by G. Dachauer.—"*On Scheibler's Process of Manufacturing Beetroot Sugar,*" by the same author.—"*A Method of Etching and Colouring Buttons and other Articles of Horn,*" by G. Mann.—"*On the Ventilation of Cesspools,*" by Toussaint-Lemaistre.

Vol. 182. No. 1. October.

"*On the Influence of Light on Silvered Glass Mirrors,*" by C. Lea.—"*On the Reducing Properties of Zinc,*" by C. Stahlschmidt.—"*Historical and Practical Researches on the Nature of Purple of Cassius,*" by J. C. Fischer.—"*Contributions to the Knowledge of Madder Colours,*" by P. Bolley.—"*On the Application of Bessemer Steel to the Manufacture of Domestic and Culinary Utensils,*" by F. W. Haardt.—"*On the Manufacture of Armour Plates in Austria,*" by the same author.—"*On the Cast Steel Projectiles used by the Austrians at the Battle of Lissa,*" by the same author.—"*On the Use of Iron instead of Copper Tubes in Sugar Manufactories,*" by A. H. Schmidt.—"*On the Absorption of Oxygen by Alloys of Lead and Tin,*" by P. Bolley.—"*Note on Chloride of Magnesia as a Bleaching Agent,*" by P. Bolley.—"*On a Yellow Crystalline Substance obtained from Indigo,*" by Crinsoz.—"*On Lesimple's Method of ascertaining the Presence of Burnt Bank Notes in Charred Ashes,*" by R. Böttger.—"*Cement for Attaching Brass to Glass,*" by Wiederhold.

Mittheilungen des Gewerbe-Vereins für Hannover. Nos. 3-4.

"*On the Influence of a Coating of Soot on Steam Boilers and Evaporating Pans,*" by J. Noggerath.—"*On a Method of Burning the Noxious Effluvia given off during the Operation of Boiling Bones,*" by Stöss.—"*On the Behaviour of Silicium during the Process of Refining Iron,*" by List.—"*Apparatus for Testing Petroleum and Solar Oil,*" by the same author.—"*On obtaining Chloride of Potassium from Carnalite at Stassfurt,*" by E. Fuchs.

Kunst und Gewerbeblatt. No. 6. June.

"*On Fluid Glycerine Soap,*" by M. Herren.—"*On a Method of obtaining Colourless Albumen from Blood,*" by Kunheim.

No. 7. July.

"*On Graphite in Bohemia,*" by V. Noback.—"*On the Chemistry and Technology of Fats,*" by P. Bolley.—"*On the Manufacture of Albumen from Blood,*" by B. Richter.

Génie Industriel. No. 190. October.

"*On the Reduction of Metallic Oxides,*" by J. Reese.—"*Alloys of Aluminium,*" by P. Morin.

NOTICES OF PATENTS.

Preparing Gun Cotton. Frederick Augustus Abel, Royal Arsenal, Woolwich. Dated April 20, 1865.

This invention has reference to the explosive compound known as gun cotton. Such compound has heretofore been employed either in a loose, fibrous, or woolly state, or of late it has been spun into the form of rovings, yarn, or thread, and has then been formed into cartridges, either by winding, braiding, or weaving.

This invention has for its object to assimilate the physical condition of gun cotton as nearly as possible to that of gunpowder by mechanically converting it into a solid conglomerate state, and imparting to it either a granular or other suitable form that will present the exact amount of surface and compactness required for obtaining a certain rapidity or intensity of combustion.

The method of treating the gun cotton, which the patentee prefers to employ in carrying the invention into practice, is as follows:—First convert cotton wool by the processes now well known into gun cotton. For this purpose he prefers to use the cotton in the form of a loose roving. When the gun cotton has been purified from acid by washing in running water and in very dilute alkali, transfer it to a beating engine of the description commonly used in the manufacture of paper, where it is reduced to a pulp, which is then converted into solid masses, such as sheets, discs, cylinders, and other forms, either perforated or not, by any of the processes ordinarily employed for producing sheets, discs, cylinders, and other forms from paper pulp. A small quantity of gum or other binding material soluble in water may be mixed with the pulp. To obtain any required degree of density of the solid gun cotton, subject the mass, whilst in a moist state, to the action of hydraulic or other presses, or of any other known arrangement of machinery for exerting the requisite pressure on the material.

To produce a granular structure the patentee either cuts the sheets, discs, and other solid forms into small pieces of the required size, or introduces the pulp, containing water and a small quantity of the binding material, into a vessel to which a vibrating motion is imparted, whereby the pulp is at once formed into granules of different sizes, which are subsequently sorted, if necessary. In the above processes, in place of water, other fluids, such as wood spirit, spirit of wine, ether, or mixtures of those liquids, with or without some binding material soluble in the liquid, may be employed.

Instead of forming the whole of the mass of gun cotton into pulp as described, a portion of the same may be left in the original state, and be mixed with the pulp in such proportions that, when subjected to the requisite pressure, such combination will become a solid conglomerate mass of the requisite density. Such solid gun cotton, whether formed of pulp only, or of pulp mixed with fibre, may also be coated or mixed with soluble gun cotton, known as collodion, applied in the form of solution.

The solidified gun cotton may also be formed of mixtures of gun cotton of different composition, the properties of which are well known—that is to say, of gun cotton which is soluble in mixtures of spirit of wine, and ether, and in wood spirit, alone or mixed with spirit of wine, and of gun cotton which is insoluble in those liquids, and the mixtures may be produced either by reducing both or only one of the varieties of gun cotton to pulp, leaving the other in a fibrous state, or by combining them when both are in the fibrous state. Such mixtures may be converted into solid masses, either by the aid of pressure alone (that is, when one or both varieties is or are in the form of pulp), or by making the soluble gun cotton present in the mixtures serve as a binding material by their treatment with the liquids above named, which act as solvents, in which case the mixtures may be consolidated with or without the aid of pressure. The patentee claims:—

First, reducing gun cotton to a pulp, and consolidating such pulp with or without the aid of pressure into the form of sheets, discs, granules, cylinders, or other solid forms, either with or without the admixture of binding materials.

Second, combining with gun cotton reduced to a pulp gun cotton in a fibrous state, and consolidating such mixture into sheets, discs, granules, cylinders, or other solid forms, either with or without the admixture of binding materials.

Third, combining soluble and insoluble gun cotton, either when both are in a state of pulp or when one is in a state of pulp, and the other in a fibrous condition, and consolidating such mixtures into cylinders, sheets, discs, granules, or other solid forms, either with or without the admixture of binding materials.

Fourth, subjecting mixtures of soluble and insoluble gun cotton, either when both are in a fibrous condition, or when both are in a state of pulp, or when one only is in the state of pulp and the other in a fibrous condition, to the action of solvents of the soluble gun cotton, either alone or with the employment of pressure, so as to effect the consolidation of the same.

Fifth, the application to the surface of the consolidated gun cotton of a solution of the soluble forms of gun cotton, or of shellac, or other suitable gums or resins.

It would be difficult to overestimate the value of this discovery. By its means the patentee has succeeded in moderating the violence of the combustion to almost any desired extent, and has thus removed the chief, if not the only, source of danger attendant on the use of this agent for warlike or sporting purposes. We understand that Messrs. Prentice and Co., of Stowmarket, are manufacturing gun cotton, in which a patent of their own is combined with the above, in the production of patent safety gun cotton which meets all the requirements so long demanded by the various scientific and practical authorities who have devoted their attention to this material. Under the new patents the safety gun cotton is so manufactured that it contains within itself the principles of safety and simplicity. Whilst, however, it is thus independent of mechanical aids, and under perfect control, strong shooting is effectually secured. The gun-cotton cartridges made by this firm on the above principle afford effective and, it is not too much to say, luxurious shooting. They are safe; give great penetration, with little strain upon the gun; make an excellent plate; emit no smoke; are uniform in power; occasion little recoil or noise; and neither foul nor injure the gun.

CORRESPONDENCE.

Spontaneous Ignition.

To the Editor of the Chemical News.

Sir,—The spontaneous ignition of pyrotechnical compositions made with chlorate of potass is indeed a very serious subject as regards the safety of both life and property. I know not if any reliable observations have been made in the matter, but the following facts were noted by myself some years ago, and may throw some light upon the probable origin of various terrible fires which have occurred on the premises of firework-makers in London. Mixtures of the three ingredients—nitrate of strontia (or barytes), sulphur, and chlorate of potash—if made up at once from *freshly* and strongly desiccated materials, are certain to take fire spontaneously within a few hours, especially if placed in a rather damp situation. The action, which I twice had the patience to watch for and witness, begins with the evolution of an orange-coloured gas; afterwards a liquefaction is set up at several points in the mass; a hissing noise and a more rapid disengagement of the gaseous matter comes on, and the composition takes fire. It is a curious thing that the addition of a small proportion of sulphuret of antimony at once prevents the occurrence of these phenomena; whether charcoal has the same effect I am not quite sure. Moreover, if such compositions, being damp, are, in order to dry them, placed too near the source of heat, the same phenomena will take place even when antimony is used in their composition. Also, compositions to produce a purple flame, if made with black oxide of copper, are almost sure, sooner or later, to take fire of themselves at uncertain periods, whether kept in a damp or dry place. The carbonate should always be used in preference.

I am, &c. R. Trevor Clarke.

Welton Park, November 13.

The Endurance of the Atlantic Cable.

To the Editor of the Chemical News.

Sir,—I have closely inspected the samples of Atlantic cable, both of 1865 and 1866, now being publicly exhibited at the Crystal Palace, and venture to express an opinion that the zinc or "galvanised" coating of the iron wires in the latter construction will eventually prove a source of weakness from the circumstance that this metal is rapidly attacked by sea water with formation of oxide and soluble chloride of zinc.

More than ten years ago I made a series of experiments upon the corrosion of sheet zinc and galvanised iron by fresh and salt water, in consequence of having had submitted to me an extraordinary instance of the destruction of a zinc-lined trough which had been inadvertently employed for the salting of meat. The animal fluids extracted from the meat appeared certainly to have had the effect of stimulating the action of the brine upon the metal, but it was found that salt water alone rapidly attacked zinc, and the use of the metal was at once discarded. Assuming this action will occur in the outer strands of the cable of 1866, there is nothing to prevent the subsequent corrosion of the iron wire itself, and the structure of this metal will have been to some extent impaired or opened out by the treatment to which it has been subjected in the galvanising process. Granting the possibility of attaining a higher standard of tensile resistance by passing the iron wires through a careful annealing treatment applied in the shape of a bath of melted zinc, the increased mechanical strength may, nevertheless, have been dearly purchased by the sacrifice of superior chemical qualities which are undoubtedly presented in the hard, smooth, and bright wire of ordinary manufacture to greater perfection than in the roughened exterior of a once galvanised wire with its iron laid bare either by the intentional removal of the zinc with solvents, or by the equally certain action of salt water.

The advantage of using hemp in the natural condition, instead of the tarred material formerly employed, likewise appears to me to be very questionable when their relative merits are examined from a chemical point of view.

I am, &c. John Spiller.

Chemical Department, Woolwich, November 19.

Dr. Will's Analytical Tables.

To the Editor of the Chemical News.

Sir,—In answer to T. Williams' query, I quote this passage from the Preface to Connington's "Handbook of Chemical Analysis":—

"The analytical tables, especially, are little more than translations of those which accompany Dr. Will's manual."

I am, &c. T. Stevenson.

November 17.

Parish Analyses.

To the Editor of the Chemical News.

Sir,—I beg to call your attention to the enclosed copy of the last report of the "Medical Officer of Health" for Merthyr, particularly to that portion of it which purports to contain the results of an analysis of several specimens of well-water in the town and district. One sentence especially is worthy of remark:—"Organic matter exists in water in three forms, as *sulphate*, or *chloride*, or *nitrite* of lime, or magnesia." Even granting that sulphates and chlorides were sometimes produced in water by decaying organic substances, how could any one say for certain that their presence proved the presence of organic matter? In fact, such a statement, if correct, would annihilate the distinction between organic and inorganic salts.

Much attention is now being paid to the presence of organic matter in water as a source of disease, and it is certainly very proper that such wells as contain offensive decaying substances should be closed; but it occurs to me that neither the interests of science nor the interests of society will be promoted if our local boards condemn water on such evidence as I now lay before you. You may not be aware that the authorities at Cardiff had been recommended by (I believe) Dr. Pain to stop up certain wells, one of which was stated (after an analysis by Mr. S., of London) to contain "3·09 grs. of organic matter and loss" per gallon; but Mr. W. Herapath, sen., of Bristol, has examined the same water, and stated that it contains only ·048 gr. of organic matter per gallon, and that the method by which Mr. S. had obtained his results was a fallacious one—viz., that of incineration. Dr. Pain, of Cardiff, had also asserted that nitrites are indicated by the loss of colour experienced on adding permanganates, an assertion which Mr. Herapath of course contradicts.

As our medical officer is a gentleman highly and deservedly esteemed for his personal worth and medical skill, I do not write to give greater publicity to any error he may have committed; but, as an amateur chemist, I feel deeply interested in everything connected with chemical science, and regret that any discredit should be brought upon it by persons not properly qualified undertaking analyses, and having the results of their analyses accepted as sufficient evidence on which public boards may put a community to expense by closing up private wells or making other alterations. It is not long since a woman who died suddenly near Merthyr was reported, not by a professional analyst, but by a surgeon, to have taken arsenic, and, on the strength of his evidence (the result of his own analysis), a verdict equivalent to *felo de se* was brought against the deceased. This is not a healthy state of affairs; and as it is probably not uncommon to employ men as analysts whose only certificate is public opinion, it would be well to discourage our coroners, public boards, and others from accepting any analysis in cases of importance, unless it be duly certified by a professional chemist.

I am, &c.

F. Souley Johnstone,
Minister of Market-square Chapel.

34, Thomas Street, Merthyr, November 20.

MISCELLANEOUS.

Medlock's Patent.—Messrs. Nicholson and Co. have applied for a disclaimer to this patent. The case has just come before the Solicitor-General.

ANSWERS TO CORRESPONDENTS.

General Index to the First Fourteen Volumes of the Chemical News.—We have had an inquiry for such an index. Its compilation will be attended with considerable trouble and expense; if, however, we find our readers generally wish for one, it shall be commenced as soon as the present volume is completed. Intending subscribers will please notify their wishes to the publisher without delay.

⁂ 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. R.—You need not add any nitric acid. Heat equal weights of oil of vitriol and copperas together to a heat short of redness.

J. R. W. S.—There is probably water in the gaspipe. Try turning the tap near the burner on full, and turning off the tap at the meter.

Manufacture of Iodine.—*A Subscriber* writes to say that if we supply him with the names of manufacturers of iodine, he can give some valuable suggestions in reference to the manufacture of the same.

W. L. R. inquires why it is that bone tallow becomes darker in colour after being heated on a water bath to 212° for one hour. Can any of our readers give the required information?

Prof. H. Wurtz, New York.—Our correspondent's letter, with enclosure, has arrived, and shall receive immediate attention.

Dr. T. E. Jenkins, Louisville.—We have to thank this correspondent for a most admirably executed series of stereoscopic photographs of the interior of the Mammoth Cave of Kentucky, taken by means of the magnesium light. The information given in the accompanying letter is so interesting that we regret it is marked, "not for publication."

W. H. Harrison.—1. Our experiments on the action of the rays of the spectrum on the different salts used in photography are published in the first volume of the *Journal of the Photographic Society*. 2. Inquire of Hopkin and Williams, New Cavendish Street.

W. Chisholm.—If a liquid would be applicable to your purpose, we would suggest the employment of bisulphide of carbon or the more volatile portions of paraffin oil or coal naphtha. These will entirely extract oil or grease from wool or cotton without injuring the fibre; and as the solvent can be almost entirely recovered by distillation, the loss would be trifling.

J. Johnstone.—Oil for tempering should be animal, as whale or fish oil. Tallow is good for small tools. Any steelworker or dealer will direct you to the best quality of steel for the tools you wish to make and the work you wish to do.

Naturalist.—A good hydraulic cement for your aquarium can be made from powdered pipe-clay, three parts by weight, to one of oxide of iron, mixed with boiled linseed oil sufficient to form a paste. Aquariums put together with thin strips of india-rubber in the joints are, however, preferable.

Received with thanks.—H. Deane, F.L.S.

Books Received.—"The Elements," by William Leighton Jordan; "Etudes et Considérations sur la Nature des Eléments (Corps non-décomposés) de la Chimie," par J. A. Groshans, première partie; "On Exuberant Growths of the Tonsils," by James Yearsley, M.D., M.R.C.S.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

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

CONCLUSION.

I MUST now stop, for my task is completed. I have tried, in the most diverse compounds and in the most varied reactions, to pursue this alliance between organic and inorganic chemistry, which all have proclaimed, but which few have hitherto tried to establish in a definite manner. In the preceding pages I have pointed out many analogies, and I have sought to express them in that typical notation which is so clear when we have to represent the ties of relationship existing between bodies. I have laid stress upon some of the fundamental data of that which is now called the *new chemistry.* But it may be wrong to call it so. For this chemistry is simply that of Lavoisier, and if during ninety years the science he created has received a magnificent development, it owes it not to a revolution but to a continuous progress; the chain of this progress has never been broken.

At the end of last century the facts concerning the composition of acids, of oxides, and of salts, composed almost the whole domain of chemistry.

Theoretical ideas relative to the composition of compound bodies in general were founded upon the study of the reactions which give rise to the oxygenised compounds, particularly to salts.

We can sum them up thus: All chemical compounds are formed by the addition of two simple or compound elements; all compound bodies have a binary constitution. This is what was called dualism.

Berzelius adopted this doctrine, and sought to strengthen it by basing it upon the facts relating to the electrolytic decomposition of salts. The electro-chemical hypothesis became the support of the dualistic hypothesis. "You see plainly," said this master, "that salts contain the elements of the acid side by side with those of the oxide, and not confounded with them; for when we submit to electrolysis such a salt as sulphate of soda, the sulphuric acid, or the electro-negative element, goes to the positive pole, and the soda, or electro-positive element, goes to the negative pole." Thus the dualistic formulæ of sulphate of soda

$$SO_3 + NaO,$$

and of salts in general appeared strengthened, not only by the facts relating to the synthesis of these compounds and their most ordinary mode of formation, but also by the decomposition which the electric current causes in some among them. We now know that the argument is bad, and that it may be turned against the hypothesis which has been so long in vogue as to the constitution of salts. We know that in the electrolysis of sulphate of soda, as in that of sulphate of copper, it is not the oxide but the metal which goes to the negative pole, and that the free alkali only appears as the result of a secondary action — namely, the decomposition of the water by the metal around the negative electrode.

But that was not known in 1834, and since this epoch have been discovered the facts which should ruin the dualistic hypothesis of the constitution of compound bodies. M. Dumas proved that chlorine can unite with organic bodies otherwise than by addition—that is to say, by substitution; that chlorine, an electro-negative element, can there replace hydrogen, an electro-positive element. Berzelius rejected the most natural interpretation of these facts, and sought to express the composition of the chlorised organic bodies by dualistic formulæ. Thus trichloracetic acid was looked upon as a combination of chloride of carbon and of oxalic acid—

$$\underbrace{C_2Cl_3 + C_2O_3 + HO.}_{\text{Trichloracetic acid.}}$$

Formulæ analogous to the preceding, and often more complicated, were attributed to the numerous products of substitution with which the labours of Laurent and of MM. Regnault and Malaguti had enriched the science. Berzelius had never before shown himself so fertile in hypotheses, and the resources of his powerful mind were wasted on this thankless task; by torturing facts to adapt them to his theory, he hastened the ruin of his ideas.

The French school has reacted against these exaggerations. M. Dumas, Laurent, and, later still, Gerhardt, entered into an energetic and victorious conflict with the author of the electro-chemical theory. Organic bodies are formed by groups of atoms united together by the bonds of affinity, and forming a whole; M. Dumas first stated this fact; Laurent and Gerhardt, adopting and developing this idea, made it the foundation of their theoretical conceptions; it is the basis of the *unitary system.*

But, as always happens, some have gone too far in this reaction. By saying, about ten years since, that simple or compound bodies can only react upon each other by exchanging their atoms, and by summing up chemistry in these words—All is double decomposition—Gerhardt himself exaggerated.

Yes, all is double decomposition in a large number of reactions, when molecules, which we may look upon as saturated, come into conflict with each other. In each of them, taken separately, the affinities of all the atoms are satisfied, and the forces which unite them are exhausted. But when they are put in contact, this state of equilibrium may be broken, and exchanges of atoms may take place, by virtue of that elective affinity of which Bergmann spoke a century ago.

But all is not double decomposition when we have to do with reactions between bodies which have not arrived at the state of saturation. A combination which contains one or more polyatomic elements whose affinities are not satisfied, may unite with new elements by virtue of the tendency which atoms possess to manifest and exert to their full extent the chemical forces which reside in them. Here it is not an exchange of atoms which forms the reaction—it is an addition of atoms. New affinities have revealed themselves and have been satisfied; the molecular edifice has increased.

Such reactions show that the combining power of the atoms is not exhausted at once, but that it is exerted by degrees. This combining power is now called atomicity. It is the basis of the modern theoretical ideas. If we wish to express in general terms the relations existing between bodies, shall we still say with Gerhardt that all should be compared with three or four substances chosen as types and able to be modified indefinitely by means of substitution? No; we can turn to a higher principle and say—

That the quantities of matter which act in chemical phenomena, and which have been called atoms, are not endowed to the same extent with the force which governs combinations.

That the diversity in the manifestation of this force, sometimes simple, sometimes multiple, gives rise to different forms of combination.

That in a given compound representing some one of these forms, all the atoms are united by a part or by the whole of the affinities which reside in them.

Finally, that this affinity is exerted not only between heterogeneous atoms, but also between atoms of the same nature.

In the diversity of forms of combination we again see the typical idea, but this idea is now only of secondary importance; it is subordinate to a more general principle.

The theory of types, suggested by an attentive study of a large number of metamorphoses, confined itself to comparing bodies together, and represented them as being derived the one from the other by substitution. We now go further, and determining in what manner affinity joins the atoms together in a given compound, we endeavour to define the relationships which exist between these atoms. But who does not also see that this theory of atomicity which we have endeavoured to explain is only the invigorated and developed expression of the law of multiple proportions? Who does not see that contemporaneous chemistry, by considering so attentively the action of affinity in combinations, and especially in those molecular additions which Gerhardt had neglected, has made in a manner a return towards the past? We may thus say that the ideas which now tend to prevail stand midway between the ancient theories and those developed by Laurent and by Gerhardt.

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*The Polymeres of Acetylene: First Part—Synthesis of Benzol,** by *M.* BERTHELOT.

MOST organic compounds may be arranged in two fundamental series—namely, the series of fatty principles, in which the weight of carbon is about six times that of hydrogen, and the series of aromatic principles, in which the relative proportions of carbon and hydrogen are about double the preceding. Without insisting on this relation, I will simply mention that the aromatic series comprehends most of the natural essences and the acids derived from them, the phenols and hydrocarbons of coal-tar, aniline, and probably a great number of therapeutic alkaloids and colouring matters—in short, the constituent principles of nearly all balsams, resins, bitumens, &c. Now, all these compounds may be theoretically connected with benzol, and in a great many instances by experiment. Benzol is, in a measure, the keystone of the aromatic edifice. This will show the importance of the synthesis of benzol, and I have carefully studied this formation.

From the beginning of my work in 1851, I have shown that benzol is formed by the action of heat on alcohol; having since formed alcohol from olefiant gas, and olefiant gas from its elements, the experimental production of benzol from carbon and hydrogen will be found demonstrated. But the compound was thus obtained under complicated conditions, in a manner to throw little light on its constitution.

However, my researches on acetylene caused me to think that this carbide might be the true generator of benzol. In fact, acetylene offers that proportion of weight between carbon and hydrogen which I have given as proper to the aromatic series. Moreover, acetylene and benzol are formed of carbon and hydrogen in exactly the same proportion; the condensation alone is different, for one litre of benzol vapour contains the same vapours as three litres of acetylene—

$$C_{12}H_6 = 3C_4H_2.$$

I mentioned the first confirmation of this theory, after comparing the decompositions of chloroform and bromoform by copper, at red heat.† The decomposition of chloroform, in fact, engendered acetylene by a regular reaction—

$$2C_2HCl_3 + 6Cu_2 = C_4H_2 + 6Cu_2Cl,$$

while that of bromoform engendered a certain proportion of benzol—

$$3(2C_2HBr_3 + 6Cu_2) = C_{12}H_6 + 3(6Cu_2Cl).$$

Benzol here seems to result from a condensation of nascent acetylene. However, this experiment, though published several years ago, does not appear to have attracted the attention of chemists.

The present memoir will, I hope, complete the demonstration of the synthesis of benzol and of its true constitution. I wish, in fact, to prove that benzol may be obtained directly, and in large quantities, by the condensation of free acetylene.

Acetylene, heated to about the temperature for fusing glass, is gradually transformed into polymeres; I described this experiment in the *Comptes Rendus*, lxii., 905. I have repeated it and accumulated the products, to enable me to make a thorough examination, and, after a series of careful, methodical manipulations, obtained a sufficient quantity of a yellowish liquid, which I submitted to a fractional distillation. I isolated a whole series of carbides of hydrogen, polymeres of acetylene (benzol, styrol, fluorescent carbides, retene).‡ I will now speak only of benzol, the most important and the most abundant of these carbides, reserving the others for a future memoir.

Benzol forms nearly half the total product, and is characterised by the following properties:—

1, Boiling-point, about 80°; 2, odour; 3, power of remaining unaltered by concentrated sulphuric acid; 4, after having been in contact with this acid, it is unalterable by iodine, and bromine does not immediately attack it; 5, introduced into a chlorine atmosphere, in the sun, it rapidly forms Mitscherlich's chloride, $C_{12}H_6Cl_6$, a characteristic crystallised compound; 6, fuming nitric acid dissolves it entirely when cold, changing it to nitrobenzol, a liquid perfectly soluble in ether, and having the odour of bitter almonds; 7, this nitrobenzol may be transformed into aniline by acetic acid and iron; 8, finally, aniline may be changed to the well-known and perfectly characteristic blue compound under the influence of chloride of lime.

The formations of nitrobenzol, aniline, and the blue colouring matter, are so sensible, that the transformation of acetylene into benzol may be seen, by operating on 30 and even on 10 cubic centimetres (12 milligrammes) of acetylene, which renders the demonstration of this fact possible in a course of experiments.

These facts explain why the formation of benzol and acetylene by the action of red heat on organic matters is always simultaneous. They are so much so that acetylene obtained in this way always retains, even after having passed through the cuprous combinations, some traces of benzol, as, by merely shaking 1 litre of this gas with 3 or 4 cubic centimetres of fuming nitric acid, an appreciable quantity of nitrobenzol, transformable into aniline, &c., may be obtained. But the proportion of nitrobenzol is very small, as the experiment fails with less than $\frac{1}{4}$ litre of acetylene. Nitrobenzol is really produced by pre-existing benzol; for acetylene, after

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* *Comptes Rendus*, xiii., 479.

† "*Leçons sur les Méthodes générales de Synthèse*," p. 309.

‡ There was besides a small quantity of naphthaline, and probably of diacetylene.

having been treated by nitric acid, precipitated again by the copper reagent, then regenerated, furnishes no further trace of nitrobenzol. I repeated, with the acetylene thus purified, the synthesis of benzol; it succeeded exactly as before.

The result of these facts is that benzol is triacetylene. It may be obtained by the direct condensation of acetylene. Now, I have prepared acetylene by the direct combination of carbon and hydrogen; the synthesis of benzol from its elements results thus from two experiments, connected by reasoning one with the other. To fully demonstrate this synthesis, I have endeavoured to establish a connexion between the two experiments. To this end, I prepared some acetylene by the direct combination of pure carbon and hydrogen; I collected it in the form of acetylide of copper, restored it to the free state, and submitted it to the action of heat. It behaved exactly like the acetylene of the preceding experiments, and furnished benzol, which I submitted to the same tests. It will be seen that in this experiment I realised, on the elements themselves, the two successive transformations which produce, the first, acetylene

$$4C + 2H = C_4H_2;$$

the second, benzol

$$3C_4H_2 = C_{12}H_6.$$

The synthesis of benzol from its elements is thus demonstrated by the most simple and direct experiments.

Acetylene is then the generator of benzol—that is to say, of the fundamental centre of the aromatic series; it is, moreover, the generator of ethylene—that is to say, of one of the fundamental centres of the fatty series, this being the extent of its chemical relations.

I will now say a few words on the theory of the transformation of acetylene into benzol or triacetylene. The only carbides capable of producing polymeres[§] are the incomplete carbides, or those capable of uniting, by the addition of hydrogen, with bromine, or hydracides. Acetylene fulfils this condition. It is thus able to fix a gaseous volume equal to its own or double its own volume—

$$\begin{array}{lll} C_4H_2 \,. & .\, C_4H_2(H_2) \,. & .\, C_4H_2(H_2)(H_2) \\ & \;\; C_4H_2(HI) \,. & .\, C_4H_2(HI)(HI) \end{array}$$

In the latter case the compounds formed offer the characteristics of saturated bodies—that is to say, incapable of uniting by addition of other bodies. Now benzol is obtained by the addition to a molecule of acetylene of two other molecules occupying the same volume; it in certain respects resembles hydride of ethylene—

$$\begin{array}{ll} \text{Hydride of ethylene} \quad . & C_4H_2(H_2)(H_2) \\ \text{Benzol} \; . \quad . \quad . \quad . & C_4H_2(C_4H_2)(C_4H_2) \end{array}$$

the first generating molecule being equally saturated in the two compounds.

It is probable that the condensation of acetylene into benzol may be accompanied by disengagement of heat, all polymeric condensations being true combinations.[||] This disengagement may be so much the more considerable as the polymere may lose most of the properties of incomplete carbides, assuming those of saturated bodies.[¶] Direct experiment is not made under conditions which would allow the verification of this conjecture; but it agrees with inductions I made relative to the thermochemical formation of acetylene and benzol,[**] the first body being most likely formed originally from its elements with an absorption of about 40,000 atoms of heat, while the formation of benzol would take place with almost no disengagement of heat. There would then be a disengagement of 40,000 atoms of heat at the time of the metamorphosis of acetylene into benzol.

If acetylene be really formed with absorption of heat, this would sufficiently account for exceptional aptitude for entering into reaction possessed by this carbide, and the extraordinary plasticity of its molecule; for by reason of this characteristic acetylene ought to cause disengagement of heat—that is to say, to do positive work by reacting on most other substances, exactly as do usually the simple bodies themselves.

On Certain Catalytic Phenomena produced with Glycerine, by ANTONY GUYARD.

PURE glycerine, like most non-volatile organic substances, has on some mineral salts that peculiar but well-known influence which consists in concealing their ordinary chemical reactions with common reagents. Thus, if we mix glycerine and hydrochlorate of sesquioxide of chromium, and if we add to that mixture a little chloride of ammonium and ammonia in excess, the whole will form an emerald green solution, from which sesquioxide of chromium cannot be precipitated; as indeed would be the case with tartaric acid, for instance.

A similar phenomenon is produced with a copper salt, glycerine, and potash or soda, and with a few other metallic salts, either with glycerine and ammonia or with glycerine and potash or soda.

In some cases glycerine and alkalies have no action whatever on metallic salts: sesquioxides of uranium and bismuth remain undissolved in a mixture of glycerine and ammonia, and protoxides of manganese and baryta are precipitated by potash or soda, even in presence of a large excess of glycerine.

Other oxides—those of nickel and cobalt, for instance—are very indifferently affected by glycerine; if this substance is in a large excess, and if potash or soda is added, the whole will form an apparent solution, from which the largest portion of the oxide is precipitated simply by destroying the viscosity of glycerine, even partially, either by warming it or by adding a little excess of water. The other portion of the oxide remains in solution, which acquires various tinges, according to its state of concentration and its temperature. With cobalt, for instance, the colour may be either a splendid blue or a greyish tinge.

With certain metallic salts the deportment of glycerine is extremely remarkable, and constitutes the phenomenon to which I want to call the attention of chemists.

If a large excess of glycerine is mixed with solutions of double sulphate of potash and titanic acid, or with sulphate of alumina, sesquichloride of iron, nitrate of lead, and protochloride of tin; and if ammonia is added, all those oxides will be kept in solution, and will not be precipitated, either by addition of an excess of water or by warming. But if each of these solutions is saturated by hydrochloric acid or by sulphuric acid in sufficient quantity to saturate not only the ammonia present but also the glycerine; though these acids have no rapid chemical action on glycerine, if we realkalify them immediately by an excess of ammonia, the different oxides will be precipitated in presence of the same quantity of glycerine which previously held them in

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[§] See my "*Leçon sur l'Isomérie,*" read before the Chemical Society of Paris.

[||] See my "*Researches on the Amount of Heat disengaged in the Formation of Organic Compounds*" (*Annales de Chimie et de Physique*, vi., 350, and "*Leçon sur l'Isomérie,*" p. 33).

[¶] Same *Researches*, p. 355, and "*Leçon sur l'Isomérie,*" p. 123.

[**] Same *Researches*, pp. 386-388.

solution, as if ammonia had simply been added to their respective solutions.

At first this seems strange, for the solutions prepared as aforesaid can be mixed with large excesses of chloride of ammonium already dissolved, and can be warmed and even boiled without showing the slightest trace of precipitation.

A similar and corresponding phenomenon takes place between sesquioxides of uranium and iron, protoxide of iron, oxides of nickel and cobalt, with glycerine and potash or soda. Solutions of a deep colour—yellow for uranium, dark brown for sesquioxide of iron, green for protoxide of iron, blue for cobalt, green for nickel, are obtained; some of which—namely, those of sesquioxide of iron and uranium—can be diluted with excess of water and warmed, and still maintain their oxide in a perfectly soluble state.

If taken as they are obtained at first; if an excess of hydrochloric or sulphuric acid is added, as formerly said, in sufficient quantity to saturate alkali and glycerine; and if immediately afterwards the whole is resaturated by potash or soda, the different oxides will be precipitated as completely as if the alkali had simply been added to their respective solutions.

The key of the phenomenon is here easily found, for if in the alkalino-glycerine solutions mentioned above we add excess, variable for each of them, of chloride of sodium or potassium, the different oxides will be thrown down even in cold solutions. Sesquioxide of chromium itself, which, if the experiment is done in the ordinary manner, seems always soluble, is precipitated from its alkalino-glycerine solution by a very large excess of chloride of sodium.

Evidently, then, these chlorides destroy the viscosity of glycerine and render it fluid, and one of the antagonistic forces being thus destroyed, the oxides obey the other and are precipitated.

In the case of ammonio-glycerine solutions, a similar explanation is true; only chloride of ammonium does not act so energetically. An ammonio-glycerine solution—that of sesquioxide of iron, for instance—can be warmed and boiled with very large excesses of chloride of ammonium without showing any precipitation; but if we aid the fluidifying effect of the salt by adding a large excess of water, sesquioxide of iron is immediately precipitated.

Some interesting phenomena are also produced with certain oxides. Thus from an ammonio-glycerine solution of sulphate of potash and titanic acid, titanic acid cannot be precipitated even if the solution is mixed with a large excess of water and of chloride of ammonium, and boiled; but if a few drops of sulphuric acid are added, the solution remaining strongly ammoniacal, an abundant precipitate of titanic acid is instantly formed.

Alumina presents also an interesting property. If an ammonio-glycerine, or a potash or soda-glycerine solution of alumina, is saturated with an acid, and precipitated by ammonia, alumina, instead of being precipitated in its gelatinous form, will affect the shape of dense flakes, which collect rapidly at the bottom of the flask, and which, if filtered, can be washed with the utmost facility.

This singular property will be found extremely useful in the preparation of hydrated alumina, and the process can be slightly modified for this special purpose in the following manner:—To the solution of the alumina salt, supposed to be pure, an excess of an acid and of glycerine is added; the whole is warmed and then precipitated by ammonia.

At first sight it appears as if the reaction I have enumerated, combined with the well-known action of alkalies on metallic salts, might be usefully employed in quantitative analysis. Unhappily it is not so. I met with practical difficulties, and even impossibilities, at every attempt I made. I will give an example. Let us take a most simple separation—that of alumina and oxide of iron.

Both are soluble in ammonio-glycerine, and in potash or soda-glycerine. Nothing seems more simple than to precipitate iron by a soluble sulphide, filter, and precipitate alumina. Practically we find this—sesquioxide of iron is very soluble in ammonio-glycerine, but alumina, on the contrary, requires an enormous quantity of glycerine to be kept in solution, and the quantity of water we must add to render it manageable is so large, the filtration would be so long, and the quantity of reagents we should have to add to it ultimately would be so great, that it is practically impossible to use it.

If we use potash and soda-glycerine, we find that both oxides are very soluble in moderate quantities of it, that a moderate quantity of water is sufficient for an easy filtration; but if we use sulphide of ammonium, we precipitate not only iron, but the whole of the alumina. If, on the contrary, we use sulphide of sodium, both alumina and iron remain in solution of a very deep green colour, and we may add enormous quantities of water and boil it for a long time without precipitating a trace of iron. We might indeed obtain a perfect saponation by this process if instead of water we were to use methylated spirit or alcohol, for in this case iron is completely precipitated in the state of sulphide, and alumina remains in solution, but the quantity of spirits is too large then to be thought of. We obtain a very interesting catalytic phenomenon, but one unhappily useless.

New Reactions of the Oxide of Tungsten, *by* WILLIAM SKEY, *Analyst to the Geological Survey, New Zealand.*

Effects of the Sudden Refrigeration of Tungstic Acid.—If tungstic acid is made red-hot, and then brought in contact with a cold surface, it assumes a black colour, which is permanent in the air.

The change in colour here produced appears to be due to the presence of the oxide of tungsten. The effect of a sudden refrigeration of tungstic acid, therefore, is to deoxidise it.

If the hot acid is dropped into kerosene oil, the same effects follow. The oil, however, may have a reducing power of its own upon tungstic acid at high temperatures; but if dropped into water the tungstic acid sustains no change, the colour of the cooled mass being the same as if it had been cooled slowly in the air. It would seem, therefore, that secondary reactions have obtained in this case, owing to the affinities of the oxygen of the water for the lower oxides of tungsten at elevated temperatures, by which the effects of sudden refrigeration are destroyed.

Solubility of the Blue Oxide of Tungsten in Organic Acids.—If acetic or tartaric acid is added to a hot solution of a salt of tungsten, the blue oxide of tungsten resulting from the deoxidising of the acid by zinc or by the electric current is entirely prevented from precipitating itself, and the solution is coloured thereby of an intensely blue colour.

Solubility of the Binoxide of Tungsten in Concentrated Hydrochloric Acid.—If a perfectly dry salt of tungstic acid is added to concentrated hydrochloric acid, a portion of the acid is gradually dissolved, and by the application of zinc the usual phenomena of deoxidisation are manifested; but if every precaution is taken to avoid a rise of temperature, if the zinc is added in small quantities, and the vessel in which the operations are going on surrounded with water, the blue colour will be observed to change to a magnificent purple and then to pink; and by still further continuing the deoxidising process, or by adding a drop of water to the pink solution, its colour is changed to a clear ruby red.

It is necessary to thoroughly dry the vessel to be used before commencement.

TECHNICAL CHEMISTRY.

On the Presence of Propionic and Butyric Acids among the Products of the Destructive Distillation of Wood, by THOMAS ANDERSON, *M.D., F.R.S.E., Professor of Chemistry in the University of Glasgow.*

IN the manufacture of sodic acetate from crude pyroligneous acid, a mother liquor is obtained, which, even when highly concentrated, refuses to yield a further crop of crystals. On the addition of sulphuric acid, however, it is found still to contain abundance of acetic acid, having a peculiar rancid smell, which led me to suspect the presence of some of its homologues.

In order to ascertain whether this was the case, a considerable quantity of the mother liquor in question was supersaturated with sulphuric acid and allowed to stand. The crystals of sodic sulphate which deposited having been separated, the fluid was cautiously distilled on a sand-bath, care being taken to stop the process as soon as the slightest trace of sulphurous acid was observed. The distillate was saturated with sodic carbonate, and on evaporation yielded an abundant crop of crystals of sodic acetate. These having been separated, the mother liquor was again concentrated, and this was repeated as long as crystals were obtained. A thick oily fluid was left, to which concentrated sulphuric acid was added in large excess, and the layer which rose to the surface was separated and distilled.

The greater part of it passed over between 117° and 120° C., and obviously consisted of pure acetic acid; but after it had distilled the thermometer gradually rose, and small fractions were collected until it reached 200°, at which point only a small quantity of fluid remained in the retort.

The fraction distilling between 138° and 143° was converted into a silver salt, which was found to contain a quantity of silver intermediate between that of the argentic acetate and propionate. The next higher fraction boiling between 143° and 148° was rectified in a small tube retort, and the latter portion of the distillate having been converted into a sodium salt was fractionally precipitated in three portions with silver nitrate. The last of these was found to contain 59·80 per cent. of silver, and the calculated quantity for argentic propionate is 59·66.

The fraction boiling between 158° and 163° having been treated in a similar manner gave a silver salt which contained 55·10 per cent. of silver, and which was the argentic butyrate, the calculated result for which is 55·30. The acid collected at this temperature had all the characters of butyric acid. It floated on the surface of a small quantity of water, and dissolved in a larger quantity, and its smell was perfectly characteristic.

The acid obtained at a higher temperature had the smell and properties of valerianic acid, but as its quantity was very small, and it was contaminated with a little sulphurous acid, I did not attempt to prepare a silver salt.

I am not aware that these acids have been before observed in crude pyroligneous acid. Their presence in it is not without interest, and is an additional illustration of the frequent occurrence of homologous compounds among the products of destructive distillation.

PHARMACY, TOXICOLOGY, &c.

On the Igniting Point of Petroleum,* by JOHN ATTFIELD, *Ph.D., F.C.S., Director of the Laboratory of the Pharmaceutical Society of Great Britain.*

CRUDE petroleum generally gives off, at common temperatures, quite enough vapour to form an explosive mixture with the air if it be in a confined space, as in a partially empty lamp, bottle, or cask. For this, among other reasons, crude petroleum is always refined before it is sold to the general public; it is distilled, and the portion which first rises into vapour is collected apart, and, under the name of petroleum-spirit, used as a substitute for turpentine. The next and larger portion which distils is the refined petroleum, so extensively sold under various names as a cheap illuminating oil. The residue is heavy oil used for lubricating purposes.

As petroleum is not a definite chemical compound, but a varying mixture of several hydrocarbons; as, in short, it has no constant chemical or physical property of which advantage might be taken in devising a ready method of taking igniting points, it follows that the method selected must be more or less arbitrary, empirical, conventional. The only feasible plan would seem to be, to select a direct method, simple in principle, easy of execution, occupying little time in performance, and inexpensive; and when this is found, to take steps for accomplishing a far more difficult task—namely, securing its universal adoption. Now the ignition method is sufficiently simple in principle; but I would advise the rejection of its application in an open dish, saucer, basin, or bowl. Even if this experiment could be always similarly performed under constant conditions, which is impossible, the rapidity with which vapour escapes from the surface of the liquid renders a thermometric reading, taken during the experiment, an unfair indication of the temperature at which inflammable vapour would be given off from the petroleum in a lamp or other closed or partially closed vessel. Again, the petroleum must not be heated in a common bottle, on account of the great liability of the latter to fracture; nor is it necessary to use a vessel contrived for violently agitating the oil and air together. But if the bottle be substituted by a short wide tube of glass, thin, so that it can be heated with safety—by, in short, a rather wide variety of the common test-tube of our analytical laboratories—then, if equal quantities of petroleum be operated on, the liquid be fairly well stirred and shaken, and the test-flame be always introduced to the same distance from the surface of the liquid, constant results may be expected. The same tube may be used in which to insert a hydrometer to take the specific gravity of the oil, and thus, with a naked thermometer somewhat longer than the test tube to act also as a stirring-rod, we have a compact and inexpensive apparatus. Half-way up the test-tube should be a mark indicating the

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* Abstract of paper read before the Pharmaceutical Society, November 7, 1866.

amount of petroleum to be operated on. The test-flame should be introduced to within half an inch of the surface of the oil.

Into the test-tube of thin glass 6 or 6½ inches long, and 1⅛ inch in diameter, pour the liquid until the tube is half full. Stir the liquid well with a naked thermometer, having the usual degrees marked on the stem, shaking also so as to keep the upper part of the tube well wetted with the liquid, and note the temperature. Now introduce a flame (of a thin splint of wood, or, far better, a small gas flame a quarter or an eighth of an inch long) into the mouth of the tube to within half an inch of the surface of the liquid, quickly withdrawing it, and noticing whether a thin blue flame runs between the test flame and the surface of the oil. If not, warm the tube by passing the bottom of it gently through a spirit lamp, or other flame, or by dipping the lower portion of the tube into hot water, constantly stirring the liquid with the thermometer, frequently noting the temperature, and introducing the test-flame every minute or so. The temperature at which the thin blue flame appears will be the igniting point of the petroleum, the point at which it gives off inflammable vapour. To correct this result, let the tube gradually cool, introducing the test-flame as before. The lowest temperature at which the vapour takes fire is the true igniting-point.

REPORT ON THE

CHEMICAL LABORATORIES

IN COURSE OF ERECTION IN THE

UNIVERSITIES OF BONN AND BERLIN.

THE CHEMICAL LABORATORIES OF THE RHENISH FREDERICK WILLIAM UNIVERSITY OF BONN.

(Continued from page 246.)

EXTERNAL ARCHITECTURE OF THE BUILDING.

THE external aspect of the new laboratories is in perfect keeping with the scale of grandeur of the ground plan.

The street front, shown in Fig. 9, is 180 feet long, and consists of a long centre structure, two stories in height, with richly decorated windows and pillars, terminated by two end blocks of greater height, each containing a main entrance with an ornamented balcony above. The impressive dignity of this front may be realised on beholding even the rough brickwork walls already finished.

The side-front facing the city of Bonn (Fig. 10), with the main entrance for students, has a depth of 250 feet, and consists of two parts, separated from each other by the carriageway leading to the courts. One of these parts is the north-east corner of the front block; the other, perfectly symmetrical in itself, has for its centre the main vestibule with its richly decorated entrance and classically ornamented roof, rising considerably above, and projecting prominently from, the remainder of this façade. On either side of this vestibule branch forth two long wings which, though only one story high, are, nevertheless, of considerable altitude, being relieved, moreover, at the two corners, by slightly projecting portions of somewhat greater height, and marked by the more elaborate architecture of the windows. The impression made on the spectator by this front is exceedingly pleasing, and if the building be viewed from a point where the two façades can be seen (and such from the position of the building will generally be the case), it will be evident how happily the architect has accomplished the difficult task of producing a building, the individual parts of which, though unlike in form, in consequence of the diversity of the objects for which they are destined, are yet so harmoniously blended with one another as not to impair its unity as a work of art.

The two other fronts, of which drawings are not given here, have the same character as that facing the city of Bonn, as may readily be perceived by looking at the ground plan of the building.

The portions of the edifice facing the courts have been disposed and ornamented in a similar manner. A very pleasing effect is here produced by the unequal height of the several parts of the building which separates the front courts. The section along the line C D of the ground plan, which is given in Fig. 6, shows those parts of the court fronts which are not mere reproductions of the exterior façades.

The inner and outer facades are coated with stucco, whilst the principal architectural mouldings are in stone. The entire building will have an uniform tint of colour; only the striæ of the walls of the ground floor will be thrown more prominently into relief by a slight admixture of graphite to the stucco.

INTERNAL ARCHITECTURE OF THE BUILDING.

The architectural ornamentation with which it is intended to decorate the interior of the institution will not be less rich than that of the exterior. The principal vestibule, a hall of considerable dimensions, is, as already mentioned, lighted by a band of highly elevated windows running round the four sides of the building immediately underneath the roof. The ceiling is divided into ornamental squares, and the walls are enlivened by projecting pillars bearing caryatides, and a rich door architecture which frames the entrance to the corridor. The corridor is divided by pillars and cross-beams into quadrangular sections. The staircase leading to the lecture theatre is a handsomely decorated hall, lighted from above, and communicating with the corridor by three arches resting on two massive columns (see Figs. 5 and 7.)

The lecture theatre, as has been previously remarked, receives its light from both sides through a range of windows, which are separated from one another by columnar pillars. In accordance with this architecture the walls and ceiling are decorated in stucco and colour.

The three laboratories, notwithstanding their necessarily simpler ornamentation, will not fail to make a favourable impression by their liberal proportions, and by the profusion of light which they receive. The walls are enlivened by the numerous windows, and by the tastefully ornamented evaporation niches projecting from the pillars between the windows (see Figs. 5 and 8); nor must the elegant and in all respects suitable fittings remain unmentioned.

The rooms adjoining the laboratories, the small lecture theatre, and the museums, are likewise appropriately decorated by stucco cornices and colouring.

And, lastly, the director's spacious residence is as richly as tastefully ornamented, and will in all respects be worthy of the institution to which it belongs. The Reporter must not enter into details upon this subject, but he cannot leave unnoticed the imposing entrance hall, illuminated by a glass cupola above, and the splendid ball-room, extending through two stories, and amply satisfying the social requirements of a chemical professor of the second half of the nineteenth century.

The author of the preceding sketch has purposely refrained from giving a description of the internal arrangements of the new building. In drawing up the plans of the institution all the interior requirements were of course carefully considered. Especial attention was bestowed on the laying out of a simple and readily accessible system of mains for the convenient supply of water, steam, gas, and sulphuretted hydrogen; on the speedy and safe removal of all by-products, whether solid, liquid, or gaseous, that is to say, on the means of easily and thoroughly cleansing the various departments, on the channels for conducting away waste water, on the flues of every possible kind, for ventilation and carrying off injurious fumes;

and, lastly, on the construction of appropriate niches for evaporation, combustion, and spectrum analysis. All these arrangements are at the present moment only in the first stage of development, and may probably during their execution undergo more or less modification. For this reason the Reporter has preferred to confine himself in this place to a general sketch of the splendid institution which, he believes, will be an ornament to the Rhenish University. A discussion on the interior arrangements is appropriately reserved for a special Report, which cannot be drawn up before they are completed and rigorously tested.

FIG. 9.

MAIN FAÇADE OF THE NEW LABORATORIES.

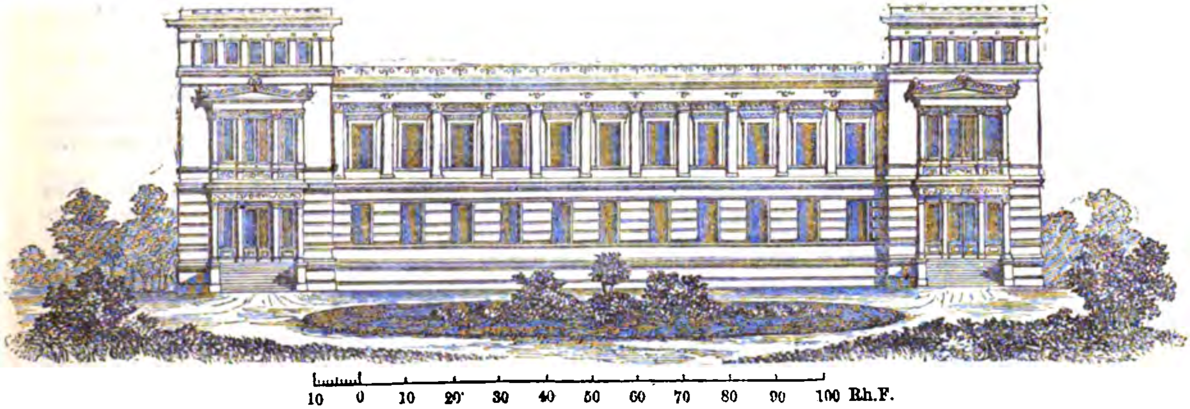
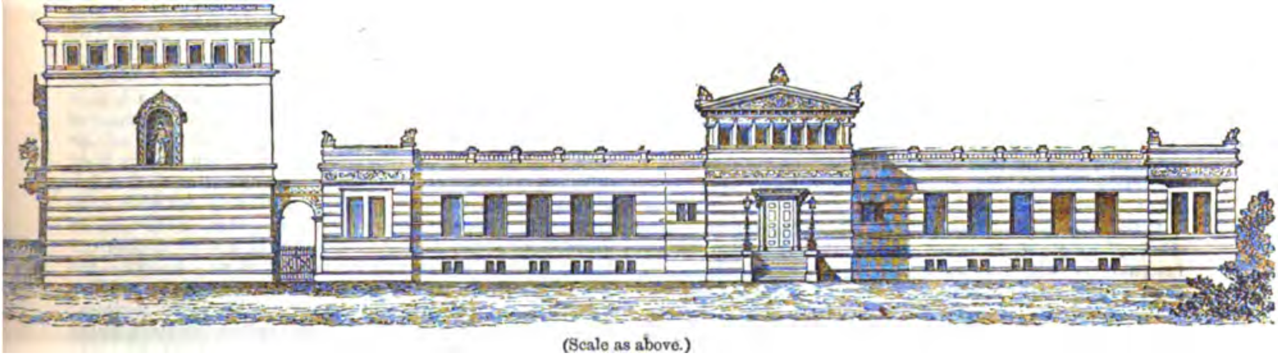


FIG. 10.

SIDE FAÇADE OF THE NEW LABORATORIES.



(Scale as above.)

(To be continued.)

PROCEEDINGS OF SOCIETIES.

QUEKETT MICROSCOPICAL CLUB.

THE monthly meeting was held at University College on the 23rd inst.; Ernest Hart, Esq., President, in the chair.

Mr. M. C. **COOKE** read a short paper "*On the Best Method of Transmitting Slides by Post.*"

Mr. S. J. **MCINTIRE** read a paper "*On the Different Kinds of Poduræ,*" in which he described their history and habits, how to mount and examine their scales, and his experience in breeding them for microscopical investigation.

Mr. N. E. **GREEN** read a paper "*On Melicerta,*" being the result of long and careful inquiry into the habits and structure of this minute form of animal life, under high powers and in thin glass cells especially constructed for the purpose.

Nineteen members were elected, and the proceedings terminated with a *conversazione.*

ACADEMY OF SCIENCES.

November 19.

"*On the Shooting Stars of November* 14," by M. Faye. This is a somewhat long account of the observations made by the author on the occasion of the recent meteoric shower. He proposes to give to such observations a character of accuracy which they had not hitherto possessed, by observing with an astronomical instrument, not the shooting stars themselves, but the position of the two extremities of the trajectory which the persistent trains of the largest stars leave on the sky. Two observers and telescopes are required; one to fix the position of each extremity. We do not glean from the paper that M. Faye put this idea into practice. The author points out some facts he has noticed in connexion with periodical meteors: one is, that the planes passing the tangent to the terrestrial orbit, and the points of divergence of the periodical meteors of April 20, August 10, and November 13, are all very nearly perpendicular to the ecliptic. And the same for the meteors of January 2 and 3, whose periodicity has been suspected. But the corresponding planes for the meteors of April 10, October 19, and December 12 are all situated nearly on the ecliptic. It results from this that the meteoric rings of April, August, and November, of which the periodicity cannot be denied, are almost circular, like the terrestrial orbit, or at least that their major axis is very close to the line of nodes—a circumstance which is remarked in many periodical comets. As to the second group, whose annular existence is doubtful, it presents one of the characters proper to sporadic stars. At the conclusion of this paper M. Morin drew attention to a graphic method of determining approximately the geometric form of the trajectories, and even the law of the movement of the luminous projectiles.

"*The Decomposition of Carbonic Acid by Leaves is not in Direct Relation with the Stomata,*" by M. P. Duchartre.

"*On the Electric Currents of the Earth,*" by M. C. Matteucci.

"*On a Fact in Experimental Therapeutics,*" by M. P. Lorain. The author gives a detailed account of a cure which he effected on a cholera patient, so far gone that death seemed imminent, by injecting warm water into his veins. The utterly hopeless state of the patient, who, before the operation, could scarcely be distinguished from a corpse; the ease with which it was performed; the marvellous rapidity with which the worst symptoms were alleviated; and the permanence of the cure; would inspire us with great hopes, were it not that the same plan has been tried with repeated failures in England.

"*On the Shooting Stars of November 13 and 14, 1866,*" by M. Coulvier Gravier. The author gives a curve in which the proportion of shooting stars occurring at this time of the year is graphically shown from 1830 to 1866. From this the author concludes that the recent display falls very far short of what was seen in 1833, but he predicts that next year the phenomena will be very much more brilliant, as predicted by Olbers. Unfortunately it will be full moon on the corresponding night next year.

"*Observations made at Metz on the Shooting Stars of November,*" by M. C. M. Goulier. These observations presented nothing very striking.

"*On a Meteor seen at Dijon, November 21, 1866,*" by M. A. Perrey.

"*On some New Instruments for observing the Organs of Vision,*" by M. R. Houdin. The author describes several instruments, which he calls respectively the pupilloscope, the pupillometer, the retinoscope, and the diopsimeter.

"*Remarks on the New Electric Machine, or Continuous Electrophorus recently described by M. Bertsch,*" by M. de Parville.

"*On the Disengagement of Gases from their Supersaturated Solutions,*" by M. de Gernez. It is known that solid particles in a supersaturated aqueous solution of a gas (soda-water) cause the disengagement of small bubbles. The author has investigated the subject, and has discovered the following facts:—1st. The solid bodies from which the gaseous bubbles are disengaged lose their property after a certain time; 2nd. Prolonged soaking in water also removes this action from them; 3rd. Heat has the same action; 4th. Solid bodies which have not been in contact with air have no action on supersaturated gaseous solutions; 5th. Air and gases provoke the disengagement of dissolved gas. Under each of these heads many experiments are given to prove their correctness. The reading of this paper was followed by a discussion, in which M. Chevreul and M. H. Sainte-Claire Deville took part.

"*Researches on Cyanic Ethers,*" by M. H. Gal. The action of hydrochloric acid on cyanic ether results in the simple union of the two bodies, forming

$$C_4H_5O,C_2NO,HCl.$$

This is liquid at the ordinary temperature, colourless, and of a pungent odour. In a small quantity of water it decomposes with evolution of carbonic acid and production of hydrochlorate of ethylamine. The same reaction takes place with hydrobromic acid. The author has also tried the action of the hydracids on M. Cloëz' isomeric cyanic ether obtained by the action of chloride of cyanogen on ethylate of soda; this is non-volatile and insoluble in water, and is totally different from M. Wurtz's cyanic ether. Under the influence of hydrochloric acid, this ether furnishes chloride of ethyl and cyanuric acid. Hydrobromic acid produces a similar decomposition.

NOTICES OF BOOKS.

CHOLERA AND ANTISEPTICS, 1866.

(A) *The Arrest and Prevention of Cholera; being a Guide to the Antiseptic Treatment.* By A. E. Sansom, M.B. Lond. London: Churchill.

(B) *Asiatic Cholera.* By F. A. Burrall, M.D. New York: Wm. Wood and Co. London: Stevens Bros., Covent Garden.

(C) *Reprint from the Appendix to the Third Report of the Cattle Plague Commission.* By Wm. Crookes, F.R.S. London: J. H. Dutton, 1, Wine Office Court, Fleet Street.

(D) *Tenth Annual Report of the Medical Officer of Health for the Holborn District Board of Works, London.*

(E) *Handbills relating to Precautions to be taken against the Cholera.* Various.

The first book of the above list is a summary of the knowledge gained almost exclusively from the late epidemic, and serves to show the steps that have been taken in advance. The whole matter of the volume is of value, and anybody may learn much from it. Dr. Sansom says in the preface that "he hopes that any educated person may be able *thoroughly* to understand the main arguments brought forward," but in justice to him we must say, that a higher knowledge than that of an educated person, in the received sense of the phrase, is required to appreciate many of his views. Much of the matter of the book we must, from want of space, pass over, but would direct attention to the following view of contagion:—The difference between contagion and infection is *practically* of value, although, on theoretical grounds, the distinction is not so apparent.[*] Thus, three diseases may be taken, all well known—the itch (Type I.), hydrophobia (Type II.), cholera (Type III.). Type I. is a parasitic disease; Type II. is contagious; Type III. is infectious and also contagious-infective, being transmissible by air or water. Our author justly remarks that "a disease may be both contagious and infectious, and altogether we get into a considerable amount of confusion." The remedy proposed is to restrict the term contagious to diseases that have been more accurately called parasitic. But what becomes of Type II.?—we must by this rule call hydrophobia an infectious disease, which disease infects the blood, but is not known to infect by air or water transmittance. The Registrar-General places hydrophobia with glanders and syphilis in Order II. (enthetic diseases) of the zymotic class, thus keeping in view the general broad relations of all contagious and infectious diseases. If we find a disease to be both infectious and contagious, the confusion is not of our, but of nature's making. By taking another standard, we find contagion standing out in still bolder relief from the other two classes—for the poison of parasitic and infectious diseases is organised, that of contagious disease not necessarily so (as generally now admitted). Again, many authors who admit the *de novo* generation of enthetic poison deny a similar generation for organised zymotic virus.

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[*] The usual distinction recognised should be shown clearly for a comprehension of the views of those who use the two expressions as meaning different things. (See note, Cattle Plague Appendix, Reprint, p. 7.)

Dr. Sansom justly lays much stress upon want of good food as a predisposing cause to cholera. We are inclined to place it at the head of the list, and two great facts of the year have not been properly insisted upon in connexion with the late cholera outbreak—we allude to the cattle plague with the consequent rise in the price of meat, and to the monetary crisis with consequent loss of employment; these causes chiefly affected the low Irish population, so many of whom died of cholera, and among whom, on the approach of the harvest and hop-picking season, the mortality was greatly lessened. Of course, they were thus removed from cholera influence, but they probably carried germs of disease with them, with at the same time a greater resisting power.

A Rabbi has attributed the remarkable freedom of the Jews from cholera almost wholly to the goodness of their meat, which by their religion must be wholesome and fresh. Mr. Sala, the popular author, attributes this freedom to quite another cause. "The Jews are great pickle-eaters, and it is very curious that this taste and their well-known penchant for smoking tobacco appear to have operated in a great measure among them as specifics against the frightful scourge of cholera, from which the Jews have hitherto been almost totally exempt." The cholera returns showed conclusively, by the high rate of mortality on Mondays as compared with other days of the week, the effects of alcohol on cholera. In Chapter III. we find a well-deserved tribute to the value of the labours of Dr. Stallard upon the subject of London pauperism—these essays have already an historical value.

Some of the most obvious social evils bearing upon cholera are also discussed, and remedies are proposed. It is remarked that "the low lodging-houses in poor localities contribute largely to the evil of overcrowding." This may be true in one sense, but it should be remembered that these houses are registered and under the surveillance of the police; and this surely is better than nothing at all, for in this case a penalty may easily be incurred, and the licence suspended. Dr. Liddle, the Medical Officer of Health for Whitechapel (who has laboured upon sanitary matters in that district for nearly thirty years, and who is second to none in experience of these matters), has frequently urged upon the Home Secretary the registration of all lodging-letting as the only remedy for overcrowding. In the East of London also a great many families are housed rent free on property belonging to railway companies without windows, water, or closet supply. The neglect in such cases is very culpable, and attention has not been sufficiently drawn to the evil. Our author's remarks on the want of consideration on the part of employers are very well-timed. On the question of pollution of rivers Dr. Sansom observes:—"The time will come, I trust, when the authorities will *prevent the introduction into any river of sewage which has not been previously disinfected.*" And at page 66 we find—"The disinfection of the water of rivers is too herculean a task."

It is also truly observed that "the exact analysis of water should be left to the chemists, whose researches have led to the most valuable results, and who have no doubt been the means, though they have received small thanks for their labours, of saving many lives." It is most desirable "that it should be a universal custom to have a constant supply of a disinfectant to every water-closet and cabinet."

The Registrar-General, in his report for the week ending October 27, 1866, expresses himself strongly on the present state of ignorance as regards disinfectants:—

"The health officers of Bristol and Birkenhead, as well as of London, bear ample testimony to the utility of the disinfection of the cholera dejections by chemical agents. This can only be done effectively under medical supervision. It is a difficult chemical experiment to be performed by an unpractised operator. To place carbolic acid or chloride of zinc, or permanganate of potash, in the hands of people who have never seen these substances, know none of their properties, and have just been terrified by the sudden loss of a father, a mother, or a child, is to do nothing. The poor people cannot be expected to know how a house is to be disinfected, and still less to perform the operation."

Dr. Sansom then discusses in an impartial manner the value of disinfectants, showing clearly that what is wanted is an antiseptic agent, which should be gaseous—not be a mere deodoriser, or yet too much of an odoriser, on which account mainly chloride of lime is objected to; but it also should be noted that spasm of the glottis caused by chlorine may be dangerous if frequently repeated. Dr. Sansom records the following case to the point:—"A patient came to me the other day suffering from sickness and much irritation of the stomach, which she attributed, and I have no doubt rightly, to the excessive amount of chloride of lime which her landlord had caused to be distributed throughout the house."

Sulphurous acid gas is with justice highly spoken of as "an agent of extreme value," with the only objection of being irritant. A great use for it could be found in purifying clothes that are infected, avoiding bleaching, as the author points out—and this doubtless is the field for its future employment, for which purpose carbolic acid might be objected to—but for purifying rooms, &c., we should prefer the latter. Sulphurous acid is summed up as being a deodorant, deoxidiser, and antiseptic. But the preference is given to the tar acids over all others. Carbolic acid, the chief of these, is shown to stop the disease by arrest of fermentation. Carbolic acid is said to "have no chemical action on the bodies with which it comes in contact, nor does it prevent chemical change, but it casts a spell on organic matter, which prevents it from manifesting vital properties," and in support of its use the cattle plague researches are, and we may say have been from the commencement of the epidemic, fully recognised.

In a memorandum† of "a plan of united action in the case of an epidemic of cholera, drawn up by the metropolitan officers of health" this year, the following statements are met with:—"*For the air of the sick chamber*—Sprinkle the floor with chloride of lime;" "ventilating openings of sewers in the middle of the streets, to be protected by *charcoal* boxes;" "areas, yards, &c., &c., to be coated with quicklime and water." "*For the disinfection of the discharges from the body*, a solution of chloride of iron, or chloride of zinc (Sir W. Burnett's fluid), is the most powerful agent, and either should be used in the quantity of about a wineglassful on each occasion. But for the disinfection of the atmosphere of a room, chloride of lime is the best, in the proportion of a teacupful of chloride of lime to a gallon of water, kept in saucers or sprinkled over the room; or the same may be used as a wash to infected bedding and particular parts of the floor, &c. *Disinfection of Clothes.*—This is a most vital matter, not only as regards cholera, but scarlet fever, measles, small-pox, and typhus. No infected clothes ought to be washed at home, or in public or private laundries, *without* preliminary *disinfection*. The best disinfectant is dry heat, at 250° Fahrenheit, where it is possible, for woollen fabrics; linen should be boiled in water, or plunged into boiling water."

In this document it will be noticed that no mention whatever is made of our most valuable disinfectants—viz., carbolic acid and sulphurous acid—perhaps from previously conceived theoretical ideas, to which cause also may be referred the recommendation of charcoal boxes for drains. But as soon as there was an outbreak we find that the majority of Medical officers saw the practical superiority of the tar acids, in proof of which we may refer to their several handbills. Carbolic acid and McDougall's powder are thus specially marked out

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† Printed at *Marylebone Mercury* office, North Street, Manchester Square.

by the Medical officers for the parish of St. Mary, Islington. Dr. Gibbon publishes a separate handbill for "the use of carbolic acid and powder" in the Holborn district. Sulphate of iron with carbolic acid are solely recommended for "privies and water-closets" at St. Giles's. Mr. Lionel J. Beale especially recommends carbolic acid for the disinfection of excreta, water-closets, and clothes. In the district of St. Mary, Newington, also, carbolic acid is specially commended for arresting the spread of cholera. This seems sufficient evidence in favour of a new disinfectant, and we rarely meet with such unanimity in favour of an expensive agent or one *theoretically* useful only. But perhaps the most extensive use for carbolic acid has been found in the purification of streets and sewers. Besides its use in London, we learn that it has been used with good effect at many other places. Thus, at Oxford, some drains and sewers were disinfected by means of carbolic acid during last autumn, and the characteristic flavour of carbolic acid was soon afterwards detected in the drinking water, to the great indignation of some householders, who doubtless would have preferred the sewage (if undetected) to the flavour of carbolic acid (so easily detected).

That ozone has no effect on the presence or absence of cholera has been shown by Schultze, Voltolini, Du Methe, Lamont, &c.,‡ but a contrary view is held by some, who think that there is a minimum of it in the atmosphere during cholera epidemics. As regards the charcoal boxes recommended for drains, we learn that charcoal does not seem to disinfect or destroy the cholera poison. The ships which were employed in transporting charcoal from Constantinople to the Crimea were ravaged by cholera.§

We shall conclude our notice of disinfection by enumerating other chemical agents recommended and used in cholera epidemics, and then discuss the later view of the nature of cholera and the rational bearings of the chemical treatment of it.

(To be continued.)

An Elementary Treatise on Heat. By Balfour Stewart, LL.D., F.R.S. Oxford: Clarendon Press. London: Macmillan and Co.

We welcome with pleasure a work on this subject, which has been so long wanted for the higher classes of schools and for students at college. Professor Balfour Stewart, as examiner at two of our modern universities where physical science is directly encouraged, has had ample opportunities of learning the wants of the students of the present day. It would be impertinent to speak of the character of the matter of a work written by so eminent an authority. We may remark that the book is concise, without losing in accuracy or being obscure. All subjects that could be included under the question of heat have been treated more or less fully, with the "latest intelligence" of matters discussed among physicists of the present day. We may cite as instances, remarks on "English and French Systems of Standards," "Anomalies of Crystallisation," "Atomic Heat," "Forms and Transmutations of Energy," and "Kinetic and Potential Energy." Of great interest is the discussion of perpetual motion and the connexion therewith of the questions of dissipation and conservation of energy. The author, too, seems to think that the question raised by Professor Jevons on the probable future exhaustion of our coal-fields is worthy of discussion, and certainly discourages the sanguine prophecy of Mr. Grove about finding a substitute for our present method of applying force. Throughout the work (as in the first book of this series), theories give way to facts, and the unknown is grouped markedly from the known. Methods of practical application of such groupings of facts are fully explained by general formulæ, and we regret that a series of problems that might be solved by the aid of these, has not been appended to each chapter, with answers. Students can hardly draw up such for themselves, and, as a matter of fact, do not take the trouble; hence their confusion when they meet with such problems for the first time in an examination paper. We hope that some appendix may be brought out to the volume to meet these wants. The necessarily restricted space of the author, has doubtless caused an omission of diagrams, when such could have been introduced with great advantage. With this work, Professor Miller's "Chemical Physics," Professor Tyndall's "Heat as a Mode of Motion" (and we hope soon to add to these the volumes by Sir William Thompson and Professor Tait on "Natural Philosophy," promised for this series), the student of this year will have a better chance of doing credit to himself than formerly he possessed. Professor Stewart is indeed a friend in need to those who require a knowledge of physics, professionally or otherwise.

A Popular Description of the Small Induction Coil; with a Variety of very Beautiful and Instructive Experiments. By "J. Y. E." Sold at all opticians'.

This is a list of experiments to be performed with induction coils. These little instruments have now become so popular, and may be obtained at so low a price, that this short account of their use is sure to be largely appreciated. The battery recommended is the bichromate of potash or "bottle" battery, which has lately, to a great extent, superseded Grove's for all electrical operations in which considerable power is required for a short time. The description of the coil itself, though short, is clear and intelligible, and the experiments seem to be well selected, the most prominence being given to those with Geissler's tubes.

CONTEMPORARY SCIENTIFIC PRESS.

[Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted.]

Journal de Pharmacie et de Chimie. October.

"*On the Alteration which Tartar-emetic, Metallic Antimony, and its Principal Insoluble Preparations experience in the Animal Economy,*" by M. Bellini.—"*On Coca of Peru,*" by M. A. Fuentes.—"*On Emulsion of Coal-tar,*" by M. Jeannel.—"*Analysis of the Ash of Cress,*" by M. Chatin.—"*New Method of Determining the Amount of Mineral Substances Dissolved in Water,*" by MM. Boutron and F. Boudet.—"*Hygienic Precautions to be taken in Hospitals during Epidemics, and particularly during Cholera,*" extracted from the Report addressed to the Minister of the Interior.—"*Clinical Researches on Bromide of Potassium, and its Employment in the Treatment of Epilepsy,*" by Dr. Voisin.

Annales de Chimie et de Physique. November.

"*Fifth Memoir on the Mechanical Theory of Heat,*" by M. Athanase Dupré (experimental part in conjunction with M. Paul Dupré).

Bulletin de la Société d'Encouragement. No. 163. July.

"*Report on M. Deleuil's Air-pump,*" by H. Tresca.—"*Report on MM. H. Bouilhet and Christofle's Electrotype Processes,*" by Barreswil.—"*Report on M. E. Blot's Terra-cotta Statuettes,*" by A. Barre.—"*Report to the Central Agricultural Committee of Sologne on various Processes for the Preservation of Wine,*" by J. B. Dumas.—"*Report to the Emperor on the Prizes to be offered at the Paris International Exhibition of 1867.*"—"*On the Extraction of Beetroot-sugar by Freezing,*" by A. Reynoso.

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‡ See Burrall, p. 30.

§ *Loc. cit.*, p. 60.

NOTICES OF PATENTS.

No. 642. *A New or Improved Chemical Mixture to be used as a Disinfecting and Preserving Fluid for the Cure of Disease among Cattle, and for other purposes.* VICTOR LARNAUDES, Paris. March 3, 1866.

THIS "new or improved chemical mixture" is :—

Natural water	100 lbs.
Sulphate of zinc	26½ „
Sulphate of copper . . .	8 oz.

For the future, it appears, all persons who prepare disinfecting fluids must take care that they do not use the above ingredients, "in or about the proportions" which the inventor may consider to be covered by his patent. We are surprised no one has yet thought of securing a patent for a mixture of hot water, alcohol, and sugar, to be used as an internal antiseptic, "or for other purposes."

Blue and Purple Colours. GEORGE PHILLIPS, of Offord Road, Barnsbury. Dated March 10, 1866.

THE patentee takes rosaniline or any suitable salt of rosaniline, such as the hydrochlorate or acetate, and mixes it with the acetate or other suitable salt or oxide of the following substances, as lead, copper, zinc, silver, iron, cobalt, strontia, baryta, magnesia, lime, alumina, and to this he adds aniline, and when the whole is well mixed together, he adds acetic, benzoic, or other suitable organic acid, and heats the mass until the desired purple or blue colour is formed. Of the substances above named to be used for the production of colour he prefers lead and baryta, and of the acids to be employed acetic, and he gives the following as an instance of the way to proceed to produce the colours :—Take one part by weight of litharge or protoxide of lead, and two parts of aniline, and mix these well together, and then add sufficient acetic acid to form a thick pasty and nearly solid mass of the two salts formed. To this add one part by weight of rosaniline, or hydrochlorate or acetate of rosaniline, and heat the whole together up to a temperature from 340° to 370°, but not to exceed 400° F., when the colour will be produced. The time required to produce the colour will depend in some measure on the mass to be acted on, but with small quantities about one hour is sufficient, the blue requiring a somewhat longer time than the purple. To purify the mass for a pure blue, when lead is used, dissolve the mass in acetic acid, and dilute with water, and boil until all the lead and red and purple colour are dissolved out and the blue is precipitated. When baryta is used treat the mass with dilute hydrochloric acid, and boil the same until the baryta and red and purple colour are dissolved out, and the blue colour precipitated, which may then be collected, and will be fit for dyeing when dissolved in acetified methylated spirit or other suitable solvent.

The patentee says he is aware that aniline red dye and aniline have been heated together, without admixture of any other substance, to form purple and blue colour, as in Girard's Patent, but the quantity of purple and blue colour thus produced from the same weight of any kind of aniline red dye, say, the acetate and aniline, is very inferior in weight to that produced by the invention herein described, and the difference is so great that a properly conducted experiment with test tubes renders the fact palpable to the eye in a short time.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, F.C.S., PATENT AGENT, 54, Chancery Lane, W. C.

2558. D. H. Saul and H. P. Armstrong, Islington, Middlesex, "Improvements in means or in apparatus employed in carburetting gas."—Petition recorded Oct. 4, 1866.

2568. W. G. Valentin, Royal College of Chemistry, and G. H. Benson, Stalybridge, Cheshire, "Improvements in the manufacture of steel."—Oct. 5, 1866.

2686. C. A. Girard, Rue des Ecoles, Paris, "Improvements in the manufacture of blue colouring matter." Partly a communication from G. de Laire, Rue de Sèvres, Paris.—Oct. 17, 1866.

2698. W. Simpson, Ilford, Essex, "Improved machinery, apparatus, and processes for preparing and treating vegetable fibres to be used as 'half stuff' in the manufacture of paper, *papier mâché*, and such like materials."—Oct. 18, 1866.

2744. J. Watts, Birmingham, "Improvements in furnaces and fire-places, and in utilising the waste heat of the said furnaces and fire-places, and in utilising and obtaining motive power from the air supplied to furnaces and fire-places."—Oct. 24, 1866.

2791. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the iodide of ethyl, and of other organic iodides." A communication from J. A. Wanklyn, Thann, France.—October 29, 1866.

2641. W. Grüne, Berlin, Prussia, "Developing invisible photographs by the action of ammonia vapours evolved from tobacco, and improvements in cigar tubes or holders and tobacco pipes for holding the said photographs."—October 12, 1866.

2756. H Phillips, Clyst Honiton, Exeter, "Improvements in the preparation of deodorising materials and in the manufacture of gas."—October 25, 1866.

2768. W. Weldon, Highgate, Middlesex, "An improved method of decomposing chloride of sodium and other compounds by means of steam."—October 26, 1866.

2788. C. McBeath, Blackburn, Linlithgow, N.B., "Improvements in the treatment or distillation of shale, coal, and other bituminous substances, and in the means or apparatus employed therefor."—October 29, 1866.

2851. J. Roberts, Brixton, Surrey, "Improvements in the manufacture of artificial fuel."

2858. F. Claudet, Coleman Street, London, "Improvements in treating waste solutions obtained from burnt cupreous pyrites."—November 3, 1866.

2924. W. E. Newton, Chancery Lane, "Improvements in treating vegetable substances, chiefly applicable to the manufacture of paper pulp and fibres." A communication from B. C. Tilghman, Philadelphia, Penn., U.S.A.—November 9, 1866.

2948. G. Crawshay, Gateshead-on-Tyne, and J. Thomas, Newcastle-on-Tyne, "Improvements in refining pig or cast iron for puddling into wrought or malleable iron."—November 10, 1866.

INVENTION PROTECTED BY THE DEPOSIT OF A COMPLETE SPECIFICATION.

2926. H. A. Bonneville, Bayswater, Middlesex, "An improved manure obtained by an improved process of purifying foul waters." A communication from J. Houzeau and E. Devedeix, Boulevard Sébastopol, Paris. —Petition recorded, November 10, 1866.

NOTICES TO PROCEED.

1782. H. G. Fairburn, St. Luke's, Middlesex, "An improved process for forming and combining small coal or coal-dust into lumps, blocks, or otherwise, to be employed for the purposes of fuel."—Petition recorded July 5, 1866.

1789. J. A. Salmon, Liverpool, "Certain improvements in furnaces."—July 6, 1866.

1912. G. T. Bousfield, Brixton, Surrey, "Improvements in the manufacture of certain alkaloids derived from aniline and its homologues, and in their transformation into colouring matters suitable for dyeing and printing." A communication from A. Poirrier and C. Chappat, Rue d'Hauteville, Paris.—July 23, 1866.

1933. J. Livesey, Park Street, Westminster, "Improvements in refining cast iron." A communication from S. Blair, Pittsburg, Penn., U. S. A.—July 25, 1866.

2658. F. Meyer, and W. Wainwright, jun., Paradise Street, Lambeth, and T. P. Pascoe, Albany Road, Camberwell, "Improvements in the manufacture of candles, and in moulds employed in such manufacture."—October 13, 1866.

2759. G. T. Bousfield, Brixton, Surrey, "Improvements in the manufacture of gases for the purposes of producing heat and the application thereof to metallurgical operations." A communication from W. Elmer, M.D., New York, U. S. A.—October 25, 1866.

2810. G. T. Bousfield, Brixton, Surrey, "Improvements in treating sheet-iron plates for the purpose of preparing the same for being coated with zinc, for producing the so-called 'galvanised iron,' and also for manufacturing such plates in imitation of Russia iron." A communication from C. H. Perkins, Providence, Rhode Island, U. S. A. —October 30, 1866.

CORRESPONDENCE.

Identification of Strychnine.

To the Editor of the Chemical News.

Sir,—The following means of identifying strychnine may prove useful, under certain circumstances, as a corroboration of other tests; I do not think it has been previously noticed. In the examination of animal mixtures for strychnine, it is very difficult to separate that base from traces of organic matter; these may nearly always be recognised in the residue of evaporation from ether or alcohol by their smell, and appear—especially where the latter solvent is used—to interfere with the characteristic crystallisation of that base in tufts of needles, which we find replaced, either wholly or partially, by granules, which to the naked eye appear to be devoid of crystalline character, but, under the microscope, are seen to consist of short and generally very irregular prisms. If a drop of dilute sulphuric acid (one of strong acid to five of water) be now added, the fragments will in a few seconds be observed to swell, assuming at the same time a rounded appearance, and if examined after an hour will be seen to form the centres of tufts of acicular crystals, sometimes of great beauty and regularity, sometimes appearing more like a mass of radiating hairs, retaining the shape of the original crystal, but much increased in size. The fragment is wasted in the process, its residue often appearing as a nucleus for the stellar tuft. The drop of liquid at the same time becomes filled with well-defined stars, formed of radiating needles of smaller size and scattered amongst the greater tufts. If an acid stronger than that described above be used, solution ensues immediately without any of these phenomena. In crystallising pure strychnine from alcohol, especially where the original solution is weak, portions of the base will often take the irregular prismatic form above mentioned, appearing thus upon the sides of the vessel exposed during evaporation.

I am, &c. Thomas P. Blunt.

Manufacture of Iodine.

To the Editor of the Chemical News.

Sir,—I have been a subscriber to the Chemical News for many years. In No. 364 I read an inquiry for the names of manufacturers of iodine. Perhaps it may serve the purpose of your correspondent to know that in this city, where more than nine-tenths of all the iodine produced in Great Britain is manufactured, there are only four works—

	Annual produce.		
One producing about .	20	kegs of 112 lbs.	each
One " " :	100	"	"
One " " .	150	"	"
One (my own manufactory)	1000	"	"
In all	1270	"	"

Should this information be what your correspondent wants, he is welcome to use it. Yours, &c.

William Paterson.

Glasgow, November 26.

MISCELLANEOUS.

Chemical Society.—The next meeting of the Society will be held on Thursday evening, at 8 o'clock, when the following papers will be read:—"*On the Synthesis of Formic Acid,*" by Mr. E. T. Chapman; "*On the Alloys of Magnesium,*" by Mr. James Parkinson.

Disinfection.—Dr. Gibbon, Medical Officer of Health for the Holborn District, has reported to the local Board of Works that whenever a death or removal of a cholera case has occurred, he has instructed the inspector to retain the key of the sick chamber until every article of bedding and clothing has been plunged into a mixture of boiling water and carbolic acid, and he "considers this method of disinfection more effectual than the somewhat costly one recommended by the Order in Council of burning every article. In order to burn you must generally remove the article, and every removal is attended with more or less risk of spreading the disease."

ANSWERS TO CORRESPONDENTS.

General Index to the First Fourteen Volumes of the Chemical News.—We have had an inquiry for such an index. Its compilation will be attended with considerable trouble and expense; if, however, we find our readers generally wish for one, it shall be commenced as soon as the present volume is completed. Intending subscribers will please notify their wishes to the publisher without delay.

*** 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. XIII. 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., II., and VII. are out of print. All the others are kept in stock. Vol. XIV. commenced on July 6, 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.

Dentist.—Dr. C. E. Francis, of the United States, recommends the following dentifrice:—Precipitated chalk, 3 lbs.; powdered borax, ½ lb.; powdered orris-root, ½ lb.; cardamom seeds, 2 ounces; white sugar, 1 lb. Flavour with either ol. rose, ol. gaulth., veroli, or jasmine. Colour with rose-pink if desired, leaving out an equivalent quantity of chalk.

Thomas Y.—The specimen enclosed is Spiegeleisen, so called from two German words meaning "mirror iron," or "looking-glass iron," and is so called from its brilliant crystals. It comes from a spathose ore found in Germany, and is a combination of four or five per cent. of metallic manganese with ordinary iron. It is used to give hardness to the soft iron made by the Bessemer process, and adds carbon as well as manganese to the melting.

Manufacture of Soap.—*N. B.* writes as follows:—"I have been making some soft soap, and find myself fast in the finishing of it, as when I have boiled three or four hours it goes ropy, and cannot get it stiff enough. Will you oblige me so much as to give me instructions how to manage, or prevent it from roping?"

Inquirer asks, "Is there any published account of the methods proposed to be adopted for the utilisation of the sewage of London, or any other large town; and, if so, where is it to be had?" In answer to "Inquirer's" second question, we do not intend to publish the paper at present.

Received.—Dr. Letheby.

Books, &c., Received.—"The Christian Times;" "The Principles and Practice of Photography," by Jabez Hughes; "On Ozone, and its Relations to Animal Charcoal," by T. W. Tobin.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Preliminary Notice of the Formation and Crystallisation of certain New Ammonio-Salts of the Metals, and the Crystallisation of some of those intensely coloured Compounds which various Organic Substances afford with certain Metallic Oxides in Presence of Caustic Alkalies, by WILLIAM SKEY, *Analyst to the Geological Survey, New Zealand.*

IT is well known that many of the double ammonio-salts of several of the metals are easily procurable, and in a crystalline form; but these salts are, as a rule, compounded with the stronger acids. Relatively to the formation of those with the weaker acids, the many blanks in the list of ammonio-salts, given in the late standard works on chemistry, lead me to suppose there is a difficulty.

If such a difficulty exists, it can be greatly lessened by the employment of the method about to be described, and by which I have been able to add rather largely to the number of the ammonio-salts.

The principle of this method is to remove the water from the solution of the ammonio-salt we wish to crystallise, without risking its decomposition by the liberation of its ammonia, as is done when we have recourse to heat.

The removal of the water, or rather the excess of water, is effected by the addition of alcohol in sufficient quantity to these solutions; the affinities of alcohol for water being greater than those which exist between the water and the ammonio-salts, these salts are precipitated.

In all those cases where not expressly stated otherwise, it is sufficient for the purpose to add to a solution of the nitrate or chloride of the metal a little of the acid whose salt we desire, and then ammonia in excess. Alcohol should then be added until a cloudiness appears, which is permanent. The mixture is then allowed to be at rest till the crystals appear; this is generally very shortly after the mixing, but sometimes not for some days. In some cases a liquid precipitate falls; it is then often necessary to repeatedly shake it up with fresh quantities of alcohol.

Copper Salts.

Ammonio-tartrate.—Easily crystallises in short needles of a dark blue colour; permanent in the air, very soluble in water; solution neutral, or nearly so. The ammonio-citrate only precipitates as a liquid, which is not changed by repeated washings in alcohol, and upon evaporation dries up to an uncrystalline hard mass which is very deliquescent.

Ammonio-oxalate.—Crystals granular; colour light blue; decomposed by water into the common oxalate of copper with evolution of ammonia.

Ammonio-phosphate.—Colour light blue; granular; very soluble in water; appears to darken a little before solution.

Ammonio-arseniate.—Like the above in every respect.

Ammonio-borate. — Colour light blue; not very soluble; slowly decomposes in the air.

Ammonio-chromate.—Crystallises in short needles, the colour of which is grass-green; soluble in water without decomposition. If these are redissolved in water, and alcohol again added in small quantity, and the solution suffered to rest for a few days, another kind of ammonio-chromate forms, which is decomposed by water.

Ammonio-sulphite. — From dilute solution forms in well-defined and lustrous needles of a purplish-blue colour, permanent in the air, but slowly decomposed by water; otherwise it is altogether insoluble therein, scarcely affected by cold hydrochloric acid, but readily soluble in ammonia or nitric acid.

Ammonio-cyanide.—Forms in well-defined needle-shaped crystals from dilute solutions; insoluble in water, but slowly decomposed by it; colour dark green; permanent in the air.

Cobalt Salts.

Ammonio-tartrate.—These crystals are of a flesh colour; they are permanent; soluble in water; their colour changes to green when exposed to the air. The ammonio-citrate of cobalt, like the ammonio-citrate of copper, does not crystallise.

Ammonio-oxalate. — Two varieties of this salt appear to form—one of which has a granular form and a red colour; the other salt is in needle-shaped crystals, and has a brown colour; both are decomposed by water, the brown variety changing its colour to green, and evolving gas, probably oxygen; the same changes take place when they are simply exposed to the air.

Ammonio-phosphate.—The colour of these crystals is pink; they are insoluble in water, but are gradually decomposed by it, becoming of a blue colour, which again turns to pink by prolonged exposure, or by contact with water. These pink crystals are also turned of a blue colour by heat, and by contact with caustic potash, the change being apparently due to the loss of ammonia.

Ammonio-arseniate.—These crystals have the same form and colour and exhibit the same reaction as the former salt; they were observed to give off gas (oxygen?) in large quantity when placed in water.

Ammonio-hyposulphite. — Colour light green; soluble in water. To crystallise this salt requires the repeated addition of alcohol.

Ammonio-cyanide.—Appears to separate in granular flesh-coloured crystals, which are almost insoluble in water; also, after the lapse of some days, hard, dark red, semi-spherical masses form upon the sides of the test-tube. These are but slightly soluble in cold water, but much more soluble in hot water, and without decomposition. They are not attacked by cold hydrochloric acid.

Nickel Salts.

Ammonio-tartrate.—Crystallises with difficulty in a granular form; its colour is pale green; it is decomposed by water.

Ammonio-oxalate. — Appears to crystallise in regular octahedrons, the colour of which is dark blue; they are soluble in water without decomposition, and rather deliquescent; when gently heated, they evolve ammonia, and the residue becomes insoluble.

Ammonio-phosphate. — Crystallises in tufts of needle-shaped crystals; scarcely soluble in water without decomposition; their colour is pale green.

Ammonio-chromate.—Colour pale green; scarcely soluble without decomposition; very soluble in ammonia; evolves ammonia when gently heated; exposed to the air, their colour speedily changes to a rusty red, but the crystals remain in form, and still possess considerable lustre.

The corresponding cobalt compound does not appear to crystallise.

Ammonio-hyposulphite.—This compound does not appear to crystallise; it is deposited as a green-coloured liquid.

Silver Salts.

Ammonio-chromate. — Discovers itself in long rhombohedral crystals of a lustrous yellow colour; they are but partially soluble in water, which easily decomposes them; they are also decomposed by alcohol, unless it is mixed with ammonia; exposed to the air, they rapidly darken, even when kept from the light, and assume the appearance of silver, the form of the crystal remaining perfect, although they are still soluble in ammonia. The ammonio-sulphate crystallised from alcohol in this manner assumes the form of needle-shaped crystals, which, although very alkaline, does not evolve ammonia, even when its aqueous solution is boiled.

Ammonio-phosphate. — Appears to separate in yellow needle-shaped crystals; these may, however, be only the phosphate of silver. As the quantity was so limited, I could not properly test them; indeed, there appears to be some difficulty in the way of obtaining any other ammoniacal salts of silver than the sulphate and chromate by these means.

Ammonio-oxalate.—Crystallises in short rhombs of a brilliant lustre, transparent and colourless; they are immediately decomposed by water. The agents used in this case were oxalate of silver and ammonia. As I could not obtain any result from the use of ammonio-nitrate of silver and oxalate of ammonia, the alcoholic solution was suffered to evaporate spontaneously.

Zinc Salts.

Ammonio-chromate. — Colour of crystals yellow, transparent, rather lustrous; decomposed by water, becoming flocculent, and evolving ammonia in considerable quantity.

Chromium, Iron, Aluminium, and Uranium Salts.

Ammonio-tartrates—With but one exception only, these salts have been crystallised.

The crystals of ammonio-tartrate of protoxide of iron and sesquioxide of chromium are green and needle-shaped; their solution is neutral to test-paper; the iron salt soon turns red by exposure.

The ammonio-tartrate of sesquioxide of iron is pale yellow; its crystals are also needle-shaped, and form in tufts.

Ammonio-tartrate of Alumina.—Is so easily decomposed by washing with alcohol into a gelatinous though very soluble variety of this salt, that to obtain it in well-formed crystals is a matter of difficulty.

Ammonio-citrate of Protoxide of Iron?—By repeatedly washing with alcohol the liquid which precipitates from a solution of protoxide of iron in ammonia and citric acid, to which alcohol has been added, the liquid becomes brown, and finally crystallises in hard granular crystals of a pale brown colour. The iron in these crystals is, however, only partly in the state of the protoxide.

Ammonio-tartrate of Uranium.—Separates in a confusedly crystalline yellow mass. It is best to use the nitrate of uranium as the source of the metal in preference to the chloride. These crystals are deliquescent, and their solution is feebly alkaline.

In regard to the other part of this notice—the crystallisation of some of those intensely coloured compounds which various organic substances afford with metallic oxides in the presence of caustic potash or soda—the following are the salts which I have been able to crystallise, and the method employed is the same as the one already described—namely, by the addition of alcohol to the aqueous solution of these compounds; a short description is given with each.

Potassio-citrate of Copper.—This salt appears to crystallise in two forms, which circumstance may be owing to difference in the proportion which its constituents hold to each other. Those which first appear are needle-shaped and of a pale blue colour, while those which come after are hexagonal, and of a much darker blue, which changes to an indigo blue when long exposed to the air; they are both very alkaline.

Potassio-citrate of Cobalt.—This salt is of a pink colour, and crystallises with facility; it is very alkaline, even after repeated solutions in water and reprecipitation by alcohol.

Potassio-tartrate of Nickel.—Colour pale green; very alkaline; appears to decompose when long exposed to the air.

It is necessary to evaporate the liquid precipitates caused by alcohol, at a very gentle heat, in all these cases, to produce these salts in a crystalline form.

As being somewhat related to the contents of this paper, it may be allowable to notice the following reactions of cobalt.

If ferricyanide of potassium is added to a solution of potasso-tartrate of cobalt, a green coloration is produced, and the addition of alcohol thereto precipitates a green-coloured substance in the form of crystalline flakes.

This crystalline substance is very soluble in water, and it has a very alkaline reaction, of which it cannot be divested by repeated solution in water and reprecipitation by alcohol.

It contains tartaric and ferrocyanic acids, with oxide of cobalt and potash.

As far as I can judge at present, these substances are not mechanically mixed, but are held together by chemical affinity to form a single compound salt, whose distinguishing appellative may be that of the tartro-ferricyanide.

Other precipitates of analogous nature have more lately been produced by substituting a ferrocyanide for the ferricyanide employed; also by substituting a copper, a nickel, or a chromium (sesquioxide) salt for the cobalt salt; and it was found that even the tartaric acid itself might generally be substituted by sugar.

It is proper to mention that the addition of a ferricyanide to a potasso-citrate of cobalt does not change its colour to green.

Since the above was written, a few additional facts have been elicited relative to these salts, which I will briefly notice.

A hyposulphite of copper and ammonia has been obtained of a dark colour by simply warming a solution of ammoniacal copper with hyposulphite of soda. The powder of this salt has a good reddish-purple colour of some permanency; it is insoluble in water, and nearly so in ammonia.

The ammonio-chromate of cadmium is easily obtained by the alcoholic process also; it crystallises in long yellow needle-shaped crystals.

It is only proper to mention that I rest upon the results of qualitative analysis only for my authority in respect to the composition I have assigned to the salts here described; but I propose to submit the more interesting of them to a complete analysis at the first opportunity which presents itself.

TECHNICAL CHEMISTRY.

On the Practice of Disinfection, by Dr.* LETHEBY, *Health Officer of the City of London.*

I HAVE much pleasure in stating what are the processes of disinfection which I have found most effective in my experience as the Officer of Health for the City of London.

The several disinfectants which I have largely tested are the following :—

1. Chlorine gas.
2. Chloride of lime.
3. Carbolate of lime.
4. Carbolic acid.
5. Chloride of zinc (Sir William Burnett's fluid).
6. Chloride of iron.
7. Permanganate of potash (Condy's liquid).
8. Animal charcoal.

Each of these disinfectants has its own particular value, and may be used on certain occasions in preference to any of the others; thus,

1. *Chlorine gas*, being a very diffusive body, is best suited for the disinfection of places which cannot easily be reached by other disinfectants. I have used it largely for the disinfection of the vaults of churches, where the atmosphere has been so charged with offensive and dangerous organic vapours, let loose from the contents of the decaying coffins, that the workmen could not enter the vaults with safety. In this manner all the vaults of the city churches have been disinfected, and the contents of them put in order and covered with fresh mould. I have found also that chlorine is best suited for the disinfection of rooms where, as is the case with the poor generally, the occupant cannot be removed for a thorough cleansing; and I have employed it with great advantage in places where persons have been sick with fever, scarlet fever, small-pox, and cholera. The process which I adopt is the following :—About a teaspoonful of the black oxide of manganese is put into a teacup, and there is poured over it, little by little, as occasion requires, about half a teacupful of strong muriatic acid (spirit of salt). In this manner the chlorine is gradually evolved, and the action is increased, when necessary, by stirring the mixture, or by putting the teacup upon a hot brick. As chlorine is heavier than atmospheric air, it is best diffused through the room by putting the mixture upon a high shelf. The quantity of chlorine thus diffused should never be sufficient to cause irritation to the lungs of those who occupy the room, and yet it should be sufficient to be distinctly recognisable by its odour. If it be properly managed, the chlorine may be thus diffused through the atmosphere of the room, even during its occupation by the sick.

2. *Chloride of lime* has been very largely used in the city during the recent epidemic of cholera. The inspectors have sprinkled it upon the floors of the houses occupied by the poor, and have scattered it about the cellars and yards. In some cases it has been used with water for washing the paintwork and the floors of rooms. Altogether, indeed, with an average staff of forty-five men, we have used rather more than seven tons of chloride of lime in this manner in disinfecting every week about 2000 of the worst class of houses in the city, and the results have been most satisfactory.

3. *Carbolate of Lime*, which is a mixture, or rather a chemical compound, of carbolic acid and lime, has been used in many cases where the smell of chloride of lime or its bleaching action has been objected to. It has been used by dusting it by means of a dredger over the floors of rooms and cellars; but as the disinfecting power of this substance is destroyed by chloride of lime, it is of great importance that they should not be used together. The carbolate of lime which we have employed contains 20 per cent. of carbolic acid; it is essential that this should be its minimum strength, or its power is not sufficiently efficacious. The strength of it may be ascertained by treating 100 grains of it with sufficient muriatic acid, diluted with its own bulk of water, to dissolve the lime, when the carbolic acid is set free, and floats upon the liquid; this, when collected, should weigh twenty grains at least. The advantage of carbolate of lime is its continuous action, for the carbonic acid of the air slowly lets loose the carbolic acid, which diffuses itself through the atmosphere in sufficient quantity to act as a disinfectant, and it does not destroy the colour of clothing.

4. *Carbolic acid* has been used as the sole agent of disinfection for privies, drains, and sinks, and for the sewers and the public roads. In the former case it has been used in its concentrated state by pouring it at once into the privy or drain, but in the latter case it has been diluted with about 2000 times its bulk of water, and sprinkled by means of the water carts upon the public way. In this manner about 1000 gallons of carbolic acid have been used in the City thoroughfares; and the acid getting into the sewers, we have observed that the usual decomposition of sewage has been arrested, and instead of a putrefactive change with the evolution of very offensive gases, the sewers have been charged to a slight extent with carbonic acid and marsh gas. As there are many coal tar acids now sold for carbolic acid, it is of importance that the adulteration should be recognised. This may be done by observing the strength of the soda solution which will dissolve the tar acid. All the inferior acids are insoluble in a weak solution of caustic soda.

5. *Chloride of Zinc*, Sir William Burnett's fluid, or, as it is sometimes called, Drew's disinfectant, is well suited for the disinfection of the discharges from sick persons, but it is hardly applicable to any other purpose. The liquid should be of a proper strength, as having a specific gravity of 1594, water being 1000; and it should contain about from 50 to 54 per cent. of solid chloride of zinc. A tablespoonful of this liquid is sufficient to disinfect each discharge from the body.

6. *Chloride of iron* is applicable in exactly the same manner as chloride of zinc, and is only suited for the disinfection of the discharges from the body. It should have a specific gravity of 1470, and should contain about 40 per cent. of metallic chloride.

7. *Permanganate of Potash* is only suited for the disinfection of drinking water; for not being a volatile disinfectant, and being very slow in its action, and requiring much of it for any practical purpose, it is not available as a common disinfectant; besides which it attacks all kinds of organic matter, and will therefore destroy clothing and be neutralised by every species of organic substance. As a disinfectant of water, however, in localities where good filters of animal charcoal cannot be obtained, it may be usefully employed to disinfect water by adding it thereto until the water retains a very pale but decidedly pink tint. The permanganate which is sold, generally has a specific gravity of 1055, and contains about 6 per cent. of permanganate of potash. It will take more than a pint of this liquid to disinfect a pint of the rice-water discharge from a cholera patient, and even then the disinfection is very uncertain.

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* Observations communicated to the Registrar-General.

8. *Animal Charcoal.*—I may state that for the disinfection of water and the removal of dangerous organic impurity, I have ascertained by experiment that the best treatment is first to filter the water through animal charcoal, and then to boil it for a few minutes. It may then be safely drunk.

The disinfection of bedding and all articles of clothing is best effected by exposing them in an oven to a heat of from 260° to 300° Fahrenheit. The exposure should be sufficiently long to insure the thorough heating of every part of the material to that temperature. When such a process cannot be used, the clothing should be put into boiling water, and kept there until the water cools to the common temperature.

I refrain from entering into any explanation of the mode of action of these several disinfectants; for whether the agent of disease is a living germ, capable of reproducing itself in the human body under certain conditions, as most likely it is, or whether it is an unorganised, or even, as Dr. Richardson supposes, a crystalline compound, the practical results are the same, and are unquestionable; and, in conclusion, I would say, by way of summary, that for the disinfection of sick rooms chlorine and chloride of lime are the best agents; for the disinfection of drains, middens, and sewers, carbolate of lime and carbolic acid are the best; for the discharges from the body, carbolic acid, chloride of zinc, or chloride of iron are the best; for clothing, the best disinfectant is heat, above 260° if a dry heat, and 212° if a wet heat; and for drinking water, filtration through animal charcoal and a boiling temperature.

I may mention that the best disinfectant for stables and slaughter-houses is that prepared by Lewis, Ash, and Co., at Bow. It is a mixed chloride and hypochlorite of zinc, and it has the advantage of mixing freely with the liquid matters of the slaughter-house, and not tainting the meat with any unpleasant odours. We have used it very largely for this purpose, and it is also applicable to the disinfection of houses in place of chloride of lime, which it much resembles in its chemical nature and mode of action.

College Laboratory, London Hospital.

PHARMACY, TOXICOLOGY, &c.

Analysis of Eland's Boontjes; a Species of Acacia yielding Food, Medicine, and Tan to the Natives of South Africa,[*] *by* JOHN ATTFIELD, *Ph.D., F.C.S., Director of the Laboratory of the Pharmaceutical Society of Great Britain.*

THIS is the local name of a plant in the Orange Free State, South Africa, derived from a Dutch word, and signifies the "little beans" eaten by Elands. From the bean the Kaffirs extract, by boiling, an oil which they use in food; an infusion of the root is employed by them as a gargle, and is taken in cases of dysentery and other affections of the bowels; while both the natives and the Dutch Boers find the root of considerable value in converting skin into leather, the Boers using it as a substitute for oak bark in tanning, and the natives employing it in the preparation of their "karosses," or blankets, by rubbing it on the flesh side of the skins of animals. The root being of considerable value as a tanning agent, it became a matter of some interest to determine the amount of tannic acid it might contain. On making experiments with this view, 13 per cent. of tannic acid was obtained as the mean of six experiments.

The beans are, in the dry state, externally of a dark chestnut colour, and about twice the size of a horse bean. On opening them, a yellowish-white kernel is seen, weighing about two-thirds of the weight of the whole seed. A given quantity of the kernel was digested in ether in the usual way, to dissolve out the oil, 34·6 per cent. of which was obtained, or 22·5 per cent. reckoned on the whole seed. The oil is of light colour, not very fluid, inodorous, and has no marked flavour.

The percentage of nitrogen in the kernel is 3·6, in the integument 1·03. This nitrogen probably all exists in the state of vegetable albumen. If so, the percentage of albumen in the kernel is 22·6, and in the integument 6·48. Or, as an average of the weights of kernel and integument of several seeds gives the weight of the kernel as 1·099 grammes, and its accompanying integument ·594 gramme, it follows that the average amount of albumen in the whole seed is nearly 17 per cent.; about three-fourths of the proportion commonly existing in peas, beans, and other leguminous seeds.

The percentage of ash in the kernel of the seed is 1·82, in the integument 1·54, or in the whole seed 1·72.

Thus, in 100 parts of the seeds or beans we have—

Albuminous matter (legumin) . . .	17·0
Oil	22·5
Woody fibre, moisture, etc. . . .	58·8
Ash	1·7
And in 100 parts of the root—	
Tannic acid	13

REPORT ON THE

CHEMICAL LABORATORIES

IN COURSE OF ERECTION IN THE

UNIVERSITIES OF BONN AND BERLIN.

THE CHEMICAL LABORATORIES OF THE RHENISH FREDERICK WILLIAM UNIVERSITY OF BONN.

(*Continued from page 259.*)

APPENDIX TO THE REPORT ON THE CHEMICAL LABORATORIES IN COURSE OF ERECTION IN THE UNIVERSITY OF BONN.

BUT few months have elapsed since the foregoing report was written. Events, however, that at other periods would have required a lifetime for their consummation, have thronged together in this brief span of time. A fierce war has broken over Germany, dividing its races into two hostile camps. The flower of the nation is still under arms, and the Prussian eagles in their victorious flight have traversed all Germany. At such an epoch, it might be thought, the arts of peace could move but slowly. *Inter arma silent Musæ.* So perfect, however, is the order which regulates the several departments of the Prussian Government that the great works of the Minister of Public Instruction for educational purposes have suffered scarcely any interruption. The building of the Bonn Laboratory, in fact, has, notwithstanding the exigencies of war, made considerable progress, and various appliances, which were mentioned in the preceding description as in project, or as existing only in their merest rudiments, have since attained completion. It seemed of interest to append to the report a brief sketch of some of these arrangements.

EVAPORATION NICHES.

In a great number of chemical operations vapours detrimental to health are evolved, which should be removed as quickly as possible from the working rooms. To effect this, every laboratory is provided with a few large places

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[*] Abstract of paper read before the Pharmaceutical Society, November 7, 1866

ventilated by chimneys, in which such work is to be conducted. But they seldom fulfil their object in a satisfactory manner. In many cases the amount of gas disengaged in a given experiment is so small that the student thinks it scarcely worth while to leave his working bench in order to conduct the operation under a chimney. The evolution of vapours, however, recurs very often, and must, particularly in a laboratory where a great number of operators are at work, ultimately contaminate the air so as to render ordinary ventilation totally insufficient. This especially occurs during the repeated evaporation of acids and ammoniacal salts in mineral analysis.

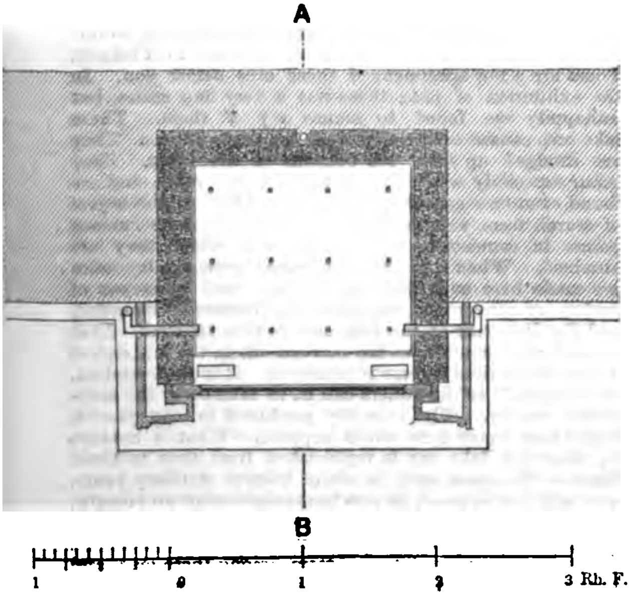
To remedy this inconvenience in the case of the Bonn Laboratories, there have been constructed, instead of one or two larger evaporation niches, a considerable number of smaller ones distributed over the entire space so as to enable the manipulator to perform such operations almost without leaving his working-bench.

For this purpose nearly all the window pillars are provided with niches. Their disposition in the three main laboratories (C, D, and E), as well as in the director's private laboratory (Z), becomes apparent by a glance at Fig. 2, page 211, and Fig. 5, page 244.

The essential conditions which an arrangement of this kind should satisfy are the following:—

1. Speedy and certain withdrawal of obnoxious gases.
2. Supply of air to support combustion.
3. Protection of the liquids to be evaporated from condensation products deposited in the flue.
4. Continuous removal of these condensation products, and of liquids that may be spilt in the niche, &c.

FIG. 11.
EVAPORATION NICHE.
HORIZONTAL SECTION ALONG THE LINE C D IN VERTICAL SECTION.



That in the construction of these niches no materials are to be employed which would be acted upon by such vapours, scarcely requires a special mention.

It has been attempted to supply these wants in the following manner:—The niches are ranged along the outer walls of the building, in the spaces between the windows; they project somewhat from the inner face of the wall, in no case, however, so far as to impede the passage round the working benches facing the window recesses. Each niche consists of an open space having an area twenty inches square and a height of twenty-six inches—dimensions generally sufficient for the reception of the apparatus here to be employed. The bench of the niche is three feet two inches above the floor of the laboratory—an elevation selected for all tables, window-sills, niches, &c. The base, the sides, the back, and the roof of the niche are made of compact sandstone; the opening in front is closed by a pane of plate glass which can be adjusted in any position by means of counterpoises acting over pulleys.

FIG. 12.
EVAPORATION NICHE.
VERTICAL SECTION ALONG THE LINE A B IN HORIZONTAL SECTIONS.

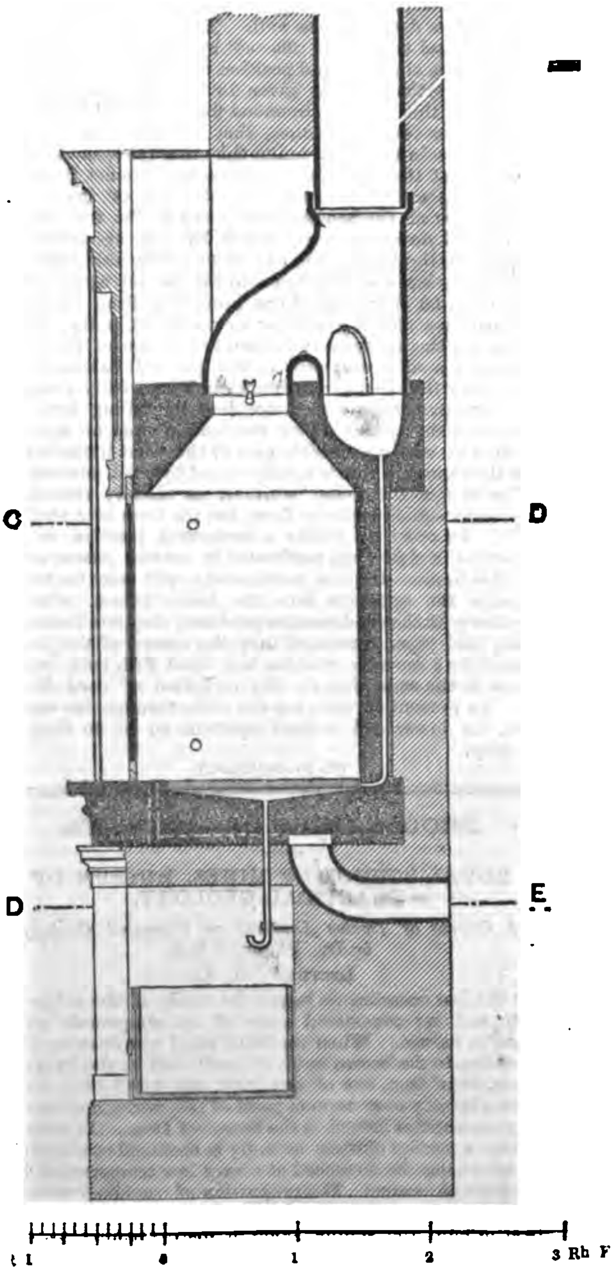


Fig. 11 shows the ground plan of the niche above the level of the working bench.

For the removal of vapours the funnel-shaped roof communicates with an earthenware pipe, seven inches in internal diameter, rising within the wall to a height of twenty-one and a half feet from the floor. A gas flame burns in the funnel to promote the draught. The gas issues from a steatite burner, which is cemented into a porcelain pipe entering from the side, and by this means the employment of metal, which would be rapidly corroded, is entirely avoided. The gas pipe, on account of its fragility, is so placed that it can be easily renewed.

To protect the liquids evaporating in the niches as much as possible from any dirt that may fall down the flue, the latter is not situated directly over the gas flame, but lies nearly a foot deeper in the wall. The connexion between the niche and the flue is effected by a Y-joint of glazed earthenware, the form and position of which are apparent from the vertical section given in Fig. 12. The upper opening of this joint is intended for the reception of the flue; of the two lower ones, that branching out closes the aperture in the roof, whilst the other lying in the prolongation of the flue fits into a second funnel pointing downwards and likewise set in the roof of the niche. Here collect all the products deposited in the flue, which are washed down its walls either by rain or condensed water; the liquid which comes down on the side next the niche being likewise directed into the funnel by means of a semicircular sharp-edged rim projecting from the interior surface of the Y-joint near its upper extremity. From the funnel the products run down to the base of the niche through a small leaden pipe let into the wall behind it.

In order that the second funnel may be readily cleansed from foreign matters which accidentally falling into the flue cannot be carried off by the leaden pipe, an opening is left at an easily accessible part of the joint immediately over the funnel, which is merely closed by brick and mortar.

The base of the niche, whither, as already remarked, the condensation products flow, has the form of a shallow basin. In order to insure a horizontal position to the apparatus, a slate slab, perforated in several places, overlies this basin. Liquids accidentally spilt may be rinsed through the openings into the basin below, whence, together with the condensation products, they run through a small lead pipe, cemented into the centre of the basin, down into a movable wooden box lined with lead, which serves at the same time for the reception of used filters, &c. To prevent air entering the niche through the waste-pipe, its lower end is bent upwards so as to form an air-trap.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology,
by Dr. Percy, F.R.S.

Lecture No. XI.

On the last occasion we began the study of the subject of iron, and we considered some of its compounds which occur in nature. When we broke off, I was drawing your attention to the brown oxide of iron; that is, the hydrated peroxide of iron, one of our most important ores, which occurs largely over various parts of the world, and in very large quantities indeed in the Forest of Dean. It contains always a portion of water actually in chemical combination, which cannot be displaced at a very low temperature like hygroscopic water. The proportion of combined water is about 12 or 14 per cent. in the pure ore. It is well to bear in mind the simple mode of distinguishing between the red iron ore and the brown. You may do this at once by means of the streak. The practice with metallurgists is to take a piece of unglazed pottery and just draw the ore across it. You will find with regard to the red ore, however bright or metallic its lustre, that the streak it makes will uniformly be red, while that of the other ore will uniformly be brown. A very large quantity of the brown iron ore, to which the French apply the term limonite, has been found in different parts of England in recent times, or perhaps I might more correctly say rediscovered. The so-called Staffordshire ore, which is found in large quantity, is nothing more than the impure brown hæmatite earth in balls, perfectly non-crystalline, and containing impurities—chiefly sand and phosphoric acid. The phosphoric acid is an impurity in these ores, sometimes of very great consequence indeed. It affects in a most material degree the value of the iron obtained from them, and I am sorry to state that in Northamptonshire ores there is a great variation in respect to the quantity of phosphoric acid. Sometimes we find a very small quantity, not more than occurs in our clay iron ores, and at other times there is a very large amount—2, 3, or 4 per cent., or more. That is a point of very serious consequence. We have also these ores occurring also in Lincolnshire and other parts of England. They occur in the oolite and in the lias, principally in the oolite, and are chiefly derived from the weathering action on a pre-existing carbonate. We have found many specimens from time to time which show the transition perfectly from carbonate to brown oxide. I pointed out to you a specimen found at Hastings, where you will find an abundance of them, showing how carbonate of iron is, by the joint action of air and moisture, superficially converted into brown oxide of iron. The carbonic acid slowly escapes, while the first oxide of iron with which it existed in combination is *pari passu* oxidised and converted into brown oxide.

There is one class of these ores which yet remains to be considered, and perhaps it is one of the most interesting. I allude to the so-called "lake ores," which occur abundantly in certain parts of Sweden, and also in Finland. There are a few specimens of these ores before you. In the exhibition of 1862 there was a very fine series, but unhappily we failed to secure any of them. These lake ores consist essentially of brown oxide of iron. They are dredged up from the bottoms of the lakes. They occur especially where rivers flow into the lakes, and are found even to a considerable extent. They are the object of search from year to year, and there are some curious points in connexion with the mode in which they are obtained. When the lakes are frozen over, sundry holes are made here and there in the ice, and by means of probes or convenient apparatus the bottom is sounded, and the discovery of the lake ores is thus effected. That done, certain boundaries are marked out in the ice, and at a convenient time the ore is taken out. It is then washed, or "jigged," as the miners call it, to take away the associated matter. The quantity produced in one year is larger than many here would suppose. What is curious is, that this lake ore is replenished from time to time. Even in the same spot, in about twenty or thirty years, you will find as much as you have taken away previously. The origin of this lake ore is somewhat curious and doubtful at present. It has been supposed to be infusorial. There are several varieties of form among these ores, and they are designated according to the supposed resemblance of their particles to familiar objects. For instance, we have "gunpowder ore," which is granular and in small pieces. Then there is "money ore," which is in small masses resembling coin. There is also "cake ore," which has received its name from another resemblance. In looking over some of the smaller ore—the gunpowder ore, for example—it may possibly furnish a clue to the structure of the Cleveland ores, which are highly oolitic—so called from a Greek word on account of its resemblance to the roe of a fish. Let us suppose that a quantity of this gunpowder ore has become diffused through earthy matter and that then, by some cementing matter, the whole mass has become firmly cemented or agglomerated, I think we should get a mass of matter like our Cleveland iron ore. I only throw this out vaguely as a hint. I do not say it is satisfactorily proved. One would have supposed that these lake ores would have contained a large amount of phosphoric acid. Well, they are not deficient in it; far from it; but still they do not contain as much as might be expected. These lake ores are used as a source of iron in Sweden and Russia for certain special purposes.

There is another variety of ore called bog ore, which is met with in bogs and swampy places. It appears to be infusorial, and is generally rich in phosphoric acid. The effect of phosphoric acid is to produce an iron excessively brittle when cold, but well adapted for casting, being very fusible.

There is one point I should not omit in connexion with this part of our subject. It may be useful to gentlemen who are curious in searching for iron ore, and many are so engaged in various parts of England—many profitably engaged. Never attempt to judge of the value of iron ore from its weight. Here is a light spongy piece of ore, apparently worthless. It is a piece I got out of a large vein at Alston some years ago. Well, light and spongy as that appears, it, nevertheless, contains about 46 per cent. of pure iron, which is a large proportion, and besides that about 11 per cent. of manganese. I have known many persons misled by considerations as to the weight of the specimen. The specific gravity of an iron ore is no test of its value.

We have spoken now of protoxide of iron and of red iron ore or red oxide of iron, and of the combination of that oxide with water under the name of brown iron ore. The next oxide is one of vast importance—at all events in a chemical point of view, and apparently in geological respects—namely, the magnetic oxide of iron. It is a curious thing that that oxide which approaches nearest to iron in constitution, containing more iron than the other oxides, is not at all magnetic—namely, the protoxide of iron. Then we come to the peroxide of iron, or sesquioxide as it is commonly called, to use the old notation. We will suppose one equivalent of protoxide combined with one of sesquioxide, and we get magnetic oxide of iron. I may state that recently it has been found that red oxide of iron, when prepared in a particular way, is highly magnetic, like the magnetic oxide. Long ago it was observed by Rose that certain specimens of peroxide of iron occurring naturally had a magnetic property; and I may state that I experimented some years ago upon specimens obtained from Cumberland, and found that they did to a small extent, but appreciably, affect the magnetic needle.

Magnetic oxide of iron may be easily formed artificially. It occurs in nature splendidly crystallised in the regular cubical system. It can also be obtained artificially crystallised. When the peroxide of iron is exposed to a high temperature alone, without the action of any reducing agent, contrary to what some people suppose, it is decomposed and reduced to magnetic oxide. It loses a portion of its oxygen, and becomes magnetic oxide. That is a point which you should bear in mind. We frequently find this magnetic oxide as a product in metallurgical operations, and sometimes beautifully crystallised. I may refer you to specimens in the case above, some of which are the finest ever discovered, I have no doubt. There are large clusters of crystals obtained in various processes in our iron and copper furnaces, and elsewhere. They are always in the form of the octahedron—sometimes clearly defined, and at other times these octahedra are grouped curiously into one another. Once I found the crystals in a specimen from South Wales in the form of the rhombic dodecahedron. That specimen is a most beautiful thing, and though I have been searching for these things for many years, I have only found the mineral once in that form when artificially produced. Those of you who are acquainted with the mineral from Traversella will, I think, recognise the very close resemblance between this artificial product and that naturally occurring at Traversella.

Magnetic oxide of iron occurs not only crystallised but amorphous. We can easily produce it in that state. There is a specimen of it in this vessel before you. We have only to take the two salts, protochloride of iron and perchloride of iron, and mix them together in such a proportion that when we put in a substance to abstract the acid what is left will be this substance. It is a very stable compound—much more so than might at first be supposed. It is not liable to become further oxidised. Here is some of this magnetic oxide prepared a long time ago in the manner described, collected upon a filter, and then washed and dried with free exposure to the air. You see it has not become converted into peroxide of iron. If it had, the oxide so formed would not have had the least magnetic property, but you see how magnetic this specimen is. It is the amorphous magnetic oxide of iron. We have lately found some amorphous magnetic oxide of iron, an iron ore of considerable importance. When common sand and even red oxide of iron are strongly heated together, they combine and form silicate of protoxide of iron, a very fusible compound, which may be frequently obtained artificially even in small crucibles, sometimes most beautifully crystallised. It is easily formed. Well, take such a silicate of iron, and heat it with common lime; that lime displaces the iron from its combination with the silica, forming silicate of lime, and you get the magnetic oxide of iron beautifully crystallised. For this experiment we are indebted to the late Professor Ebelmen, who had the direction of the porcelain works at Sevres. It may also be formed by heating chloride of calcium with sulphate of protoxide of iron—that is, common green copperas. This has to be performed in a covered crucible. Kuhlmann made it crystallised in that way. It may also be produced by the action of the vapour of fluoride of iron on molten boracic acid. Mitscherlich formed it in this manner. There is one observation which appears to be important in mineralogical operations. I allude to a statement made by Becquerel. He tells us that he found on a bar from the foundation of an old castle, which had been some time under water, three layers of oxides. The outermost layer consisted of hydrated sesquioxide of iron, the second of anhydrous or red oxide, and the third, or innermost, of magnetic oxide. The layers of red and magnetic oxide were distinctly crystallised.

When metallic iron undergoes oxidation under water, or in contact with gravelly matter, it has a marvellous power of agglomerating the particles together, and consolidating them into a most firm and substantial lump. I had specimens illustrating this on a former occasion. You may see this at almost any seacoast place where those iron drain-pipes happen to be stretching themselves along the shore. You see there various kinds of shells most firmly adherent, and sometimes pebbles. So firmly are they agglutinated, that I have tried vainly to knock them off with a hammer. Then, again, I have seen an iron instrument taken out of the bed of a river, with an accumulation of gravel round it as big as a man's head, and the mass was not friable, but hard. It is quite possible that engineers might make a practical application of this cementing power of iron. No doubt some thousands of tons of fragments of iron thrown down pell-mell against the foundation of a structure—in making an embankment, to wit—would in time greatly add to the consolidation of the whole.

Now as to the mode of occurrence of magnetic oxide of iron in nature. First I will take the amorphous variety, which we have met with of late in Yorkshire—specially at Rosedale, in that county. The mineral there found is in carbonate of lime really, and it contains silicate of iron. You may properly put the question to me, "What right have you to call this magnetic oxide of iron?" Well, perhaps I have no very good right: at all events, I cannot offer you a certain and conclusive proof of the fact. Here is an iron ore which is magnetic, which is amorphous, and which, I think, there is some reason to suppose does contain the iron in the state of magnetic oxide, and it is also polar. I do not know whether magnetic oxide of iron occurs in any other locality in England. In nature it occurs massive, sometimes in magnificent crystals and in very large quantity indeed. I might take you to beds of it twenty, thirty, fifty, or a hundred feet in thickness in Canada; and in Gellivard, in Lapland, there is almost a mountain of it, and a very beautiful mountain it is. I believe attempts are being made to construct railways there, and render this mineral accessible to our markets. Then we have it at Arendal, in Norway, in several parts of Sweden, and in the Ural. It is, in fact, one of the ores of Sweden. There are two principal ores used in Sweden—the red oxide and the magnetic oxide. They also use the lake ores, but only for inferior purposes, such as casting. With reference to its abundance in Canada, Sir William Logan has given statements which seem almost incredible. At Arendal it occurs in granite, and in the well-known so-called metamorphic rock, gneiss, and also with garnet. It is interesting to note this association of it. It is also found in serpentine in connexion with garnet, augite, and hornblende, in Bohemia. It occurs in association with greenstone, granular limestone, garnet, hornblende, augite, and quartz, with augitic porphyry at Blagsdal, in the Ural; and in drusy cavities filled with crystals both of magnetic oxide of iron and iron pyrites. The association of iron pyrites and magnetic oxide is important, as it may tend to furnish us with some clue to the formation of the magnetic oxide. It occurs also with calcspar and analcime. In Thuringia it is found in hypersthene rock with crystallised carbonate of iron. Then it has been found also in association with dolomite in Canada. Sir William Logan has told us of its association in the very substance of the rock. It is also found in basalt, as at Taberg. The magnetic quality of certain basalts is supposed to be due to the association of this magnetic oxide of iron, it being diffused through their mass. I called your attention in the last lecture to a statement made by Professor Andrews, of Belfast, that the basalts which manifest a magnetic character contain metallic iron diffused through them, but I do not think he has clearly established the fact, though he got a precipitate of metallic copper when the rock was immersed in a solution of sulphate of copper. I think it would be easy to account for the deposition of the copper, supposing the iron did not exist in the metallic state in the rock. Magnetic oxide of iron occurs also in lava at Monte Somma, in several sedimentary rocks, and in clay slates in France.

There appears to be no doubt that proofs exist, though their number is limited, that magnetic oxide of iron has been the result of sedimentary deposition. It has a character in which sedimentary origin appears to be plainly indicated, but with regard to the way in which these masses of oxide of iron have been produced opinion is by no means decided at present. It is a very difficult subject, and one richly deserving close and continued attention. No doubt ultimately we shall know vastly more of these interesting points concerning chemical geology than we do at present. It has been conjectured by some persons that there are cases in which the magnetic oxide of iron has actually been molten and poured into crevices and into fissures, and so formed; but I think, upon the whole, when we survey the general mode of the occurrence of this important and remarkable mineral in the world, we shall say that it is, perhaps, the result to a great extent of the so-called metamorphic action, which we have reserved for future consideration. But the plain long and short of it is this—that we know very little about it of a satisfactory kind—about the chemistry of it, at all events. I would especially ask those gentlemen who may have an opportunity of examining these rocks hereafter to note particularly the associates of the rocks, and the materials which may exist in the magnetic oxide of iron itself. Now, I will give you an instance of the importance of such observation. In certain cases, there is no doubt, free silica is present. We know that if magnetic oxide of iron is brought in contact with silica at not a very high temperature, combination takes place, and silicate of protoxide of iron is formed. Now, it is impossible to assert, supposing we admit the contemporaneous presence of these two things—the silica and the magnetic oxide of iron—that they could have been exposed, in conjunction, to a high degree of heat. Thus, a small fragment of silica, occurring in a free state in a rock of this kind, may furnish us with strong evidence of the precise conditions under which the rock has been formed, or rather, the conditions with regard to temperature under which it has *not* been formed.

(To be continued.)

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 30, 1866.

R. Angus Smith, *Ph.D., F.R.S., &c., Vice-President, in the Chair.*

Professor R. B. Clifton, M.A., F.R.A.S., late of Owen's College, but now of Oxford, was unanimously elected an honorary member of the Society.

"*On the Manufacture of Sulphide of Ammonium,*" by Peter Spence F.S.A., F.C.S.

Hydrosulphuret of ammonia, or sulphide of ammonium, is at present chiefly used in the laboratory, where it is a very useful reagent in metallic and other analyses, and it has often been thought it might be more extensively used if it could be made cheaply and of good quality. At present it is made by directly charging liquor ammoniæ with sulphuretted hydrogen gas, but this is a very expensive mode, and, from the fact that most of it thus obtained is not fully charged, it would seem not to be an easy mode of making it. Having occasion some time ago to require it largely in the manufacture of sulphocyanide of ammonium, I invented for myself a mode of making it very economically, and fully charged with sulphur.

In communicating this plan to the Society I do it in the hope that it may be useful in the laboratories of those who produce some of their own reagents. The Society must not, however, give me too much credit for generosity, for had I found a market for the article making it worth my while to make it largely, I should have held it secured by patent, but as it is not, I make the gift for what it is worth. I have by this plan made the article to some extent for a London house, and have sent them some 30 to 40 carboys; but the demand was only fitful, and although they were highly satisfied with the quality and would have given me my own price, it was not worth my while to continue the process.

The mode of manufacture is merely to mix a salt of ammonia—say sulphate or chloride—with double its weight of soda waste or gas lime (either being suitable), and blowing into the mixture a jet of steam and passing the vapours through condensing apparatus; the distillate is pure sulphide of ammonium. It may be as well to mix the two bodies in a portion of water; and even in that case it is needful to be careful with the condensing pipes, as sulphide of ammonium being much more volatile than water, it comes over so strong at first as to condense in a solid form. I had nearly a serious accident with it, which I name to induce caution. I was passing the still when at work and saw something was wrong. I called my manager, who, with the man at work, examined the pipes, and found them closed; on opening them with an iron rod there was a flow of liquor and a strong blow of gas; seeing and feeling this, I called to the man to leave it instantly, but he hesitated. My manager then seized him by the arm and pulled him away, and he instantly fell down and became rigid as a log of wood; his breast was now rubbed forcibly to bring on breathing, which had quite stopped, and a doctor who was sent for poured cold water on his head. He now went into most violent convulsions, which lasted over an hour and a half, when he got gradually round and was able to work next day. I ascribe the saving of his life to the rubbing of his breast, as complete asphyxia had taken place with the rigidity of death. Sulphuretted hydrogen is most powerful in its effects on animal life, but when combined with ammonia it seems even more active; one peculiarity of it in both forms, however, seems to be that if you escape with life it leaves no bad effects afterwards. I have myself oftener than once suffered from it, but only temporarily.

With this caution to those who attempt making sulphide of ammonium, and stating that otherwise there is no difficulty in the process, I conclude this communication.

ACADEMY OF SCIENCES.

November 26.

"*New Experimental Researches on the Silkworm Disease,*" by M. J. Pasteur.

"*On Molecular Forces,*" by M. Babinet.

"*Reply to M. de Parville's Remarks on the Analogy between a previously described Instrument and the Continuous Electrophorus,*" by M. Bertsch.

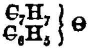
"*On the Geographical Position of Rio de Janeiro,*" by M. Liais.

"*On some Observations concerning the Porosity of Caoutchouc,*" by M. le Roux.

"*Researches on Chloride of Benzyle,*" by MM. C. Lauth and E. Grimaux. Chlorotoluol, C_7H_7Cl, according to M. Cannizzaro, is identical with the hydrochloric ether of benzylic alcohol or chloride of benzyle. Heated with dilute nitric acid, it becomes changed into hydride of benzoyle

$$\Theta_7H_7Cl + 2N\Theta_3H = H_2\Theta + \Theta_7H_6\Theta + HCl + N_2\Theta_4.$$

The change into hydride of benzoyle is more readily effected when chloride of benzyle is treated with acetate of lead These processes give very satisfactory results, and might be commercially available for the preparation of essence of bitter almonds (hydride of benzoyle) and benzoic acid. Essence of bitter almonds is also formed by acting on acetate of benzyle with nitric acid. Heated with water and freshly precipitated oxide of lead, chloride of benzyle saponifies, and produces benzylic alcohol. Thus, starting from chloride of benzyle, we obtain all the terms of the series—aldehyde, acid, alcohol, and ether. Phenate of potassium and chloride of benzyle give rise to phenate of benzyle,



$$\left.\begin{array}{l}\Theta_7H_7\\ \Theta_6H_5\end{array}\right\}\Theta$$

crystallising in small scales. Heated with hydrochlorate of rosaniline, or with free rosaniline and alcohol, chloride of benzyle furnishes a very beautiful and pure violet.

"*On the Action of Acid Chloro-, Bromo-, Iodo-, and Sulpho-Compounds on the Ethyl- and Methyl- Hydrocyanic Ethers,*" by M. Armand Gautier.

"*On the Action of Soluble Salts of Strychnine, associated with Curara, on the Large Cetacea,*" by M. L. Thiercelin. The author proposes to kill whales by poison instead of by the harpoon. He finds that it is necessary to administer a dose of 0·0005 gramme for each kilogramme of animal; therefore a whale weighing about 60,000 kilogrammes would require 30 grammes of the mixed poison. The author accordingly prepared cartridges of poison, and started on a whaling expedition. Ten whales were met with, and had the poison fired into them from a harpoon-cannon; they all died rapidly, eighteen minutes being the longest time required.

"*On a New Instrument, the Iconoscope, intended to give Relief to Plain Images examined with the Two Eyes,*" by M. E. Javal. From the description we judge that this is an instrument similar to one which has long been known in England. It consists of an arrangement of prisms so placed that each eye receives an impression from the same point of view. On looking through the instrument at a picture, the eyes always preserving the same amount of convergence, and being thereby unable to judge that the objects are on a flat surface, the painting has a semblance of relief.

"*On the Vital Qualities of Beer Yeast,*" by M. H. Hoffmann.

"*On a New Process for making Sulphate of Iron,*" by M. Mène.

The Section of Geography and Navigation recommended that Mr. G. H. Richards, of London, should be elected correspondent, in place of Admiral Fitzroy, deceased.

NOTICES OF BOOKS.

Temperature in Acute Disease. By Thos. A. Compton, M.D. (Dub.), B.A., L.R.C.P., M.R.C.S. London: John Churchill and Sons. 1866.

In a pamphlet of about 20 pages, with diagrams, Dr. Compton gives the results of his investigations on the subject of the temperature in acute disease. The cases that have been daily investigated are 200 in number, and these temperatures have been taken at the time of day when a mean result of the temperature of the human body in health may be generally obtained, viz., at 2 p.m. Our author acknowledges with justice the value of the researches of Professor Wunderlich, Dr. Aitken, and Dr. Sydney Ringer. We think that the field is a good one, in which many a student of medicine might gain for himself laurels. Dr. Gibbon states that the normal average temperature of the axilla in a healthy adult is, in his opinion, "97° 4′—*i.e.*, one degree less than the temperature hitherto most generally received as the normal one." Surely one degree should make some difference in diagnosis, and we hope soon to record observations on temperature, which may settle the question. The only way to obtain this is for the varying conditions, ages, temperaments, &c., of healthy people, to be taken into consideration over an extended area, and tables for accurate use to be drawn up, so that we shall not state that x is the abnormal temperature of a patient old or young, but that x is by so much greater or less than the normal y for that age, condition, sex, &c. We believe that the subject is sufficiently fresh for such accuracy to be attained as may be consistent with the demands of ordinary clinical practice. The question is certainly of sufficient interest to repay any amount of labour, careful and accurate, that may be expended upon it, and all who have the power should add their mite. We make these remarks now, because Dr. Compton's book shows how these researches may be carried out, and we may safely recommend it for the purpose. At present we want accurate results without theories. We can endorse the concluding note of the pamphlet:—"The instruments used in these observations were manufactured by Messrs. Casella (of Hatton Garden, London), whose clinical thermometers can always be depended upon. No reliance can be placed on registration taken with the ordinary German thermometers as generally imported into this country, as I have found the error in some of them to be as much as 2° Fahr. when compared with a standard instrument. *English thermometers are, consequently, strongly recommended.*" We may add that good English instruments may also be obtained from Messrs. Cetti and from Messrs. Negretti and Zambra. The methods and instruments for research are within the reach of pathologists; workmen only are now wanted We must protest, however, against the notion that a mass of reports is needed. A few reliable results will be invaluable; a number of inaccurate statements without regard to sources of fallacy cannot fail to retard the success of ultimate results.

NOTICES OF PATENTS.

Dyeing, &c. William Dancer, Cornbrook, Hulme. (Provisional protection only.) Dated March 17.

This invention consists in the production of new purple and blue colours upon textile fabrics or yarns, for which purpose the patentee employs the well-known aniline dye "magenta," and other similar colours. These colours, or salts of these colours, he reduces and obtains leucaniline and similar bodies; having obtained such bodies, he next acts upon them or their salts by means of acetic, aldehyde, acrolein, or other aldehydes, or mixtures of the same. In this manner new compounds are produced, which may be printed or put upon the textile fabrics or yarns, and afterwards submitted to the action of bichromate of potassium or other oxidising agents of a similar kind, when the new colour will be produced and at the same time fixed upon the material employed, the shade of colour produced depending upon the respective quantities of aldehyde and leucaniline. Violets and blues may also be produced by the oxidation of the compounds obtained by acting upon leucaniline by means of iodide of ethyl, iodide of isopropyl, aniline, and benzoic, and similar acids in a similar manner to that employed for their production from rosaniline or its salts. The proportions used are about as follows:—For one gallon of colour take the amount of leucaniline, obtained by reducing four ounces of rosaniline or magenta, boil this for about five minutes with three ounces of aldehyde, precipitate with caustic soda or lime, and dissolve the precipitate in one gallon of dilute acetic acid.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

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

2168. W. Welch, King Street, Southsea, Hants, "Improvements in the manufacture of cement compositions, and in the method of applying and securing plastic cements to iron and other surfaces."—Petition recorded August 23, 1866.

2779. J. Sharp and R. Smith, Blackford, Perth, N. B., "An improved explosive compound or powder."—October 27, 1866.

2873. N. F. Taylor, Manby Street, Stratford, Essex, "Improvements in means for operating on air or aëriform fluids by hydrocarbons for purposes of illumination."—November 6, 1866.

3002. W. Grüne, Berlin, Prussia, "A chemical decoration on gold, silver, and other similar metals, and colours on porcelain, glass-wares, crystal-wares, delft-wares, potters'-wares, and similar matters, called 'Grüne's proceeding.'"—November 15, 1866.

3014. A. E. Blavier, Angers, France, "A proceeding of conservation of cereals and substances, alimentary, vegetable, and animal."—November 17, 1866.

3030. A. P. Price, Lincoln's Inn Fields, "Improvements in the manufacture of carbonate of soda." A communication from Dr. A. Blügel, Utrecht, Holland.—November 19, 1866.

Notices to Proceed.

1846. A. Prince, Charing Cross, Middlesex, "Improvements in the means of preserving timber from decay." A communication from G. P. Ball, New York, U.S.A.—Petition recorded July 13, 1866.

1885. R. Irvine, Magdalen Bridge, Mid Lothian, N.B., and P. Brash, Leith, Mid Lothian, N.B., "Improvements in the treatment of certain residues in order to obtain fatty acids therefrom."—July 19, 1866.

1915. G. Mountford, Grasscroft, near Greenfield, Yorkshire, and G. L. Loveridge, Hayes Street, Manchester, "Improvements in the tanning of hides and skins."—July 23, 1866.

2204. H. A. Dufrené, Rue de la Fidélité, Paris, "Improvements in the manufacture of beer and other alcoholic liquids, and in the apparatus employed therefor." A communication from C. Tellier, Rue Boulainvilliers, Passy, Paris, August 27, 1866.

2778. E. Howard, Redhill, Surrey, "Securing perfect immunity from danger in the use of paraffin, camphine, and other lamps, liable hitherto to explode, whether fed by rock oil, crystal oil, paraffin, camphine, belmontine, or other combustible carbonaceous oils."—Oct. 27, 1866.

2924. W. E. Newton, Chancery Lane, "Improvements in treating vegetable substances chiefly applicable to the manufacture of paper pulp and fibres." A communication from B. C. Tilghman, Philadelphia, Penn., U.S.A.—November 9, 1866.

CORRESPONDENCE.

Decomposing Water with the Induction Coil.

To the Editor of the Chemical News.

Sir,—Can any one inform me if, by any arrangement, it is possible to decompose water by the induction coil? I have tried the experiment, but failed—the current passing through the acidulated water without producing any perceptible effect. Is not the current of the coil alternately positive and negative, thus neutralising itself?

I am, &c. E. W.

Manufacture of Iodine.

To the Editor of the Chemical News.

Sir,—Like your correspondent, Mr. Paterson, I have been a subscriber to the Chemical News since the commencement of its publication. I have also observed the inquiry in reference to iodine in No. 364, and Mr. Paterson's reply in No. 365; but as he has omitted to give the names of any manufacturers except himself, I beg to subjoin the following, which, I believe, includes the names of all the iodine manufacturers in Great Britain:—William Paterson, Glasgow; John Ward and Co., Glasgow; The British Seaweed Company (Limited), Dalmuir, near Glasgow; John Carrol, Mile-end, Glasgow; F. R. Hughes and Co., Borrowstouness; John Loughran, Ramelton, Ireland; The Irish Marine Salt Company (Limited), Galway.

I am, &c. Kelp.

Glasgow, December 3.

Durability of the Atlantic Cables.

To the Editor of the Chemical News.

Sir,—It seems to me that Mr. Spiller's communication respecting the duration of the Atlantic cables is calculated to inspire unnecessary alarm. He seems entirely to have overlooked the fact that the iron sheathing of the cables was merely provided to give sufficient weight to sink them, and also tensile strength sufficient to overcome the immense strain exerted on them while suspended in the ocean. No strain exists upon them now, lying as they do half sunk in silt in the bed of the Atlantic. The only parts about which anxiety may be felt are the shore ends and those portions passing over the Irish bank. But the former may be renewed at any time without affecting the main cables, and the latter we must suppose to lie upon the declivity in such a manner, owing to the large amount of slack there paid out, that no strain is felt upon them any more than in other parts of the cables.

The iron sheathing being eaten away does not destroy the cables, as the double insulating case is quite unacted on by the salt water. But there is no reason to suppose that the iron sheathing will be so rapidly eaten away. For three reasons I argue that it will last a great length of time. Firstly, owing to the protection afforded by the hemp (which might, however, have been tarred); secondly, that owing to the stillness of the water at such depths the stratum of ferric chloride formed will prevent, by its slow diffusiveness, fresh sea water from acting on the iron; and thirdly, the silt will be slowly and continuously deposited on the cables, forming an impervious siliceous or calcareous sheath. There is, I think, therefore no reason to fear the loss of the cables for many years to come.

I am, &c. T. B.

MISCELLANEOUS.

Disinfectants and Deodorisers.—The Lords of the Admiralty have ordered that the use of Burnett's disinfecting fluid shall be discontinued in the Royal Navy, in consequence of several fatal cases of poisoning having occurred, from its having been accidentally swallowed by seamen. Moreover, it has been discovered that the Burnett's fluid is not a disinfectant, but only a deodoriser. Carbolic acid is now to be used throughout the fleet.

The Royal Society.—At the general meeting of this Society on November 30, the following elections took place:—*President*—Lieut.-General Edward Sabine, R.A., D.C.L., LL.D. *Treasurer*—William Allen Miller, M.D., LL.D. *Secretaries*—William Sharpey, M.D., LL.D., and George Gabriel Stokes, Esq., M.A., D.C.L., LL.D. *Foreign Secretary*—Prof. William Hallows Miller, M.A., LL.D. *Other Members of the Council*—Lionel Smith Beale, Esq., M.B.; William Bowman, Esq; Commander F. J. Owen Evans, R.N.; Edward Frankland, Esq., Ph.D.; John Hall Gladstone, Esq., Ph.D.; William Robert Grove, Esq., M.A., Q.C.; William Huggins, Esq.; Thomas Henry Huxley, Esq, Ph.D.; William Lassell, Esq.; Prof. Andrew Crombie Ramsay, LL.D.; Colonel William James Smythe, R.A.; William Spottiswoode, Esq., M.A.; Thomas Thomson, M.D.; William Tite, Esq.; Vice-Chancellor Sir W. P. Wood, D.C.L.; and the Lord Wrottesley.

Royal Polytechnic Institution.—On Monday evening, at the invitation of Mr. Pepper, we witnessed a new optical illusion at the Polytechnic—the Decapitated Head. Many of our readers are well acquainted with the optical principles on which these illusions depend, but it is well worth a visit to see the detail carried out in the way that it is at this Institution. The Cherubs still float in the air, so that there are now two of these very clever illusions exhibited here. Some of Dr. Tyndall's experiments have also been brought recently before the public in the lecture on Combustion by Invisible Rays. Experiments showing the propagation of waves were shown, also the effect upon sulphate of quinine paper of the ultra-violet rays of the spectrum. The absorbent power of a solution of iodine in bisulphide of carbon over luminous rays, and its transparency to heat rays, was rendered strikingly evident by igniting paper, a cigar, etc., when such bodies were held in the focus of the rays issuing from the electric lamp after passing through the solution. At the conclusion of the lecture, the attention of the audience was drawn to the improved ventilation of the theatre; there is now no fault to be found in this respect, although previously it was very imperfect. In this brief notice we have confined ourselves to the more scientific part of the entertainment, but visitors who prefer lighter amusement are also provided for. We understand many novelties are in preparation for Christmas, and those who have watched the success which the energetic director has met with each year, both in the scientific novelties and popular entertainments provided for his holiday audience, will have no reason to fear that such judiciously administered doses of science will ever be unpopular with the rising generation.

On the Effect of Temperature on Organic Matter in Water.—Dr. Frankland writes: "With regard to the temperature at which the putrefaction and decay of organic matter in water take place, I find that the following is all that appears in the printed report of my evidence on the subject in the case 'Duke of Buccleuch and others *v.* Alexander Cowan and others,' recently tried at Edinburgh. 'Where a river becomes sluggish—as where it is pent up by a weir—the quantity of organic matter, and also of mineral matter, increases in some cases very considerably; but that is only the case in warm weather, and the temperature of the water must be 55° Fahrenheit and upwards, for this effect to be produced. The putrefaction of the mud in the bed of the river ensues, and the previously insoluble matter becomes soluble matter.' The safest and most sensitive test of putrefaction in water is the relative proportion of oxygen to nitrogen in the dissolved gases. The river North Esk as it flowed through the Duke of Buccleuch's grounds at Dalkeith Palace, in March and in June last, afforded striking evidence of this kind as to the effect of temperature upon the absorption of oxygen by the organic matter of water (it is only when the whole of the oxygen dissolved in the water is consumed, that the latter assumes a true and offensive putrefactive condition). On the 3rd of March the temperature of the water in the North Esk was 38° Fahrenheit, and the proportion of oxygen to nitrogen in the dissolved gases was $O:N = 1:2{\cdot}02$. This is the normal proportion in water free from organic matter. On the 21st of June the river emitted a putrid odour, the temperature of the water was 60° Fahrenheit, and the proportion of oxygen to nitrogen was $O:N = 1:25$; thus the amount of dissolved oxygen was reduced to a mere trace, and the organic matter was in a putrescent condition."

Storm Warnings and Weather Reports.—The Board of Trade has issued the following circular, dated November 29:—"The Board of Trade have had under consideration the report of a committee appointed by the Royal Society, the Admiralty, and the Board of Trade, to inquire into the constitution and functions of the Meteorological Department, which recommended, as the most important step to be taken, the transfer of the management of the business of the department to a scientific body. The Board of Trade have also consulted the Royal Society on the subject of this report, and the President and Council of the Royal Society concur generally in the measures recommended by the committee, and are prepared to undertake the duty proposed to them. With regard to the issue of storm-warnings, the President and Council of the Royal Society are of opinion that 'at present these warnings are founded on rules mainly empirical,' and, therefore, should not be issued under the superintendence of the scientific body to whom the discussion of meteorological observations will be committed. The President and Council think, however, that 'in a few years they may probably be much improved by deductions from the observations in land meteorology, which will by that time have been collected and studied; and that the empirical character may thus be expected to give way to one more strictly scientific, in which case the management of storm-warnings might be fitly undertaken by a strictly scientific body.' Under these circumstances the Board of Trade are compelled to suspend, from December 7 next, 'Cautionary Storm Warnings,' which have from time to time been issued by the Meteorological Department of the Board of Trade.

It is hoped that the warnings may be resumed by the new Meteorological Department at no distant time upon an improved basis. In the meantime the daily 'Weather Reports' will be received and published as heretofore. If at any port or place there is a desire to have these reports, or any part of them, communicated by telegraph on the morning on which they are received, they shall be so communicated on a request to that effect being sent to the Board of Trade, accompanied by an undertaking to pay the expense of the telegram from London to the port or place.—T. H. Farrer."

Crystal Cod-liver Oleine.—Some weeks ago we noticed an essay by Bedford Brothers on cod-liver oleine. We have seen the oleine, and can say that it is, as described, of a pale amber colour, almost destitute of odour, and so tasteless as to be unobjectionable. The oil bears subjection to an extreme degree of cold without signs of deposit of solid fatty matter, and is virtually a pure oleine, the quantity of stearine or margarine present being so small as to exclude the idea of any medicinal action being derived from them. We are not called upon to offer any opinion as to the medicinal advantages of oleine over margarine, but medical practitioners of eminence have found that the oleine of cod-liver oil is the best constituent. It is unnecessary for us to enter into detail, but we may state that it would be difficult for a cod-liver oil to be offered of a more palatable character than the crystal oleine in question.

New Process for extinguishing Fires.—Our attention has been drawn to a new process for extinguishing fires in mills, steamships, and other buildings, by means of carbonic acid and nitrogen gases, which has recently been patented by Messrs. Dawson and Co., of Milnsbridge, Huddersfield. The process can be carried out with a facility which could have been hardly expected. By forcing the enormous volume of gases, which arise from the combustion of ordinary fuel in furnaces of ordinary steam boilers, &c., first through a cooling chamber, and thence into a room, it is easy to maintain outward currents of those gases for any length of time, through any reasonable amount of openings, such as broken windows, crevices, &c., which are likely to exist; and thus in effect to completely seal the room from the external atmosphere, and also to keep the temperature so low as not to injure the most delicate materials or machinery. On July 25 last about 1000 persons assembled in the vicinity of the chemical works of Messrs. Dawson and Co., to witness an experiment made by the patentees. It was determined by the firm to set on fire an upper room of one of their numerous buildings, in which should be placed a large pile of wood and shavings, sprinkled with spirits of wine and other inflammable liquids, so as to prove, to a demonstration, the power of the patent. The room, about 100 feet by 20 in size, was lighted in several places simultaneously, and very quickly the flames, burning bright and clear, were seen by the whole of the persons present. No doubt whatever was entertained but that the fire had got a firm hold, and if the patent was not genuine, the mill would shortly be burned to the ground. One of the firm then went round to where the appliance was situate, and set the apparatus to work. In less than one minute, the fire, which had been gaining in intensity every moment, owing of course to the ignitable nature of the material in the room, was put out, and not a vestige of its presence remained, except in the blackened roof and sides of the building, and the charred wood and shavings in the room. The gases were conducted into the room where the fire existed by means of flues; and as soon as a certain proportion of these gases to the atmospheric air in the room was arrived at, combustion was at once arrested. The necessary gases can be obtained in great abundance, and for any length of time, at a very short notice and at a small cost—three or four tuns not costing more than a few shillings. Numerous experiments made upon the gases taken from chimneys, under varying circumstances, have proved that they can easily be obtained of the proper quality for the purpose. It has been found that, by ordinary good firing with covered grates, the oxygen of the atmosphere is thoroughly consumed by the fuel, and even that the gases are efficient with one-third of their volume of atmospheric air in admixture.

Agates.—The Reese River (California) *Reveille* says, that about three miles north of Ione there is an isolated mountain, some five hundred feet high, which is called Agate mountain. Its entire surface upon all sides from summit to base, is covered with agates and concretions, and on digging into the soil they are found like potatoes in a hill. The agates are usually oval and sometimes globular in form, and varying from one to four inches in diameter, and are beautifully banded and striped. In the hands of a skilful lapidary they could be fashioned into pleasing ornaments. The various concretions are found in great abundance, and many of them are particularly beautiful. In their sphericity they are sometimes found as perfect as a ball, though generally the spherical shape is quite distorted. They are hollow, and usually filled with crystals. On breaking them open their interior is often found to be irregularly hollow and lined around with a layer of quartz crystals, forming what is termed a geode—a "little crystal grotto." Some of these hollow concretions contain a smaller concretion inside, which rattles when shaken in the hand.—*Drug. Circ.*

Meetings for the Week.

Monday, December 10.
Medical Society, 8 p.m.
Tuesday, December 11.
Royal Medical and Chirurgical Society, 8½ p.m.
Photographic Society, 8 p.m.
Wednesday, December 12.
Society of Arts, 8 p.m.
Thursday, December 13.
Royal Society, 8½ p.m.
Friday, December 14.
Astronomical Society, 8 p.m.

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. XIII. 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., II., and VII. are out of print. All the others are kept in stock. Vol. XIV. commenced on July 6, and will be complete in 26 numbers.

Chemi.—Small specimens of indium are to be obtained at some operative chemists' in London; but the price is by no means low.

H. S. P.—We do not know that any special account has been given of the method employed in blasting underground with gun cotton. Can any of our readers favour us with the required information?

Phototype wishes to be informed where he can meet with an account of the experiment in which a ray of light falling on a silver plate has deflected a galvanometer.

W. Skey.—We have to thank our correspondent for two additional papers—No. 8, "*On the Effect of Ammoniated Copper upon Vegetable Fibre*," and No. 9, "*On the Nature of the Gas which is given off from Fresh Charcoal when immersed in Water.*" Their publication shall follow that of the papers already in hand.

An Exhibitor.—You had better apply at the office at South Kensington. If your allotment is not taken possession of by February 15, they will be treated as resigned, and appropriated to the purposes of the exhibition. We believe March 10 will be the last day on which chemicals can be deposited in the building.

Received, with thanks.—Dr. Letheby; J. Cliff.

Books Received.—"Inorganic Chemistry," by Geo. Wilson, M.D.; revised and enlarged by S. MacAdam, Ph.D., &c.—"Elements of Chemistry;" Part III., Organic Chemistry, by W. Allen Miller, M.D., &c.

THE DISCOVERY OF THE SODIUM AMALGAMATION PROCESS.

OF all controversies, those relating to priority of discovery are the most uninteresting both to the claimants and to the public, the most difficult to settle, and the most unsatisfactory when settled. It has been my misfortune already to pass through one such controversy, in which the points at issue turned upon the question whether April, 1861, or May, 1862, happened first in chronological order, and whether May 1 occurred before or after May 16; and I have been resigned, after a wearying and harassing argument, extending over many months, to abandon the contest for Continental recognition as hopeless; for, in spite of all my efforts, it appears to have been decided, by the weight of academic and personal influence, that in French scientific works thirteen months are to be blotted out of the chronology of discovery.

It seems as if a similar controversy were imminent with respect to sodium amalgamation. Some courteous, straightforward, and most flattering remarks[*] of Professor Henry Wurtz, of New York, have been seized upon by certain writers in English newspapers, and by them either garbled and twisted into an insinuation of unjustifiable misappropriation,[†] or assumed to be sufficient reason for the entire suppression of my name.[‡]

It is very probable that anything I may adduce in answer to these newspapers will fail to neutralise the effect of their remarks. An error, once circulated by the press, retains the vitality of its injurious influence to all time, for an accusation of this sort has a piquancy which its refutation seldom possesses. And were it not that my silence, actuated really by utter weariness and detestation of barren and fruitless controversy, has already been misconstrued into concession, and that, persisted in longer, it might seem to justify that interpretation, I should assuredly have allowed such trifles to pass unnoticed.

In reply, then, to Professor Wurtz's remark about concession, may I be allowed to state that in questions of priority of discovery it is quite out of the power of either claimant to make concessions to the other? The settlement of the question must rest upon certain dates and facts; and all we can do is, to state these data clearly and temperately, and to receive with equanimity whatever decision may logically be deduced from them; therefore, the "concession" of a date or fact means the suppression of a truth.

It is a very common error in scientific ethics that "priority of publication constitutes priority of discovery." I venture to say that this rule has no existence, and, from the nature of the case, it can and ought to have none. Professor Asa Gray, one of the leading scientific men in the United States, has commented very clearly on this point, and his decision is now universally accepted. He says[§]:—"The fact of a *discovery* is to be established by evidence, and no sort of evidence by which it may be established can be excluded. Abundant illustrations of this may be adduced from the history of almost every science. The rule which has here been misapprehended is one which fixes *nomenclature*. Naturalists have established, and physicists adopted, the very necessary rule that the publication is essential to give reality to a *name*, that the name first published takes precedence. The discovery of a fact or a thing, and the imposition of a name, are two different matters, and not rarely dissociated. The first is to be established by any good evidence; the second is governed by an arbitrary but most just rule."

The date of a discovery is a question of *fact*, and not a question of nomenclature, and may be authenticated by whatever testimony can be adduced.

Now, supposing that this question of priority involved any scientific honour, any pecuniary advantage, or were even likely to interest any one in the remotest degree, I could prove that, as long ago as 1861, the sodium amalgamation process was not only matured in my mind, but fully described on paper and handed by me to a well-known New York firm for publication. I could show that it has been a common topic of discussion with my scientific friends any time within the last seven years;—that in 1864 the process was so much a matter of conversation, that I was urged to lose no time in securing my rights by a patent;—that about the same time successful experiments on a somewhat large scale were conducted at Manchester on rich Californian quartz;—that early in 1865 equally conclusive experiments were tried in conjunction with Mr. Readwin, both at Manchester and in North Wales;—that the first publication of the process in this or any other country (even antedating that of both our patents) was communicated personally by myself to the editor of the *Mining Journal*, and by him published in June, 1865. All this would not be difficult to prove.

No doubt Professor Wurtz, did he care about it, could adduce similar evidence, which would prove beyond a doubt that he also had an acquaintance with the process before he patented it: but *cui bono*? There being neither honour nor profit, but only worry and loss of time, to be derived from this unsatisfactory exhumation of evidence, why will contemporary writers not allow Professor Wurtz and myself the credit of *each* having made an independent discovery? The history of invention abounds

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[*] "I shall but refer briefly to the conflicting claim to priority of discovery which was entered by Mr. Wm. Crookes, one of the most learned, industrious, and successful of the English scientists. The graceful concession of this point which Mr. Crookes is considered of late, both by scientists and jurists, to have made, by his own silence, and by publications in the journals ostensibly authorised by him, it is thought will not prove any appreciable detraction from the laurels so well and worthily won by him in the field of chemical discovery." From a paper on "The Utilisation of Sodium in Gold and Silver Amalgamation," read before the American Association for the Advancement of Science, by Prof. Henry Wurtz, of New York City. See also *Silliman's Journal*, vol. xli, p. 216.

[†] ". . . More especially as in England we are accustomed to attribute its origin to one who has already had the annoyance of having his right to another chemical discovery seriously disputed . . . Dr. Wurtz has fair grounds for demanding at least some explanation from Mr. Crookes to account for the apparent plagiarism." —*Mining Journal*, April 13, 1866.

[‡] ". . . Professor Henry Wurtz, of New York, the gentleman to whom the honour of having discovered the sodium process is now generally conceded."—*Mining Journal*, November 24, 1866.

"The honour of having discovered the sodium process is generally conceded to Professor Henry Wurtz, of New York."—*Mechanics' Magazine*, November 30, 1866.

[§] *Silliman's Journal*, September, 1863.

with analogous cases, and I am willing to believe that the discovery of the practical value of sodium in gold and silver amalgamation was a *bonâ fide* discovery on the Professor's part, as I hope he believes it to have been on mine. But for me to concede the discovery—that is, to admit that I have no claim to the credit of *originality* —is as much out of my power as it is far from my intention, involving as it does both the suppression of facts and the possession of an unreasonable amount of self-abnegation.

William Crookes.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

*The Polymeres of Acetylene: Second Part, Benzol,** *by M.* Berthelot.

Benzol is the principal, but not the only, product of the condensation of acetylene. The following are my observations on the subject:—

I. 1. The liquid obtained by this condensation begins to boil at about 50°, and furnishes, first a mobile and very volatile carbide, with a penetrating and alliaceous odour; concentrated sulphuric acid absorbs and destroys it immediately, taking a red colour. It is probably diacetylene—

$$C_8H_4 = 2C_4H_2.$$

But I have not been able to obtain it in sufficient quantities for examination.

2. Then comes benzol, or triacetylene—

$$C_{12}H_6 = 3C_4H_2.$$

The boiling point rises rapidly from 90° to 135°. Between 135° and 160° I collected styrol or tetracetylene—

$$C_{16}H_8 = 4C_4H_2.$$

The proportion rises to about a fifth of the total product. This carbide appears to me perfectly identical with the styrol furnished by the decomposition of cinnamate of potash, according to the following characteristics: —1. Boiling point; 2. Odour; 3. Action of sulphuric acid (transformation of the carbide into polymeres; 4. Action of fuming nitric acid; Action of bromine (production of characteristic crystallised bromide); 6. Action of free iodine (immediate transformation of the carbide into polymeres); 7. Action of ioduretted iodide of potassium (immediate formation, without the aid of heat, of iodide of styrolene in beautiful crystals, spontaneously destroyed in less than an hour, with regeneration of the iodine and formation of a polymere). No other carbide among those I have tested has produced an analogous crystallised iodide, under the influence of the same reagent.†

I have ascertained that tetracetylene possesses all these peculiarities, and notably the specific formation of crystallised bromide and iodide.

4. After styrol, the boiling point rises rapidly to about 210°. I collected separately what passed between 210° and 250°. This product remaining liquid, I placed it in a refrigerating mixture, which determined the separation of a crystallised body; I expressed it from the mixture, and then recrystallised it. It proved to be naphthaline, $C_{20}H_8$, which I verified by its properties in the free state, by the formation of nitronaphthaline, finally by examining the combination formed by this carbide with picric acid dissolved in alcohol. This characteristic combination was discovered by M. Fritzsche.

Naphthaline is here derived from 5 molecules of acetylene, with separation of hydrogen—

$$C_{20}H_8 = 5C_4H_2 - H_2.$$

It seems to me probable that the liquid in which it was dissolved may be pentacetylene—

$$C_{20}H_{10} = 5C_4H_2,$$

formed directly by acetylene, but soon partially decomposed, with loss of hydrogen, and thus producing naphthaline—

$$C_{20}H_{10} = C_{20}H_8 + H_2.$$

Naphthaline is also formed, but in much smaller quantities, by passing pure acetylene through a tube, heated to bright redness, when it is resolved almost entirely into carbon and hydrogen.

5. Between 250° and 340° there passed various liquids, possessing in a high degree the fluorescence characterising pyrogenous resin-oils and others analogous to them. These liquids cooled quickly, furnished no crystals. I have not otherwise studied them, for want of means of comparison; but it seems to me likely that they contain polymeres six, seven, and eight times condensed.

6. Towards the boiling point of mercury a considerable quantity of a crystallised carbide was distilled, in the form of brilliant plates, impregnated with liquid. After being purified, this carbide had the properties of retene, and, with picric acid, furnished the compound discovered by M. Fritzsche.‡

I will here mention that retene has been obtained by M. Knauss by distilling a tar from resinous wood, and examined by M. M. Fehling. This carbide is very important, on account of its diffusion; not only is it found in pyrogenous products, but it has also been observed in various turfs and fossil resins; the bodies called fichtelite, scheererite, and phylloretine, are identical with retene.

After its generation by means of acetylene, retene must be regarded as enneacetylene—

$$C_{36}H_{18} = 9C_4H_2.$$

7. This was not the end of the condensation. After it had passed, tarry products remained in the retort. Part of it was still capable of being distilled, while the rest was destroyed, with formation of carbon. I have not fully studied these substances.

II. Great light is thrown upon the formation of pyrogenous carbides by the preceding facts, and by those I have already published on the direct combination of acetylene with other carbides. The process by which is effected the progressive accumulation of organic molecules, to form complex derivatives, is here clearly shown, and it furnishes a demonstration of the theory by which I interpreted the simultaneous formation of the carbides $C_{2n}H_{2n}$, in the distillation of formiates and acetates. But while the condensations take place only on the nascent carbides C_2H_2, in the latter case, on the contrary, acetylene gives an example of a carbide quite as simple, and capable of similar condensations, directly and in the free state.

I will here observe that the explanation of the theory of homologues may be found in synthetical phenomena. Nevertheless, it must not be regarded as a particular consequence of the polymeric condensation and the

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* *Comptes Rendus*, lxiii., 515.

† It only succeeds with pure, or nearly pure styrol, iodide of styrolene being very soluble in liquid carbides, and not being capable of reproduction by the evaporation of its solutions.

‡ I have compared this carbide with a specimen of retene kindly supplied by M. Fritzsche.

ulterior combination of polymeric carbides with other bodies, simple or compound. Thus is explained, to confine ourselves to an example from the homologous bodies, the parallelism of the benzoic series, derivatives of triacetylene, with the styrol series, derivatives of tetracetylene.

$C_{12}H_6 = (C_4H_2)_3$, benzol.
$C_{14}H_6O_1 = (C_{12}H_6)C_2O_4$, benzoic acid.
$C_{14}H_6O_2 = (C_{12}H_6)C_2O_2$, benzylic aldehyde.
$C_{14}H_8O_2 = C_{12}H_4(C_2H_4O_2)$, benzylic alcohol.
$C_{36}H_{30}O_2 = C_{12}H_4(C_{14}H_{26}O_2)$, sycocerylic alcohol.
$C_{16}H_8 = (C_4H_2)_4$, styrol.
$C_{18}H_8O_4 = (C_{16}H_8)C_2O_4$, cinnamic acid.
$C_{18}H_8O_2 = (C_6H_8)C_2O_2$, cinnamic aldehyde.
$C_{18}H_{10}O_2 = C_{16}H_6(C_2H_4O_2)$, cinnamic alcohol.
$C_{52}H_{44}O_2 = C_{16}H_6(C_{36}H_{38}O_2)$, cholesterine.

This parallelism shows the possibility of the existence of a multitude of as yet unknown styrol derivatives, and more generally that of the regular derivatives of various polyacetylic series.

Remarks on M. Stas's Memoir on Atomic Weights, by M. MARIGNAC.

FIVE years ago[*] I gave an account of a memoir by M. Stas on atomic weights. After having bestowed on this remarkable work the praise it justly deserved, and having also declared that the author appeared to me to have attained the utmost limit of accuracy possible in researches of this nature, I took the liberty of expressing some doubts, not on the exactitude of his determinations, but on the certainty of the conclusion he drew from them—*i.e.*, that no simple relation exists between the atomic weights of bodies. I expressed a wish to see these determinations repeated by more varied methods, in order that it might be proved that the variations which would result from them in atomic weights, were far from reaching the differences which manifest themselves between the numbers thus attained and those which must be admitted if simple relations between the atomic weights of different bodies are supposed; and that these differences cannot be attributed to anomalies in the composition of the combinations used in analysis in the determination of atomic weights.

In the preface of his new memoir[†] M. Stas combats this objection, exaggerating its signification. He considers it as the negation of the principle of definite proportions and the invariability of atomic weights. I never gave it such a signification, nor had I any idea of casting a doubt on this fundamental principle of chemistry.

But I ask if it may not happen that certain compounds (though they appear to us to offer very definite characters and a constant composition) may contain a little excess of one or other of their elements, in consequence of the particular conditions which must have been fulfilled for their preparation and purification. As an example I quote monohydrated sulphuric acid, which it was for a long time believed must have a perfectly definite composition, when in such a state as to experience no further change by ebullition; whilst it is now certain that it then contains a minute excess of water. This is no reason why there should not be a monohydrate of perfectly normal composition, such as is obtained by crystallisation. I confess that I shall maintain the doubt which I then expressed for each compound, till it shall have been proved by rigorous comparative experiments, that the methods employed for its preparation really produce it in a state of absolute purity. I hasten to say that M. Stas's new experiments prove to me most satisfactorily that the objection I had raised has no foundation for any of the bodies on which this *savant* had grounded his determinations. But his works themselves show us what caution must be observed before certifying that a body has been obtained in a state of purity. Has he not, indeed, proved that iodide of silver prepared by means of the nitrate of this metal cannot in any way be divested of an excess of this salt, and that hitherto it has been absolutely impossible for him to obtain a chloride of potassium which does not contain a trace of silicic acid?

If certain bodies cannot be completely purified from mixture with a foreign substance, may it not also happen that, in a similar state of mixture, they possibly contain an excess of one of their elements? Be this as it may, I do not at all regret having raised these objections, if they have in any way contributed to the production of the new series of researches which M. Stas has just published. It is a magnificent work, which will remain a model of patience and perseverance in surmounting difficulties, and of ingenious methods for carrying analytical and synthetical experiments to the highest degree of precision.

But it would be impossible to give an idea of it by an extract. It is a book to be consulted by all chemists who wish to devote themselves to researches requiring rigorous exactitude. I must confine myself to remarking some of the most important results obtained by the author.

The first memoir is devoted to proving the constancy of chemical proportions. To this end M. Stas first determines the relation between chlorides of ammonium and silver, by varying the conditions of preparation of the first salt, and by ascertaining its reaction on the solution of silver, whether cold or at 100°. The constancy of the results obtained in these different circumstances proves that chloride of ammonium and chloride of silver present no perceptible variation in their composition.

Another proof of the invariability of chemical proportions is given by a series of experiments relative to the transformation of chlorate, bromate, and iodate of silver into chloride, bromide, and iodide, under the deoxidising influence of sulphuric acid. M. Stas shows, by taking the minutest precautions and by working on very considerable weights of materials, that these transformations take place with the most perfect exactness, without any trace of silver or of chlorine, bromine, or iodine being found in excess. In the following memoirs M. Stas (whether by the same or by new methods) repeats the determination of the atomic weights which he had established a few years ago, and thus responding to the wish I had expressed, he shows that various methods, resting on the synthesis or analysis of entirely different compounds, lead to almost identical results. This gives a fresh confirmation to the law of chemical proportions. As examples, I quote the results obtained for silver and nitrogen.

The mean atomic weight of silver is:—

1st. By synthesis of the sulphide and analysis of the sulphate	107·920
2nd. By synthesis of the iodide and analysis of the iodate	107·928
3rd. By synthesis of the bromide and analysis of the bromate	107·921
4th. By synthesis of the chloride and analysis of the chlorate	107·937

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[*] *Bibliothèque Universelle de Genève*, December, 1865, t. xxiv., p. 271, and CHEM. NEWS, vol. v., p. 57.

[†] *Archives des Sciences Physiques et Naturelles* (Nouvelle Période), t. ix., année 1860, p. 97, and CHEM. NEWS, vol. xiv., pp. 75, 87, 205, 218, 229, 241.

The atomic weight of nitrogen is:—

From the relation of chloride of potassium to the nitrate	14·043
From the relation of chloride of sodium to the nitrate	14·048
From the relation of chloride of lithium to the nitrate	14·046
From the relation of chloride of silver to the nitrate	14·044
According to the synthesis of nitrate of silver	14·042

It may be judged by the comparison of these numbers to what a degree of precision the author has attained in such difficult researches, and how impossible it is to attribute to errors of experiment the differences which appear between these numbers and those required by Prout's law—*i.e.*, 108 for silver and 14 for nitrogen.

In conclusion, as a summary of this immense work, these are the atomic weights which result, for some simple bodies, from M. Stas's experiments. I have compared his recent determinations with those he had obtained in his first work, to show how little modification the latter have required, notwithstanding the unheard-of precautions to which he has subjected himself in his new experiments. These numbers are related to the atomic weight 16, adopted by hypothesis for oxygen. In this table I have entered the atomic weight of hydrogen, which is admitted by the author to be most probable, according to the *ensemble* of the researches relative to this body:—

	1865.	1860.
Oxygen	16	16
Hydrogen	1·025	—
Silver	107·930	107·943
Nitrogen	14·044	14·04
Bromine	79·952	—
Chlorine	35·457	35·46
Iodine	126·850	—
Lithium	7·022	—
Potassium	39·137	39·13
Sodium	23·043	23·05
Sulphur	—	32·074
Lead	—	206·91

According to M. Stas, the examination of these numbers entirely justifies the conclusion which he had announced in the sequel of his first work—*i.e.*, that Prout's law is a pure illusion, and that no simple relation exists between the atomic weights of bodies.

I can now raise no further doubt as to the exactitude of the preceding numerical results, and I quite acknowledge, with M. Stas, that the atomic weights of bodies do not strictly present the simple relations which Prout's hypothesis would require.

But it is impossible for me to allow that it can be a simple effect of chance which causes nine at least out of these twelve bodies to have weights represented by numbers which only differ from entire numbers by quantities infinitely less than those which would have been foreseen by the calculation of probabilities. Indeed, the mean deviation which, for such a large number of bodies, ought to approach 0·5, is, on an average, only ~~0·09~~, even by taking chlorine into this general calculation; it is only 0·068 if this element is set aside as belonging, perhaps, to another group.

Nevertheless, it seems to me useless to enter into this discussion, for I could only repeat the observations which I had offered at the sequel of M. Stas's first memoir.

I shall only add that this question cannot be solved with very great probability till the atomic weights of most bodies are known to us with as much certainty as those which M. Stas has determined. But if, in these future determinations, there is found the same proportion of bodies whose weights approach entire numbers in such a remarkable manner, it seems to me impossible not to rank Prout's law with those of Mariotte and Gay-Lussac, and equally impossible not to admit the existence of an *essential* cause, by virtue of which all atomic weights ought to present simple relations, recognising, at the same time, *secondary* causes, leading to slight perturbations of these relations.

Action of Alkalies upon the Ferro- and Ferri-cyanides of Iron, by WILLIAM SKEY, *Analyst to the Geological Survey, New Zealand.*

It is generally set forth in those chemical works which treat upon these substances that "their colour is instantly destroyed by alkalies," but from the results of a few experiments made upon them, it appears this statement requires some qualification.

Thus, if either of these compounds is treated with a very weak solution of caustic or carbonated alkali, the colour thereof receives such an accession in its intensity as to rival the colour of indigo blue.

If a solution of "Turnbull's blue" is employed, the change of colour is very marked, while the solution keeps as clear as before. If used for writing purposes, it gives an intense blackish-blue ink on drying, and which is of some permanency; the addition of a certain quantity of ferricyanide of potassium affords a bright green ink.

Like the aqueous solution of basic Prussian blue, these compounds are precipitated from their solution by the addition of alcohol or soluble salts, especially if these have strong affinity for water.

It appears that the change in the intensity of the colour is caused by the abstraction of a portion of the ferro- or ferri-cyanic acid, for if these compounds are repeatedly washed with water until nothing more is dissolved from them, the addition of the alkali in quantity only sufficient to produce these changes, immediately brings either of these acids into solution.

A great excess of carbonate of ammonia, by virtue of the action it exercises upon the oxides of iron, dissolves these blue compounds, forming with them pink or red solutions, which, when spread upon paper, are at first almost invisible, but gradually darken if an excess of ferricyanide has been used. The final colour is bright green.

These reactions appear both interesting and suggestive—interesting as affording other instances of indigo-blue-coloured compounds of iron, to add to those of the tannate, gallate, and phosphate, and suggestive as intimating the possibility that in all these ferri- and ferro-compounds of iron the metal is in the same state of oxidation as it is in these other salts above alluded to.

March 9.

Chemical Society.—The next meeting of the Society will be held on Thursday evening, at 8 o'clock, when the following papers will be read:—"*On the Basicity of Tartaric Acid*," by Mr. Perkin; "*On the Absorption of Vapours by Charcoal*," by Mr. J. Hunter; "*On the Reactions of Hydroiodic Acid*," by Mr. E. T. Chapman.

Paroxybenzoic Acid.—This acid has been transformed into protocatechucic acid by M. Barth. He operated on the various derivatives of paroxybenzoic acid—that is to say, the ethylo-, nitro-, bromo-, and amido-derivatives.—*Zeitschr. Chem.* 373.

REPORT ON THE
CHEMICAL LABORATORIES
IN COURSE OF ERECTION IN THE
UNIVERSITIES OF BONN AND BERLIN.

THE CHEMICAL LABORATORIES OF THE RHENISH FREDERICK WILLIAM UNIVERSITY OF BONN.

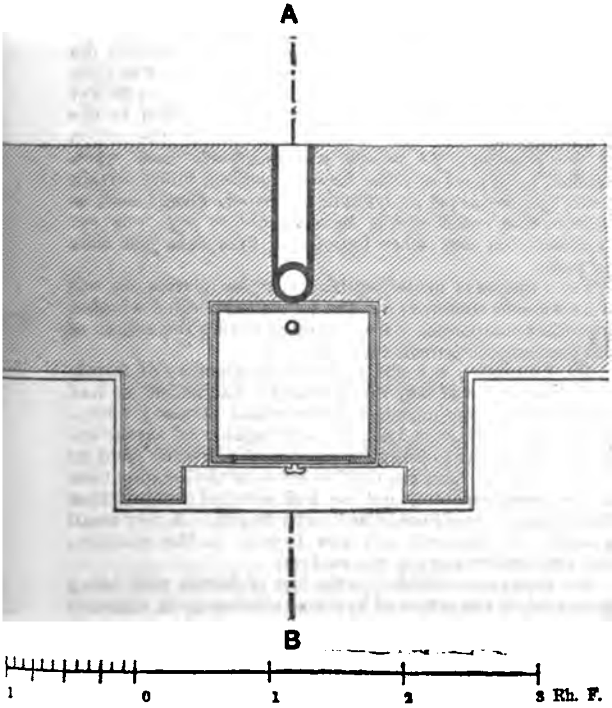
(Continued from page 270.)

A few words on the supply of air will complete this sketch. Under ordinary circumstances the niches will draw the air from the laboratories, and thus materially contribute towards their ventilation, and for this purpose the window-panes closing the front are not to be let down to the very base. To prevent, however, if many niches of a laboratory were simultaneously used, a return current in any one of the flues, a free supply of air is provided even whilst the fronts are hermetically closed. This proceeds directly from the external atmosphere by a curved earthenware pipe, the position of which is seen in both Figs. 12 and 13.

FIG. 13.

EVAPORATION NICHE.

IZONTAL SECTION ALONG THE LINE D E IN VERTICAL SECTION.



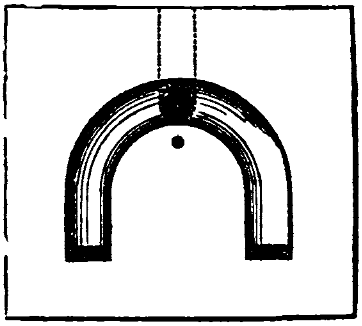
One end of this tube, hidden by a rosette, terminates in the outer face of the wall, the other lies flush with the smooth and regular cement slab on which the basement slab of the niche rests. In the lower face of this slab is a broad shallow channel in the form of a horse-shoe, communicating at the bend with the earthenware pipe, and at the ends with the niche, by means of vertical slits, similar in section to the groove itself, through which the air issues just behind the window-pane. Fig. 14 gives a view of the basement slab from below, showing the supply-pipe, the crescent-shaped channel, together with the two slits carrying the air up into the niche. The slits may be either partially or entirely closed by two lids of plate glass (shown in Fig. 11).

The front of the niche, as already mentioned, is closed by a strong pane of plate glass, the movement of which is regulated by counterpoises hidden within the pillars of the wooden frame, which, in elevation, is given in Fig. 15, representing the niche as seen from the laboratory.

FIG. 14.

EVAPORATION NICHE.

LOWER SURFACE OF BASEMENT SLAB.



In the corners, between this wooden framework and the wall of the room, are fixed the pipes supplying the niche with gas, which enters a few inches above the level of the working bench from either side through porcelain tubes traversing the stone walls of the niche. From these tubes, visible in Figs. 11 and 12, the gas may be conducted by means of caoutchouc tubing to any apparatus in the niche.

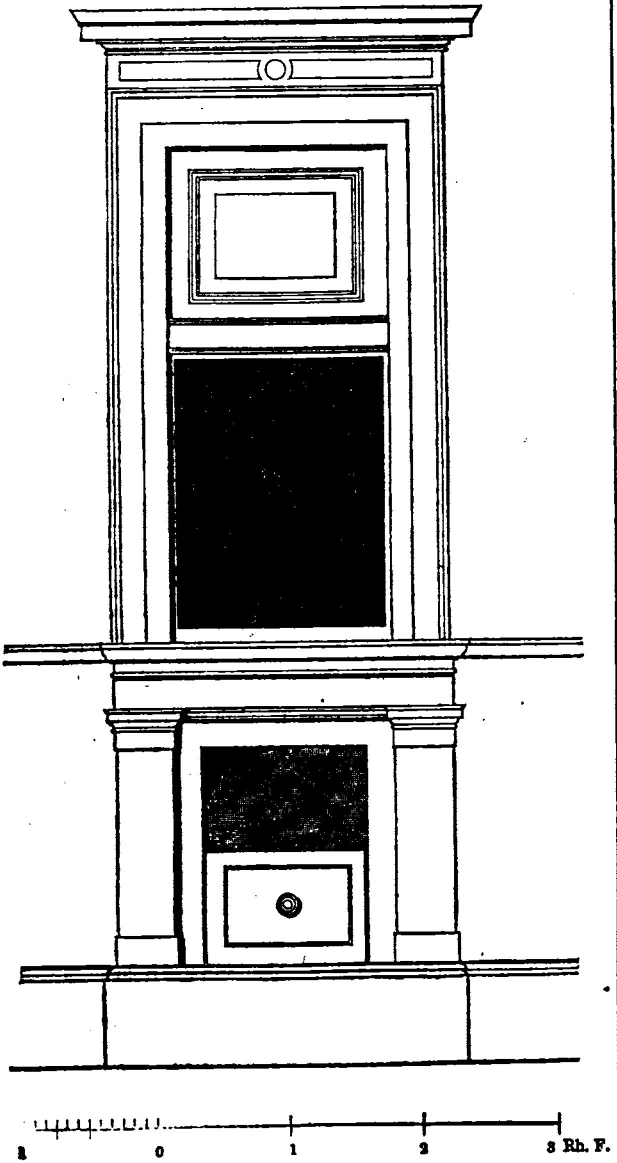
The flues ascending from the niches can also be conveniently used for carrying off the vapours evolved on the working benches themselves. In many experiments the apparatus required is so complicated, or occupies so much space, that it cannot conveniently be fitted up in the niche itself. In such cases it is merely necessary to make the entire apparatus air-tight, and to connect its end by means of caoutchouc tubing with the interior of the niche. For this purpose the latter is provided with two other porcelain tubes passing through its walls near the roof, and visible in Fig. 12. The ends of these tubes, which project into the laboratory, are closed with corks when not connected with apparatus generating gas to be removed.

Lastly, it should not be left unnoticed that sandstone was by no means the material originally intended for the construction of these niches. Indeed, the three sides, the roof, and the base were to have been made of glazed eathenware, but the plan had to be abandoned, since, in spite of numerous trials, it was found impossible to procure from the works in the neighbourhood of Bonn slabs of the required dimension perfectly smooth and free from flaws and cracks.

Perhaps a better result may be obtained at the celebrated works of March, of Charlottenburg, where the evaporation niches for the Berlin laboratory, for which the construction devised by Mr. Neumann for the Bonn institution has served as a model, are in course of preparation. Be this as it may, the failure of the attempt to construct the niches in earthenware has suggested the idea of substituting glass for the material previously tried. With regard to cleanliness, resistance to the action of almost all gases, and even elegant appearance—more especially if the spaces between glass and wall be filled with plaster—this material leaves nothing to be desired. There are, however, some difficulties in the mode of joining the glass plates which have not yet been overcome.

The experiments on this new construction are still going on; their result, however, has been so far promising that in the Bonn laboratory only those niches, the completion of which was indispensable for the continuation of the building, have been made of sandstone. The glass casing, should it prove practicable, could then be still adopted for the remainder of the niches.

Fig. 15.
Evaporation Niche.
Elevation.



At a later period the reporter may have an opportunity of stating what material has been found best suited for the construction of these niches.

A Narrow Escape.—At the works of the Magnesium Company, Manchester, owing to the recent floods in that part of the country, a very narrow escape from a tremendous explosion occurred. About 4 cwt. of sodium was stored in one part of the works, and here the water rose to within an inch of the mouths of the jars containing it. The roof had to be unslated to allow the men to get it out before any damage took place.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 6.

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 library donations announced. The following gentlemen were ballotted for and duly elected Fellows of the Society, viz.:—A. C. Cook, Ph.D., Demonstrator of Chemistry, King's College, London; Henry Dircks, C.E., Whitehall Club and Bucklersbury; James Forrest, Ashburnham Road, Greenwich; William Huskisson, Gray's Inn Road; A. F. Marréco, Newcastle-on-Tyne, and J. Hancock Richardson, of the same place; Alexander Morrison Thomson, D.Sc., Sydney, New South Wales. The names of the following candidates were read for the second time, viz.:—John Broughton, B.Sc., Chemist to the Government Cinchona Plantation, Madras Presidency; Mr. Watson Smith, Analytical Chemist, 26, Portland Crescent, Manchester; and Mr. Walter Noel Hartley, Pathological Laboratory, St. Thomas's Hospital.

Mr. Ernest T. Chapman read a paper "*On a New Synthesis of Formic Acid.*" From a consideration of the results obtained by Mr. Thorp and himself, Mr. Chapman was led to believe that the action of bichromate of potash and sulphuric acid, and of permanganate of potash with the same acid, did not consist merely in the addition of oxygen or removal of hydrogen, but that, in many cases, hydroxyl was either substituted for hydrogen or superadded to the substance oxidised. The author finds that, by the action of permanganate of potash and sulphuric acid upon purified lampblack or other forms of carbon, under certain conditions described in detail in the paper, formic acid is produced—a result which, he ventured to say, was not explicable on any other hypothesis than that just now set forth.

The President made inquiries as to the relative amount of formic acid obtained; and Dr. Frankland asked whether any other compounds were generated during the action of the permanganate upon carbon.

Mr. Chapman, in reply, said that the quantity of formic acid produced was very small indeed; that which he had collected for examination was the result of many operations, and the process did not seem capable of extension. It was important to limit the amount of sulphuric acid to the exact proportion required to saturate the alkaline base of the permanganate, and he had satisfied himself that the lampblack itself contained no hydrogen. A very small quantity of carbonic acid was formed in the reaction, and throughout oxygen was evolved.

Mr. Newlands alluded to the fact of formic acid being generated by the action of hydrated alkalies upon carbonic oxide.

Dr. Muller referred to previous statements relating to the action of sulphuric and nitric acids upon carbon, whereby small quantities both of fixed and volatile carbon compounds were produced.

Dr. E. J. Mills desired information upon the mode of collecting the carbon—whether or not a paper filter was employed?

Mr. Chapman said he fused or deflagrated the lampblack with a minimum of saltpetre in order to effect its purification from hydrocarbons, then washed it by decantation, and collected in a funnel stopped with a plug of ignited asbestos. He had specially looked for carbonic oxide in the gas evolved from the permanganate, but could not find a trace.

Mr. Parkinson exhibited, and gave an account of, "*The Alloys of Magnesium.*" These were generally prepared by bringing magnesium wire into contact with the primary metals fused beneath a layer of salt, fluor-spar, or a mixture of the latter with kryolite. None of the alloys offered any promise of practical employment, from the fact of their being invariably very brittle and easily tarnished. The only exception to this rule was the zinc alloy, which appeared to be permanent; whilst, on the other hand, the combinations of lead and bismuth were distinguished for the rapidity with which they were affected by the air. The author described the compounds which magnesium forms with phosphorus and arsenic, and called in question the accuracy of Mr. T. P. Blunt's statements relative to the black phosphide of magnesium.* At a red heat the metal decomposes even carbonic acid; and when mixed with fine sand and strongly ignited, a metallic silicide is formed, which disengages the spontaneously inflammable hydrogen compound by the action of water or dilute acids. Mr. Parkinson suggested the possibility of employing the magnesium amalgam in medicine as a substitute for *hydrarg. cum cretâ.*

Dr. D. S. Price doubted the expediency of attempting the production of an iron magnesium alloy in the manner described. Spiegeleisen, if not other kinds of cast iron, were said to contain traces of magnesium.

Mr. Tarner certified to the use of cast-iron vessels in the manufacture of magnesium according to Sonstadt's patent, the metal being distilled in a current of hydrogen.

Mr. Vernon Harcourt and Mr. Spiller spoke upon other points raised by the author in his communication.

Mr. R. H. Smith read a short paper "*On the Oxidation of Ethylic Benzoate.*" The author finds that benzoic ether is, by the action of bichromate of potash and sulphuric acid, simply resolved into benzoic and acetic acids. The ether was digested for several hours with a 12-per-cent. solution of the bichromate without any more than mere traces of gas being evolved. The acids formed were separated and recognised by their respective saturating capacities, as well as by various qualitative tests.

Mr. Chapman, at whose suggestion the experiment was undertaken, spoke of the permanent character of benzoic acid, and probably of all the other acids of this group, which, in respect to their resisting the action of oxidising agents, resemble the acids of the acetic series.

The President moved a vote of thanks to the authors of the several communications, and adjourned the meeting until the 20th inst., when a paper "*On some Reactions of Hydriodic Acid,*" by Mr. E. T. Chapman, will be read.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, by Dr. Percy, F.R.S.

Lecture No. XI.

(Continued from page 271.)

The next substance we shall consider is vivianite, a compound of some interest. This vivianite is phosphate of iron. There is a species occurring in Delaware —a tribasic phosphate of iron containing water. It speedily colours when exposed to the air, assuming a blue tint. The interesting point is that this mineral is found in boggy ground, where animal remains exist, the phosphoric acid being derived undoubtedly from the phosphate of lime in the animal remains. Vivianite has been known to occur in fossil teeth. Then there are certain fossil shells in the Black Sea presenting phosphate of iron. You may also see bones taken out of the ground presenting a considerable quantity of this blue phosphate of iron. The condition required appears to be the long-continued action of water containing a salt of iron upon phosphate of lime, and there may be some secondary agents at work for aught we can tell. This compound is soluble to a certain extent in water, and more especially so by the aid of carbonic acid. There is no difficulty in accounting for its crystalline form. We can produce it crystallised, in fact, without much difficulty.

I may pass over the silicate of iron, except in reference to its formation as an accidental product in metallurgical operations. It has been stated that the silicate of protoxide of iron has been met with in Ireland, and I state that upon the authority of the late Dr. Thompson. I made inquiry about it some time ago, and got this specimen from a mineral dealer. It was said to come from the locality in which Dr. Thompson reported silicate of iron to be found, but on examining the specimen it appeared to be very like a slag, and therefore I regard the occurrence of silicate of iron in nature as very doubtful at present. There is another silicate, a blue or greenish silicate. Sand, when it is green, is supposed to owe its colour to the intermixture of silicate of iron. Silicate of iron seems to contain the oxides in two states, the protoxide and the peroxide, and though we have tried to ascertain the conditions we have not been able to do so. We can produce it by double decomposition. If we take a soluble silicate like silicate of soda or potash, and add it to a salt of protoxide of iron, we get silicate of iron of a green colour.

Now for one of the most important of the natural compounds of iron—the carbonate of iron. To the carbonate of iron we in a great measure owe our national prosperity. This compound abounds in nature. It consists essentially of one equivalent of carbonic acid and one of protoxide of iron. It contains no water. It occurs sometimes very beautifully crystallised indeed, and occasionally massive, forming large crystalline rocks, sometimes in masses, and sometimes in lodes or veins. We can produce it artificially in the amorphous state, as we have done here, with certain precautions—the absence of oxygen especially. Here is some which Mr. Smith has been good enough to make. We have taken some carbonate of soda and a salt of protoxide of iron, mixing them together in the solid form in a tube, and then closing the hole so as to exclude the air. The carbonate of iron has been gradually formed. It is white at the bottom, but a little air has got in and darkened the surface. It is a substance which becomes speedily acted upon by oxygen—the oxygen of the air to wit. We cannot expose this carbonate of iron which we have formed without its being further oxidised with the elimination of carbonic acid, just as the ore at Hastings is decomposed and converted superficially into oxide of iron combined with water. This furnishes us with a clue to the occurrence of this compound in nature. We have it abundantly in our coal measures. It is perfectly certain that the conditions under which it was formed were such as to exclude oxygen. That is perfectly certain, or it would have been decomposed. But although it is so easy to act upon carbonate of iron when thus prepared, it is possible to produce a specimen of carbonate of iron which shall not be so easily acted upon. Now, here is a specimen—not chemically pure, but essentially composed of carbonate of iron. Though long exposed, it has undergone but very slight decomposition. After a time it generally becomes a little brown on the surface by exposure.

Carbonate of iron has been artificially obtained crystallised. Senarmont so prepared it in the form of a greyish white sand, hardly attackable by dilute acids. A great deal depends here upon the state of aggregation of a body. You may get the same substance, chemically, in very different states of aggregation: in one it shall be easily acted upon by an acid, in another with great difficulty, or hardly at all. Well, that is the case, to a certain extent, with this carbonate of iron. If we obtain it in the simple way I described, it is easily acted upon; if we obtain it at a high temperature, it is much more difficultly acted upon. Senarmont informs us that that which he obtained remained nearly unchanged in dry air, and very slowly acquired a pale brown colour in moist air. He made it by exposing a mixture of sulphate of protoxide

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* Vide *Journal of Chemical Society*, May 1865, p. 106.

of iron—that is, common green copperas—and carbonate of soda, or of protochloride of iron and carbonate of lime, in hermetically sealed glass tubes—in the first instance to a temperature of 150° Centigrade, or beyond, and in the other case to a temperature of from 130° to 200°, during from 12 to 36 hours. The salt was darker in colour and more permanent in the air the higher the temperature employed and the longer its duration. He says the form of the crystalline mass was distinctly rhombohedral. There is no difficulty in accounting for the conditions under which carbonate of iron may have been thus formed in nature. Probably here hydrothermic action may have played a very important part. There is a carbonate of peroxide of iron, but it possesses very little interest for us. It was doubted whether it did exist, but it has been shown of late that there is such a thing, though it is of a very transient character.

Carbonate of iron in nature is called spathic ore. It is seldom pure, and generally contains carbonate of lime, carbonate of magnesia, and carbonate of manganese.

The solubility of carbonate of iron in nature is a point which I think we should bear in mind. Bischoff has made observations upon this subject. He says that 10,000 parts of pure water dissolved about 28 parts of precipitated carbonate of iron such as you have here. The precise quantity is 28·09. The same quantity of water dissolved of the natural carbonate only 6·0755 parts. You may call the quantities dissolved 28 parts and 6 parts. He says the mineral is dissolved more rapidly by the application of heat, but at the same time it is quickly decomposed. There is no doubt about the solubility of carbonate of iron being greatly increased by carbonic acid, and a short time ago there was a patent taken out for the preparation of artificial chalybeate water on this principle. The carbonate of iron was dissolved in water containing a large amount of carbonic acid. On exposure of the solution to the air, a rusty appearance was produced, owing to a brown precipitate being thrown down.

Now as to the impure carbonates of iron—for these are the most important minerals with which we have to deal. We have the sparry iron ore occurring in this country. We have very fine specimens of it in Somersetshire. I have seen it at Alston Moor, in a small lode there. It occurs also in other parts of England. That at Alston Moor contains carbonate of lime, which reduces its value. In Styria there are enormous masses of this sparry iron ore, and also at Stalberg, in Prussia. It has been the source of iron from time immemorial. At Siegen, in Prussia, it occurs in lodes—that is, fissures of the earth filled up with it—not in beds and masses. It also occurs at the same place in slate. Here is a specimen from Alston Moor. It does not contain much ore—only 21·7 per cent., but it might be valuable for its lime as well as its iron. It has been used as a flux in glass furnaces with advantage, both the lime and the iron being serviceable, the iron being reduced and the lime acting as a flux. We have a great quantity of the amorphous and non-crystalline carbonates of iron. All the iron ores of our coal-measures are of this class. In the museum above you may see specimens of almost every kind in the kingdom. This clay iron ore is a characteristic example. There it is like a lump of hardened clay, of a greyish-brown colour. It is sometimes much lighter than that, and sometimes much darker, this colour being simply owing to the intermixture of coal or bituminous matter, and nothing more. Sometimes we find great nodules in these cracks, which are covered over with sparry iron ore in distinct crystals. This ore occurs in coal-measures either in continuous beds or nodules, these nodules being distributed, and varying in size, being sometimes no larger than a penny piece, and sometimes as large as a man's head, or very much larger. They consist essentially of carbonate of iron, but they contain always, without exception, a little carbonate of lime, carbonate of magnesia, carbonate of protoxide of manganese, and phosphoric acid. The phosphoric acid is very variable in proportion, and the quantity is sometimes very small. They contain also a little sulphur in the form of iron pyrites, and sometimes as a sulphate—perhaps sulphate of lime. Potash or soda is invariably present—sometimes one, sometimes the other, sometimes both, but potash generally. Silica and alumina are present in combination, as silicate of alumina—fire clay in fact. If you take one of these ores, reduce it to powder, and act upon it by hydrochloric acid, so as to remove everything soluble, you get a residue which is fire clay—good fire clay. Then there is generally water in combination, and there may be hygroscopic water. There is also coaly matter, as in the blackband ironstone, which was brought into use in this country in the year 1806 by Mr. Dick. Before that time its value was not recognised. I have pointed out to you how in these iron ores we sometimes get further metalliferous matters—copper pyrites, sulphide of nickel, sulphide of zinc or blende, and so on, but there is one which I have not mentioned, met with in the blackband iron ore; it contains a notable quantity of silver, about half an ounce to the ton. It is a singular thing we should find silver there. There is no doubt that it must have gone down from water. It is diffused over a pretty large extent. Then, I have no doubt that there is always titanium. We always find titanium in the products of our blast furnaces, but attempts to find it in the iron ore have not been successful, though of late we have approached nearer to success than we ever did before.

These clay iron ores differ not only in compactness and colour, but also in their intimate structure. I do not know any that do not present an oolitic structure. If there are any, they are very few at all events. We shall find that the clay iron ores in their formations are very distinctly oolitic in structure—like the Cleveland iron ore to wit.

For the reasons previously given, we conclude that all these impure carbonates of iron have undoubtedly been thrown down under conditions involving the absence of oxygen. Perhaps there was an abundant evolution of carbonic acid at the time—nothing more likely. There may have been carbonic acid, carburetted hydrogen, and perhaps something else besides. Suppose a bed of coal to have been first deposited, and upon this bed of coal a quantity of clay, and then suppose the iron to be deposited, the whole having gone down or been submerged gradually. We know perfectly well the coal would be in a state of decay—nay, it is in a state of decay even now. Thus the gases I have mentioned would come bubbling up from the coal below, through the mass above, and forming the carbonate of iron. But, however this substance may have been obtained, it is certain that oxygen could not have been present, and that is the point on which I am anxious to fix your attention especially.

I may state that these ores contain on the average about 33 per cent. of iron. The South Staffordshire ores may be taken as a fair typical example of this class of compounds. Sometimes we find 41 per cent., and sometimes the proportion is as low as 26 per cent. When we get what is called a very lean clay iron ore, it is only fit for making Roman cement, common Roman cement being made, in fact, from such ores. There is a singular variety to which the name of brass was given. It was thrown aside on the pit mounds in South Wales by experienced coal workers as apparently worthless. It turned out to be a good iron ore, and realises now many shillings a ton. Here is a specimen of this substance. It is very important that gentlemen interested in these matters should see these samples with their own eyes. They then get impressions which they do not readily lose, and which they cannot get any other way. This clay contains bituminous matter. Now who would take it to be iron ore? Instances of this sort are continually turning up, showing the importance of accurate scientific knowledge. Some of our practical men affect to despise science, though happily during the last 20 years there has been a great revolution in this respect, and many mining men now possess a large amount of scientific information which they turn to practical account not only for their own benefit, but also for that of their employers. Only quite recently I heard of a valuable tin ore being thrown away largely as worthless through its real character not being recognised. Here in the museum you can have an opportunity at all times of seeing these specimens arranged; but there is another kind of collection which I think of great importance, such as a small home collection, which ladies and gentlemen who are interested in mineralogical subjects should always keep. You should look at these things again and again, and study their appearance until you have thoroughly become master of them. I should strongly recommend the practice, especially among youths, of the formation of little collections of this kind. One never knows how he may require the information which these will afford him. His knowledge may be called into exercise either in this country or elsewhere in different parts of the world.

The Cleveland iron ore is highly oolitic in structure—some of it beautifully so, consisting of little roundish grains, covered with a brownish coating, and cemented with a greyish-green matter. It is a carbonate of iron containing about 30 or 40 per cent. of metallic iron, but it contains also free silica, thus showing that the silica which was separated by the action of acid from that ore has been in combination with iron ore in two states—protoxide and peroxide. We get gelatinous films produced by the action of the acid, and we get also distinct crystals of anatase, which is a titanium mineral. The crystals were very closely examined by Professor Miller, of Cambridge, and he recognised distinctly their crystalline form. I do not think the occurrence of anatase had been previously recognised.

Our information with regard to the conditions of the formation of these iron ores in coal measures is scanty. What I have said about their mode of formation applies in a great measure to the Cleveland iron ore. We find it in coal measures, in lias, in oolite, in the wealden down at Hastings, and in the tertiary.

Some time ago, when I was in South Wales, I saw a large quantity of iron ore, which had been dredged up by fishermen at the Isle of Wight, sold at Cardiff for ten shillings a ton. I saw many truckloads going up to some large iron works there.

I should recommend you to examine the specimens showing the conversion of carbonate of iron into peroxide by gradual weathering action. Here is a very characteristic specimen. We have here the same structure as in the carbonate, but the composition is entirely different. It is here converted into brown peroxide of iron. Now, we should naturally expect, in a bed of great depth, that we should get the carbonate deeper than the peroxide; and that is the fact. I do not say that it is necessarily so, but the deeper we go the more likely we are to get the carbonate.

The next metallic substance to which I must devote attention is copper. Now copper is a very important mineral, and it occurs in various forms in nature. I cannot dwell upon the chemical properties of copper, but must give you credit for information on those points. It crystallises in the cubical system, and the crystals are sometimes well defined in metallurgical operations. We have specimens of octahedra of copper obtained by fusion, but they are exceptional, but after electrotype processes we get it well defined sometimes; and if you compare the little foliated pieces of natural copper with some of the copper crystallised artificially by voltaic agency, you cannot hesitate in coming to the conclusion that both have been produced under essentially the same conditions—namely, by voltaic agency—in the one case in the laboratory of the chemist, and in the other case in the laboratory of nature, as it is called. Copper occurs abundantly at Lake Superior, but it is too pure to be profitably worked. It could be obtained more easily if mixed with sulphur. It cannot be blasted owing to its extreme toughness. It can only be cut by the slow operation of chisels, and that involves great expense.

Now, let us see how we find copper in nature. It is found in mesotite in Siberia, and in one of the Faroe Islands; and it is found in amygdaloidal trap in various parts. Now, trap is an igneous rock—a rock which has been melted. It is perfectly certain that copper could not have been there at that time, because the copper and the trap have very widely different specific gravities, and if the copper had been present when the trap was melted, the copper would have gone to the bottom. We see that every day in our copper furnaces. Well, then, the copper in this case must have got into the rock, after the rock was fused, by the action of copper salts, and the deposition of copper by electrical or other agency. The Lake Superior copper is likewise found in trap, intersecting sandstone, and it is very curious that in the Lake Superior copper deposit we find silver.

Now I would beg particular attention to this. You see how we get important conclusions from apparently trifling points. There are those two metals together—metallic silver and metallic copper. They are not alloyed, but they are in close proximity, and sometimes singularly intermingled together. The silver is silver, and does not contain copper; and the copper is copper, and does not contain silver. Now, if these two metals had been melted together, they would have been alloyed, and when once alloyed they would not have been again separated. That shows that this copper and silver could not have been melted together, and must therefore have been deposited in some other way, probably by voltaic agency. That is a very important point. Then we get sometimes, from Lake Superior, very characteristic specimens of crystallised carbonate of lime, containing copper crystals in the interior. Copper is found in pseudomorphs after red oxide of copper, and also after arragonite itself. These pseudomorphs are false forms. I have pointed out to you what was meant by them. For instance, a crystalline matter disappears and leaves behind it a mould, which gets filled in by some other substance, and this substance then gets a crystalline form not belonging to itself, but belonging to the substance which was originally present and formed the mould. Or a substance may disappear gradually and be replaced by another body, crystal by crystal, and so we may get a pseudomorph in a different way. I had a pseudomorph of metallic copper some time ago. There is little doubt that it was produced by the decomposition of oxide of copper by some reducing agent—possibly by some reducing gas, but that is not certain at present. In the majority of cases in which we meet with metallic copper in nature, undoubtedly that copper has been thrown down from solution, and most probably by the agency of the voltaic current.

The red oxide of copper is one of the most interesting ores of copper, and one of the most interesting and beautiful compounds of that metal. It occurs crystallised in the same system as metallic copper itself—namely, the cubical—and we have it in the octahedron, or in the rhombic octahedron. I will invite your attention specially to one of the cases up yonder, in which you will find beautiful specimens of this rare mineral converted into malachite, from near Lyons. We obtain it sometimes in metallurgical products, occasionally well crystallised. There is no difficulty about that. Then we can get it in the wet way by boiling common cane sugar with sulphate of copper. Fine crystals may be thus obtained. Becquerel tells us that it may be got by exposing a piece of metallic copper in a solution of nitrate of copper to a temperature of 400° Centigrade, under a pressure of four or five atmospheres. No doubt it may be obtained in other ways.

Here is a quantity of chloride of copper into which a piece of metallic lead was immersed some years ago. It has not been opened since the year 1858. A variety of compounds have been produced here. Here is another illustration—a sort of little artificial mine. The action has been going on for five or six years. We had here a piece of lead placed in another salt of copper—nitrate of copper. Nitrous oxide was developed for a long time, but I do not know what compounds have been formed—no doubt half-a-dozen things. I present these to you in illustration of the singularly complicated local reactions which have occurred, and do occur still, undoubtedly, in our mines. Here, again, is some chloride of copper with some common salt, chloride of sodium. We get here metallic copper and chloride of copper and chloride of sodium, and the whole surface of this is covered with a beautiful deposit of red oxide of copper. The red oxide of copper in nature very often occurs in association with metallic copper. We have numerous specimens of that in the museum above. Occasionally we may take a specimen which is apparently green malachite, but on examining it we may find in the interior red oxide of copper, and in the middle of that we may meet with metallic copper. I have seen the red oxide of copper and the malachite around a nucleus of metallic copper. I could point out to you a singular illustration of this in the collection of the British Museum. It is among the things brought over by Mr. Layard, and it is the result of an action which has been going on two or three thousand years. There is a portion of a vase, which happened fortunately to be broken, which is quite green on the exterior—in fact, it is green malachite, and underneath is a glass coloured with red oxide of copper. I obtained a piece of that glass, and had it cut for a microscopic object. It is beautifully coloured, and resembles porphyrine. Red oxide of copper is one of the prettiest objects you can see in mineralogical collections. Unfortunately, these fine specimens from Chessy, which have been in great request, are not very abundant.

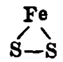
NOTICES OF BOOKS.

Lecture Notes for Chemical Students. By Professor Frankland, F.R.S. London: J. Van Voorst. 1866.

[Second Notice.]

We cited, in speaking of the graphic representation of chemical substances, a mode of writing the formula of pyrites which may be taken to represent the disposal of the active bonds of that substance. Now there are two minerals, pyrites and marcasite, both expressed by the formula FeS_2, and yet differing in many of their physical properties, such as hardness, specific gravity, and crystalline form. Dr. Frankland gives for pyrites the graphic formula—

We may, therefore, reserve the other mode of graphically representing the bisulphide of iron for the more oxidisable mineral, marcasite—



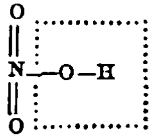
Any one who has carefully studied the peculiarities of pyrites and marcasite will readily perceive the facilities which the graphic notation affords for representing and even explaining these and similar peculiarities.

In addition to the points already indicated, these lecture notes are particularly distinguished by the very free use made of graphic formulæ. In these every atom of each element present in a compound is represented by a separate symbol. Although the author adopts many compound radicals in his symbolic formulæ, these radicals do not at first sight appear as such in the graphic notation. But the following examples of the two methods of notation will sufficiently show how they both express the same views; we must premise that these radicals are expressed in an abbreviated form, as follows:—

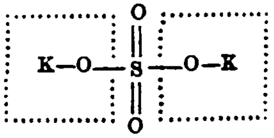
Hydroxyl $(HO) = Ho$
Potassoxyl $(KO) = Ko$
Zinkoxyl $(ZnO_2) = Zno''$

We now cite the names and formulæ of several common salts into which these groups enter by means of the unsatisfied or unlinked bonds of their dyad element, oxygen. In the graphic formulæ we mark the position of the radicals by dotted lines.

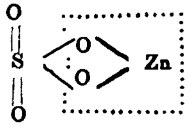
Nitric acid NO_2Ho



Potassic sulphate SO_2Ko_2



Zincic sulphate SO_2Zno''



Some of the most interesting graphic formulæ in this volume are those assigned to minerals. We cannot but hope that the new light thrown upon these most instructive compounds will awaken an interest in chemical mineralogy. A careful study of many of the formulæ adopted by Dr. Frankland for some of the rather rare and less intelligible minerals has convinced us that much labour and thought must have been expended upon this branch of the science. Minerals are so often contaminated with intruding substances, and are so often mixtures of allied or isomorphous minerals, that it is very difficult to assign to them reasonable formulæ. We believe that our author has been unusually successful in accomplishing this hard task, sometimes, it may be, by a happy guess, but rather, as a general rule, by the aid of those new views on the functions of the elements which he has so thoroughly expounded. The alarmingly complicated silicates have not deterred our author from attempting their graphic portraiture; witness the representation of saponite and lepidolite on the plate facing page 178. With a few of these mineral formulæ, however, we venture to feel a little dissatisfied. Chloropal, for example, is represented as a *ferric* trisilicate, although it invariably contains iron in the *ferrous* condition; for the powdered mineral, thrown into acidulated potassic permanganate, instantly decolorises it. Then again, in the expanded formula for chloropal given on the plate facing page 103, the oxygen atoms are represented as sometimes dyad, somtimes triad, and sometimes tetrad. This surely must be a slip of the lithographer's pen, introducing by mistake a series of unnecessary bonds between some of the oxygen atoms. The graphic formulæ of the basic and normal sulphates are particularly admirable; we can here do no more than direct attention to those given on the plates facing pages

177, 187, and 194. Were we to attempt to point out in detail all the interesting portions of the book before us, we should, in fact, find some difficulty. The whole work, from beginning to end, is worthy of the most attentive perusal and the most careful study. We close the book with our pleasant anticipations on taking up the volume more than fulfilled by its perusal; we close it, moreover, with the intention of opening it over and over again. We will not now offer any further remarks concerning the merits of the volume; we heartily recommend our readers to study it for themselves.

The Principles and Practice of Photography familiarly Explained. By Jabez Hughes. Seventh Edition. London: Simpkin, Marshall, and Co.

A new edition of this excellent work is sure to be welcomed by all photographers, for there are few who may not find something to learn from it. A good deal of new matter will be found, for which the author has gained space by omitting many of the less used dry-plate processes, while giving a more detailed account of the two most popular of these—viz., the tannin and the collodio-albumen processes. The third part contains many papers likely to be of service to advanced photographers, dealing with such subjects as the construction of glass houses, the use of the solar camera, &c.

CONTEMPORARY SCIENTIFIC PRESS.

[Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts or full translations of the more important papers here announced will appear in early numbers of the Chemical News.]

Poggendorff's Annalen. No. 8. October.

"*On a New Method of Measuring the Velocity of Sound in Gases,*" by J. B. Zoch.—"*Optical Researches: 4. On the Elliptical Polarisation of Light by Reflection from Metallic Surfaces,*" by G. Quincke.—"*On Lullin's Experiments and on Lichtenberg's Figures,*" by A. von Waltenhofen.—"*On Observing the Vibrations of Sounding Plates by Reflection,*" by A. Kundt.—"*On some Peculiar Cases of the Production of Sound by Flames,*" by the same author.—"*On the Radiant Heat which accompanies Fluorescence,*" by V. Pierre.—"*On the Tangent Photometer,*" by F. Bothe.—"*On the Theoretical Calculation of the Magnifying Power of Microscopes,*" by Arndt.—"*On the Crystallisation of Sulphide of Sodium,*" by H. Finger.—"*On Mohr's Theory of the Formation of Hail,*" by A. Krönig.

No. 9. October.

"*On some Peculiarities connected with the Formation of Twin Crystals of Pericline,*" by G. Rose.—"*An Experimental Proof of the Expansion of Solids under the Influence of the Galvanic Current, independently of the Heat produced by the Action of such Current,*" by E. Edlund.—"*Optical Researches: 5. On the Manufacture of Metallic Mirrors,*" by G. Quincke.—"*On the Absorption of Radiant Heat by Dry and Moist Air,*" by H. Wild.—"*On the Influence of the Interposition of Glass Tubes in the Galvanic Circuit,*" by K. W. Knochenhauer.—"*On the Use of Perchloride of Iron in Galvanic Batteries,*" by A. von Eccher.—"*On the Capacity for Heat of various Soils and its Influence on Vegetation, together with some Critical Remarks on the Methods of Estimating the same,*" by L. Pfaundler.—"*On the Perforation of Tinfoil by the Electric Spark,*" by W. Hankel.—"*On the Ebullition of a Fluid when in Rotary Motion,*" by A. Mousson.—"*On a Meteorite found at Tamentit, Africa, described by Gerhard Rohlfs,*" by A. Sass.—"*On a Shower of Meteors described by Captain Cook,*" by W. H. Miller.

Kunst und Gewerbeblatt. Nos. 8, 9. August-September.

"*On Disinfection as a Precautionary Measure against the Spread of Cholera,*" by M. von Pettenkofer.—"*On Amber,*" by Buff.—"*Practical Observations on certain Mineral Colours,*" by E. Dieterich.—"*On the Results of Ozonometric Observations,*" by the same author.—"*On the Preparation of Metals in a State of Fine Subdivision by Amalgamation,*" by J. Fuchs.—"*A Composition for Gilding Porcelain,*" by H. Reinsch.—"*On the Poisonous Nature of the Colours used for Colouring Slate Pencils,*" by the same author.

NOTICES OF PATENTS.

Utilising the Residue from Chlorine Gas. William Francis Deane, Farnworth. (Provisional protection only.) Dated March 13,

The patentee proposes to take the residuum liquor arising in the manufacture of chlorine from oxides of manganese, and treat roasted iron pyrites containing copper therewith, the chemical action of which is as follows:—The liquor containing chlorides of iron and manganese and free acid dissolves copper and iron contained in the pyrites, which becomes added to the metals already held in the solution; now submit this liquor or solution to the reducing action of metallic iron, either in the form of plates, rods, or otherwise, upon which the copper is deposited in a metallic state, and thus the copper is extracted from the liquor. The liquor thus freed from copper may now be neutralised with carbonate of lime, or other alkaline earth; the remaining metals in the neutralised liquid may then be either precipitated with milk of lime, and either the whole or a portion of the iron may be separated first from the manganese by contact with carbonate of lime or other carbonated alkaline earths, and the manganese still in solution may be precipitated and again treated by any well-known process for the production of chlorine. If desired, this separation of the manganese from the solution may be made previously to the depositing or separation of the copper therefrom by the same treatment of carbonate of lime, by which process the manganese remains in solution as chloride of manganese, and the metals of iron and copper are precipitated as carbonates to be afterwards brought into solution by an acid from which the copper is extracted by the immersion of iron plates or rods.

The liquor obtained, after contact with the pyrites, can be neutralised by an alkaline earth or carbonate thereof, and the chloride of manganese in solution be precipitated and utilised, and the precipitates of carbonates of iron and copper may be dissolved by an acid, and the copper obtained in the form of sulphuret by treatment with an alkaline sulphuret or sulphuretted hydrogen, which last result is oxidised and brought into the form of sulphate of copper.

MISCELLANEOUS.

The Cattle Plague.—Fresh outbreaks of cattle plague are occurring in Lancashire, Yorkshire, and Cheshire. There can be no question that this recrudescence of the disease in counties from which it had been effectually stamped out is of grave importance, and more especially at this period of the year. The farmers are now gathering the cattle into their sheds. Whilst cattle are in the fields the means for preserving them from the plague are greatly facilitated by the ease with which they are separated, but now that they are being taken for the winter into sheds, previously the seat of this peculiarly insidious and active poison, the danger of infection of the herds is considerable, unless the most careful precautions have been taken for the thorough disinfection of these sheds. The manner of best effecting this is clearly pointed out by Mr. W. Crookes, F.R.S., in his able report to the Cattle Plague Commissioners on the subject. He recommends that every shed and all parts of the shed should be first washed, and then washed down with a hot solution of carbolic acid water, to the strength of one per cent. of acid in the water; then that the sheds should be closed, crevices stopped, and the interior fumigated by burning a roll of sulphur upon hot coals in a shovel. The total expense of this need not, he says, exceed a few shillings. The operation is one of the greatest simplicity; and by this we might probably guarantee ourselves against a recurrence of serious disasters. The caution is one which is certainly timely, and, we hope, will not be wasted. Farmers may think that six months' disappearance of the disease, while their cattle have been in the fields, renders a return of the pestilence unlikely in their sheds, but it has, we believe, been proved that the germs of the poison may retain their vitality for six months, and it is highly probable that they may do much longer.—*British Medical Journal.*

The Benevolent Fund of the Pharmaceutical Society.—We have been requested to announce that a public dinner will be held at Willis's Rooms on Wednesday, February 20 next, for the purpose of obtaining donations and subscriptions and enlisting general sympathy on behalf of the Benevolent Fund. All the leading firms, wholesale and retail, town and country, have consented to become stewards, and it is to be hoped that this excellent Institution will derive as much benefit on this occasion as it did at the like festival in 1848. Few offshoots of the Pharmaceutical Society deserve more encouragement from members, associates, and friends.

Composition and Quality of the Metropolitan Waters in November, 1866.—The following are the Returns of the Metropolitan Association of Medical Officers of Health:—

Names of Water Companies.	Total solid matter per gallon.	Loss by ignition.*	Oxidisable organic matter.†	Hardness.	
				Before boiling.	After boiling.
Thames Water Companies.	Grains.	Grns.	Grains.	Degs.	Degs.
Grand Junction . . .	21·33	1·00	0·76	14·5	6·5
West Middlesex . . .	21·31	1·00	0·84	14·5	6·0
Southwark & Vauxhall .	21·33	2·08	1·68	15·0	6·0
Chelsea.	21·57	1·50	1·32	14·5	6·5
Lambeth	21·67	1·86	1·43	14·5	6·0
Other Companies.					
Kent	27·00	0·40	0·28	18·0	9·5
New River	19·98	0·69	0·52	15·0	5·0
East London . . .	22·69	0·99	0·72	15·5	7·5

* The loss by ignition represents a variety of volatile matters, as well as organic matter, as ammoniacal salts, moisture, and the volatile constituents of nitrates and nitrites.

† The oxidisable organic matter is determined by a standard solution of permanganate of potash, the available oxygen of which is to the organic matter as 1 : 8; and the results are controlled by the examination of the colour of the water when seen through a glass tube two feet in length and two inches in diameter.

As is usual at this season of the year, the amount of organic matter in the water is larger than at other times. It is entirely of a vegetable nature.

H. Letheby.

The Virtues of Borax.—The excellent washer-women of Holland and Belgium, who "get up" their linen so beautifully white, use refined borax as a washing powder, instead of soda, in the proportion of one large handful of powder to about ten gallons of boiling water. They save in soap nearly one-half. All the large washing establishments adopt the same mode. For laces, cambrics, &c., an extra quantity of the powder is used; for crinolines, requiring to be made stiff, a strong solution is necessary. Borax, being a neutral salt, does not in the slightest degree injure the texture of the linen. Its effect is to soften the hardest water, and therefore it should be kept on every toilet table. To the taste it is rather sweet; it is used for cleaning the hair, is an excellent dentifrice, and in hot countries it is used, in combination with tartaric acid and bicarbonate of soda, as a cooling beverage. Good tea cannot be made with hard water. All water may be made soft by adding a teaspoonful of borax powder to an ordinary-sized kettle of water, in which it should boil. The saving in the quantity of tea used will be at least one-fifth.—*Med. and Surg. Rep., from Druggists' Circular.*

Meetings for the Week.

Tuesday, December 18.

Pathological Society, 8 p.m.
Ethnological Society, 8 p.m.
Anthropological Society, 8 p.m.

Wednesday, December 19.

Society of Arts, 8 p.m.
London Institution, 6½ p.m.

Thursday, December 20.

Royal Society, 8½ p.m.
Linnæan Society, 8 p.m.
Chemical Society, 8 p.m.

Friday, December 21.

Philological Society, 8 p.m.

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. W. Wilson, Ulverstone, wishes to know the present address of a firm of analytical chemists, "Evans and Jones."

A Druggist.—Ammonia is not an uncommon impurity in commercial phosphoric acid. Mr. Parkinson has found as much as 5 per cent. of ammonia in some samples.

F. A. W.—You have given too little information to enable us to draw any inference from the experiments.

J. S. shall receive an answer by post.

A Constant Reader will find a complete table of symbols and atomic weights, according to the different notations, at p. 96 of our tenth volume.

Photo.—Santonine is converted into photosantonic acid by exposure to light. It is probable that this reaction is capable of practical application in photography.

Peter X.—You will find M. Delenda's paper on the discovery of ancient remains in the new volcanic islands at p. 732 of the current volume of *Comptes Rendus.*

J. Wilson.—Nitrate of hydrogen is *not* a very rare or expensive chemical—in fact, it may be considered an article of commerce. Its common name is nitric acid or aquafortis.

The Ethics of Journalism.—The compromise which some journals make so as to meet, at the same time, their views of literary honesty, and their desire to appear original before their readers, is sometimes very amusing. Thus a *Magazine* last week prefaced an abstract of Mr Spiller's letter which recently appeared in our columns with the words, "*A correspondent* writes to a *contemporary.*" . . . Our friend, the editor of the *Magazine* in question, is informed that if he has conscientious scruples against mentioning the Chemical News when he fills up with our paragraphs, he is quite welcome to appropriate them without acknowledgment.

B. N. is desirous of obtaining an appointment as demonstrator in chemistry or analyst to a manufacturing company, either at home or abroad: he would prefer Australia. We are not acquainted at present with any such opening; but it is very probable that an advertisement would afford the means of bringing his requirements before those who may require such services.

A Student in Chemistry.—It is unreasonable to expect a 50-cell Grove's battery to keep in good order after continuous work for six hours. From 1 to 1½ hour is the longest time that a battery ought to be kept in uninterrupted action; after that time the heat becomes so great, and the action so violent, that the platinums are liable to become red-hot and melt. The violent action occurring in some of the cells immediately they were charged probably arose from bad amalgamation or the presence of nitric acid in the sulphuric acid. The action ceased after six hours' work, obviously because the acids had become saturated,

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Separation of Antimony and Arsenic, *by* H. Pellet *and* John Clark.

In 1843 Jacquelain found,* while studying the comparative reactions of antimonuretted hydrogen and arsenuretted hydrogen on different metallic salts in solution, that among others nitrate of silver was reduced. This reaction has been employed by different chemists for detecting the presence of antimony or arsenic in cases of poisoning, and not long ago Houzeau† described a process for estimating the arsenic contained in the hydrochloric acid of commerce, which was based on the fact that when arsenuretted hydrogen was made to pass through a dilute solution of nitrate of silver, a quantity of silver was reduced corresponding to the amount of arsenuretted hydrogen which had passed through the solution, and that the quantity of silver reduced could readily be determined by titrating the solution before and after the operation.

The following is a simple process for separating antimony and arsenic when they occur together in solution. It is based on the actions which antimony and arsenic in the form of antimonuretted and arsenuretted hydrogen exert on a dilute solution of nitrate of silver:—

The action of antimonuretted hydrogen, as we have verified, may be expressed by the formula—

$$3AgONO_5 + SbH_3 = SbAg_3 + 3HO + 3NO_5.$$

The action of arsenuretted hydrogen on the nitrate of silver is entirely different, and may be represented by the following formula, which we have also verified:—

$$6AgONO_5 + AsH_3 = 6Ag + AsO_3 + 6NO_5 + 3HO.$$

From these reactions it will not be difficult to see how a separation may be effected by means of nitrate of silver. To effect the separation it is sufficient to conduct the mixture of arsenuretted and antimonuretted hydrogen, produced in Marsh's apparatus, with pure zinc, water, and hydrochloric acid, into a tube containing a moderately dilute solution of nitrate of silver. Every trace of arsenuretted and antimonuretted hydrogen is absorbed, all the antimony is precipitated with the reduced silver, and all the arsenic is contained in the solution as arsenious acid. The presence of arsenious acid may easily be detected by adding ammonia, drop by drop, to the filtered solution till the free nitric acid is neutralised, when a yellow precipitate of arsenite of silver forms, which is soluble in an excess of the precipitant; by removing the excess of nitrate of silver with hydrochloric acid, and precipitating the arsenious acid with sulphuretted hydrogen; or by oxidising the arsenious acid and precipitating as the arsenate of ammonia and magnesia. As for the antimony, its presence may easily be detected by treating the black powder, which has been separated by filtration, with concentrated nitric acid, evaporating to dryness on a water-bath. and dissolving out the nitrate of silver with water. If antimony was present, it will remain as antimonic acid.

This process may be employed for separating very minute quantities of antimony and arsenic, but the results obtained when these bodies are present in considerable proportions, although they approach very nearly to the truth, are not quite exact, owing to the formation of a small quantity of a black powder, which is insoluble in hydrochloric acid, and was found to contain antimony, arsenic, and zinc.

A similar phenomenon was observed by Wiederhold,‡ when an alloy of five parts of zinc and one of antimony was dissolved in dilute sulphuric acid; a small quantity of a black powder remained undissolved which was insoluble in dilute acids, and on analysis was found to contain antimony, zinc, and lead (?) [A process almost, if not quite, identical with the above is in common use in laboratories.—Ed. C. N.]

On the Non existence of Carotine.§

The red crystals found in the ligneous parenchyma of the carrot, and which have been considered as due to the immediate principles—carotine and hydrocarotine—are, according to MM. Frorde and Soeaur, nothing more than cholesterine coloured by a red pigment.‖

They possess its crystalline form, its solubility in various vehicles, its indifference with regard to reagents, and its centesimal composition.

There seems to be no relation between the proportion of these crystals and that of the fecula contained in the carrot. Moreover, some chemists maintain that the carrot we have experimented upon is the kind which contains the smallest quantity of fecula, that the wild carrot contains the most (two-thirds of its weight in the dry state), and that that used for feeding cattle much resembles the wild carrot in this respect.

The amylaceous principle decreases from the exterior to the interior; it is accumulated in the rind and medullary rays; the maximum is found in the cortical cellules near the cambium.

The granules vary in size. When, in consequence of the growth of the leaves and roots, these granules reabsorb, a dark core may be observed in them.

Hence it results that the season influences the amount of fecula, which acounts for the greater quantity in autumn than in summer, and also for its occasional entire absence. This variability has been already mentioned by Vauquelin, as well as by Bouchardat. Schmidt found afterwards from 7 to 8 per cent. of cane-sugar in the carrot.

MM. Frorde and Soeaur also ascertained the presence of asparagine, and, they believe, of bimalate of lime.

PHARMACY, TOXICOLOGY, &c.

Liebig's Extract of Meat.

The following communication from Baron Liebig appears in the *Pharmaceutical Journal* for November:—

In the last number of your journal (October, p. 196), I find an excellent contribution from Messrs. Deane and Brady on "The Results of the Micro-Chemical Examination of Extract of Flesh."

I beg you will allow me to make a few remarks which may form a proper basis of judgment of extract of meat, and particularly of South American, respecting its colour, taste, and consistency.

You are probably aware of my having accepted the office of Director of the Scientific Department of Liebig's Extract of Meat Company (Limited), and on conditions calculated to offer to the public a complete guarantee of

Vol. XIV. No. 368.—December 21, 1866.

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* *Ann. de Chim. et Phys.*, t. ix., p. 472.

† *Ann. du Conservatoire*, t. vi., p. 344.

‡ *Ann. Pogg.*, cxxii., 491.

§ *Arch. der Pharm.*, cxxvi., 204.

‖ This is not the first time cholesterine has been found in vegetables—see *Arch. der Pharm.*, xlii., 527, analysis of a work by M. Benoke, where the existence in plants of this immediate principle is put beyond a doubt, though it has hitherto been considered as exclusively proper to the animal organism.

the genuineness and purity of the extract manufactured by that company.

One of my former assistants, Mr. Seekamp, is the manager of the chemical branch of the manufactory at Fray Bentos; another of my assistants, Dr. Ch. Finck, is acting at the general depot of the company. One manufactures the extract according to my special directions; the other receives it at Antwerp, and is bound to take a sample of each package, and to forward it to my laboratory at Munich for analysis. The packages are tin canisters of 36 to 45 lbs. each; the extract is sold only after being approved by myself. You will perceive thereby, that I not only control the manufacture according to my process of the extract at Fray Bentos, but also its quality when sold by "Liebig's Extract of Meat Company (Limited)," and I may safely assert, therefore, that the Fray Bentos extract does not contain any gelatine, or anything that can be considered as such.

Gelatine does not belong to the composition of extract of meat, and must, therefore, be excluded as much as possible; it gives more consistency to the extract, and allows, to the detriment of buyers, of a larger percentage of water, and makes it liable to turn mouldy. But the action of tannic acid, as a reagent, might lead to erroneous conclusions, against which it is necessary to guard.

In my little work "On the Chemistry of Food" (Taylor and Walton, London, 1847), I say, p. 141: "The portion of juice of the flesh which is soluble in cold water, but not in alcohol, is precipitated by tannic acid; the precipitate softens like plaster in hot water, and cannot be distinguished from the tannate of gelatine, but it differs from gelatine by that characteristic property of both, that it does not gelatinise when concentrated." Extract of meat, then, may and does precipitate with tannic acid, even when entirely free from gelatine.

By the exclusion of gelatine, the yield in extract is naturally diminished. According to a recent communication received from Mr. Seekamp, 34 lbs. of fresh lean meat yield only 1 lb. of extract, as manufactured at Fray Bentos (corresponding with 45 to 48 lbs. of butchers' meat, inclusive of fat and bones).

It has been observed that the colour and taste of the Fray Bentos extract vary; this is owing to the difference of sex and age of the animals.

The meat of oxen always yields an extract of darker colour and stronger flavour, reminding somewhat of the flavour of fresh venison, pleasant when diluted; the extract of cows' meat is of lighter colour, and a mild flavour, and is preferred by many persons. The meat of animals under four years cannot be used for the manufacture of extract; it yields a pappy extract of weak taste, like veal, and without flavour.

According to the predominance of ox or cows' meat, the colour and taste of extract varies, which is by no means a fault of the manufacturing process, and is fully explained by the preceding remarks. The extract of ox meat is, however, richer in creatinine and sarkin than the cows' meat extract.

The extract received from Munich, and examined by Messrs. Deane and Brady, was cows' meat extract—the Bavarian Pharmacopœia prescribing the use of cows' meat, and not of ox meat.

These gentlemen observed that they never experimented on a sample which they had any reason to believe to be adulterated with chloride of sodium (common salt). My experience has taught me that such falsification, more especially by retail dealers, is by no means a rare occurrence, and it is even practised by manufacturers.

I hold a sample of extract, manufactured by Dr. Tenner, of Darmstadt, containing 9 per cent. of common salt, and, besides, 26 per cent. of water more than the Fray Bentos extract. He sells it in jars, with labels stating that the extract is prepared "according to Liebig's process."

It is extremely difficult, as regards extracts of meat, the genuineness and purity of which are not discoverable by the eye, to protect the public against fraud; all manufacturers prepare their extract according to what they call "Liebig's process;" but since I have given only general, and not special, directions for manufacture, it so happens that every one fills in the details after his own fashion, and the consequence is that not one of these extracts is, in its composition, like another.

There exist only two special directions for the manufacture of extract of meat, the one in the Bavarian Pharmacopœia, the other in the Pharmacopœia Germanica, but these directions are not mine.

Munich, October 22.

PHYSICAL SCIENCE.

A Certain and Efficacious Method of Preparing Glycerine Soaps Liquid, by M. J. PLATEAU.

WHEN I published my fifth series, I had made numerous attempts to find the best way of preparing glyceric liquid; and, indeed, with this liquid, as I then prepared it, a bubble of one decimetre diameter, placed on an iron ring, in the open air of the room, remained for three hours; this persistence would seem great compared with the two minutes' maximum duration of a bubble of the same diameter, formed in the same circumstances, with a simple solution of soap. Again, several successive preparations made in the same manner had given similar results, so that I looked upon these methods as certain. But in the new preparations used during the following summer, always with English glycerine and Marseilles soap, bought at the same shop, I did not obtain the same success. I then felt the necessity of resuming the study of glyceric liquid, in order to discover surer methods and a more general application. I have thus arrived at a simple theory of the liquid in question, which theory will be found explained in the memoir, and which made me devise some means of preparation, the almost complete certainty of which I think I can now guarantee, having made use of them a great number of times with glycerines of two productions and two different soaps. Moreover, the surface acquired a persistency much superior to that obtained by the most successful of the first experiments.

English glycerine (Price's), recommended in my fifth series, always appears to me the best.

A warm room must be selected, and the temperature must not become lower than 20° C. during the whole continuance of the preparation—at least in the daytime. Some Marseilles soap is taken which has been recently bought, and therefore preserving all its moisture; this is cut into very small fragments, and one part in weight of it dissolved at a moderate heat in forty parts of distilled water. When the solution has sunk to almost the same temperature as the room, it is filtered; then three volumes of this solution and two volumes of Price's glycerine are poured into a flask and shaken vigorously and for a sufficient length of time for them to be well mixed; after which it is left for seven days. On the eighth morning the flask is plunged into water, which has been cooled by stirring pieces of ice in it, so as to lower its temperature to about 3°, and this same temperature is maintained for six hours, by suitable additions of ice. The liquid is afterwards filtered through a very porous paper, but the contents of the filter must be prevented from getting warm again, otherwise the precipitate determined by the cold might partly dissolve; therefore, before filling the filter, a small stoppered tube, full of pieces of ice, is placed in it. This tube ought to be inclined so as to rest laterally against the filter; finally, the bottom of the flask which carries the funnel, is surrounded by pieces of ice. Then, taking the liquid from the cold bath, the filter is immediately filled. The first portions of the liquid which pass are thick; these are poured back, and after this has been repeated two or three times the liquid collected becomes absolutely clear. I need not add that if the filtration lasts very long the ice in the little tube must be renewed from time to time; as to that which is placed round the bottom of the flask, it is designed to prevent the reheating of the portions which passed first, and dissolving the precipitate. If the liquid is in a large quantity, it must be distributed in several filters, placed on separate flasks and acting simultaneously. The filtration being ended, the liquid is left to itself for ten days, and then the preparation is complete.

In the best conditions the liquid thus prepared gives extraordinary persistence. A bubble of one decimetre diameter, rested, in the open air of the apartment, on a ring of iron wire of four centimetres in diameter, previously wetted with the same liquid and left quiet, can maintain itself for eighteen hours—that is to say, six times as long as the liquid obtained by the method mentioned in my fifth series. The component substances of the liquid, being industrial products, vary more or less from one sample to another, so that I have only occasionally obtained the above result. However, the superiority of my new method, and the degree of confidence which it deserves, may be judged of by what follows.

Of twenty-one preparations effected successively during the last four summers, and with different samples of Price's glycerine and Marseilles soap, two only, in which the glycerine and soap were the same, gave me bad results, but I have good reason to suspect that there was an error in the weight of the soap. All these liquids have been tried by means of a bubble of one decimetre, rested on a ring, as I have said. Omitting the two failures, there remain nineteen samples, for three of which the maximum persistence was five hours, for three others seven hours, for two eight hours, for four nine hours, for four ten hours, for one eleven hours, for one twelve hours, and for one eighteen hours.

It is very remarkable, that, when the persistence is great enough, the film, after an hour or two, attains an obviously uniform thickness over the whole bubble, except, indeed, the small lower cap intercepted by the metallic ring. This uniformity is discovered in the disposition of the colours.

Moreover (and this is not less worthy of interest), the colours first rise towards the first orders, then generally come down again to the red and green of the last, and sometimes even nearly to the white. This retrogradation of tints proceeds, as I have shown in my fifth series, from the glyceric liquid absorbing the humidity of the surrounding air.

The theory which I have made of glyceric liquid leads again to this conclusion—that, by substituting some pure oleate of soda for Marseilles soap, a liquid superior even to the best prepared from soap may, by a far simpler method, be obtained, and this is fully confirmed by experiment; indeed, I found it sufficient to dissolve at a moderate heat the oleate of soda in distilled water, then to mix the glycerine with this solution, the whole in rather different proportions to those of the soap liquids. By the next day or the day after, the liquids thus prepared were ready for experiments, and they continually gave me bubbles of one decimetre in the open air, the maximum persistence of which exceeded twenty-four hours. The solution of oleate of soda is then the true glyceric liquid; it is that of theory, it excels that of soap, and its preparation is of the easiest. Unfortunately, pure oleate of soda is not found in trade, and therefore, to procure it, it is necessary to have recourse to the scientific chemist.

In a close vessel the bubbles of glyceric liquid show a still greater persistence, especially when an absorbent substance, such as chloride of calcium, is deposited at the bottom of the vessel—for instance, with a liquid of oleate of soda, which was not particularly good, and gave in the free air a maximum persistence of only twelve hours, obtained, without desiccating the air of the vessel, a maximum persistence of forty-one hours, and, with desiccation, of more than fifty-four hours.—*Les Mondes.*

PROCEEDINGS OF SOCIETIES.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology,
by Dr. Percy, F.R.S.

Lecture No. XII.

When speaking of the silicates of iron the other day, I ought to have dwelt a little longer on one or two points in connexion with them. I spoke of the so-called silicate of iron, said, on the authority of the late Dr. Thomson, to occur in the Mourne mountains in Ireland, but I have seen only one specimen of it. There is another silicate of iron, not a very satisfactory one, called cronstedtite. It is a silicate of the peroxide of iron. Silicate of iron, in combination, exists to a very large extent in minerals forming the crust of the earth—as, for example, in many volcanic rocks. It is there as silicate of peroxide of iron, and furnishes, of course, when those rocks are subjected to weathering or decomposing action, a fertile source of silica and iron, especially iron.

Of the compounds of copper, I think the first in order for our consideration is the well-known mineral called malachite—that beautiful green mineral so much prized by lapidaries and others for ornamental purposes. Here it is. It is a compound of carbonate of copper and oxide of copper. It may be easily made artificially by chemical decomposition. If to a solution of chloride of copper, for instance, we add a solution of carbonate of soda, this salt is thrown down as the resulting product, carbonic acid escaping. This carbonate has been obtained crystallised from protochloride of copper at a high temperature, or by double decomposition from protochloride of copper and bicarbonate of lime, kept at a temperature of 255° Centigrade during eighteen hours. These experiments are due to the late M. Senarmont.

The disulphide of copper is a very important compound in many respects, both mineralogically and chemically. We can very easily combine the two substances, sulphur and copper, simply by heating them, and we get occasionally, if fortune favour us with the production of accidental cavities in the mass, very variably formed crystals, but in the wet way it is clear that nature has formed this mineral. It may be prepared, according to Senarmont, by precipitating the salts of the deutoxide of copper—that is, red oxide—by alkaline sulphides, at a temperature o' 200° Centigrade, in presence of an excess of bicarbonate of soda or potash. There is a wet method, then, for its formation. Becquerel tells us that he has produced it by one of his electro-chemical methods—monosulphide of potassium acting for a long time upon a sheet of copper. This monosulphide—a common compound of sulphur and copper—acting on the sheet of copper produced crystallised disulphide. Then, again, it has been obtained crystallised by Durossé from the decomposition effected when the vapour of protochloride of copper comes in contact with sulphuretted hydrogen at a high temperature. The mineral is well known under the name of red ruthite. It is a very important ore of copper—one of the finest ores we have.

We will next take copper pyrites. This may be represented, as I said on a former occasion, as composed of one equivalent of bisulphide of copper (CuS_2), combined with one equivalent of the sesquisulphide of iron (Fe_2S_3). We can produce this compound by certain dry methods. Here is a specimen which we have produced directly by the action of heat. It is not exactly copper pyrites in point of composition, but nearly so. I gave you a proof on a former occasion, that copper pyrites in some cases must have been produced through the agency of liquids. On no other principle can we possibly account for its occurrence in the cracks of clay iron ore, to wit, where it is not unfrequently found. Senarmont has actually made it by a wet process, by exposing a mixture of perchloride of iron and chloride of copper, together with a solution of a higher sulphide of sodium than the monosulphide, in sufficient quantity to decompose the chlorides, and a great excess of bicarbonate of soda, to a temperature of 250° Cent. for some time. He thus got the mineral crystallised. The disulphide of copper is found occurring sometimes as a petrifying agent in the production of fossils.

Now as to lead. The ore of lead, *par excellence*, is, as I told you, galena, which is the sulphide of the metal. It occurs abundantly in nature, and with it, as I gave you reason to believe, is always associated an appreciable, though not pecuniarily valuable, proportion of gold and silver. The silver frequently occurs in very large quantity comparatively, and then becomes an object of profitable extraction. A very large quantity is produced in this country. All galena (I assert it again without fear of contradiction) from whatever source, whether European or American, will be found to yield sensible traces both of gold and silver. The association of these three minerals together is a very curious point worth dwelling upon.

Frémy made galena by the action of bisulphide of carbon upon litharge—not a method likely to have been employed by nature. He also made it by the action of the same compound upon other compounds of lead. Durossé made it by the action of sulphuretted hydrogen upon chloride of lead at a high temperature; and Becquerel made it by the action of sulphide of ammonium upon litharge—that is, protoxide of lead at a high temperature under pressure. Becquerel also obtained it by an electro-chemical method. He introduced some black sulphide of mercury into a glass tube, and poured thereon a solution of lead. After some six weeks, crystals of galena appeared just above the sulphide of mercury. I gave you proof of the aqueous formation of sulphide of lead; there is no doubt of its being so formed. I had a specimen from the Bedworth coal-field, in Warwickshire; it is a piece of coal in which there is a large massive lump of galena. I need hardly say that, the bituminous coal being unaltered, the lead must have been thrown down from an aqueous solution. Then, again, its occurrence in certain iron ores makes it pretty clear that in many cases, if not in all, the galena we meet with in nature has been produced in the wet way.

The action of air and moisture on galena may produce sulphate of lead. We find sometimes magnificent specimens of sulphate of lead or anglesite. I showed you some on a former occasion from America. We have had specimens from Anglesea, but they are now very rare. If sulphide of lead be decomposed by oxidation under certain conditions, the product must of necessity be sulphate of lead. The point of interest in connexion with this is that very frequently we do not find sulphate of lead upon galena which has been exposed to weathering action, but carbonate of lead. It is impossible to explain the formation of that by the action of air upon sulphide of lead. There must have been sulphate of lead first formed, and that being so, there must have been a subsequent decomposition by some agency, and there is one sufficient to account for it. I allude to bicarbonate of lime. I have given you the fact that by direct experiment there was immediate decomposition of freshly thrown down sulphate of lead by bicarbonate of lime in solution. Becquerel tells us that he got it crystallised by keeping galena in a concentrated solution of sulphate of copper and common salt for several years. I need not say anything about white lead or cerusite. It is a carbonate of lead produced from galena by the action of moist air. Cerusite is natural white lead. In the museum above there are perhaps some of the finest specimens in the world of this substance.

We now come to zinc. The oxide of zinc occurs in nature, and sometimes we obtain it as an artificial product in our furnaces. One of the most important natural compounds of zinc is undoubtedly blende—that is, the sulphide of zinc. This we can prepare directly, though not at all in a satisfactory manner, by heating zinc and sulphur together. It may, however, be produced by double decomposition from chloride of zinc and sulphuretted hydrogen brought together at a high temperature, or by passing a slow current of hydrogen over the amorphous sulphate of zinc. We obtain it amorphous easily enough at a bright red heat, and, according to Senarmont, it can be got crystallised by heating salts of zinc with alkaline sulphides at 175° Cent. Then, again, Becquerel has given us certain electro-chemical methods for making this sulphide of zinc. I need not trouble you with them.

Carbonate of zinc is a compound which, I think, there is no difficulty in accounting for the formation of. We can readily enough produce its solution in water containing carbonic acid; and when this is exposed to the action of the air, a portion of the carbonic acid goes off, and down goes the carbonate of zinc. I may direct your attention to a very fine illustration of this in the museum above, where you see a portion of stone from an old mine which had been long exposed to water containing carbonate of zinc in solution. It is encrusted with a beautiful layer of carbonate of zinc.

Now as to tin. The chief ore of tin, or *the* ore properly so called, is the ore consisting of tin and oxygen in the proportion in which they are combined in common peroxide of tin or stannic acid. There are one or two compounds of tin, which I will bring before you as interesting in a chemico-geological point of view.

We obtain the peroxide of tin crystallised sometimes as an accidental product in copper furnaces. Here is a very beautiful specimen of it, which was the result of sublimation in some way or other in a copper furnace. You will be able to inspect this afterwards. It is by no means commonly met with. It was supposed to be another oxide at first, but that has been proved to be an error. It is the true peroxide of tin crystallised by sublimation. It is well to bear these points in mind when we come to consider the bearing of volcanic methods of action upon geology. We have prepared it upon a small scale by sublimation. According to Deville it may be produced by the decomposition of chloride of tin by sodium, the two being brought together in a porcelain tube heated to bright redness.

With these remarks I will close what I have to say concerning the metals. I might amplify greatly upon this point, but it would take at least three or four lectures to do thorough justice to it. I have endeavoured to select such information concerning the metals as bears especially upon the formation of mineral lodes and veins. We shall shortly have to consider the subject of the formation of mineral lodes and veins, and there I shall generalise as much as I can; but before I take up that part of our subject I think it may be best to consider another very important one—namely, metamorphism. I need not say a great deal on that point.

What is meant by metamorphism? Of course it implies change of some kind. Is it simply a change in a sedimentary rock or some other rock effected subsequent to its deposition, and without any essential alteration in its percentage chemical constitution? No, I think not. I think the term "metamorphism" ought to be much more comprehensive and extensive than that. Here is the definition of metamorphic rocks which was given some time ago by Sir Charles Lyell. It is extracted from one of his books:—"A stratified division of hypogene rocks, highly crystalline, such as gneiss and mica schist, and so named because they have been altered by plutonic action." I would venture to suggest that this implies far too limited a definition of the term "metamorphism." That term, according to the notion of the present day, embraces various changes which do not come in that category. I have collected as far as I could all the various kinds of changes which may take place in rocks after their deposition, and I have endeavoured to classify them. Metamorphism is undoubtedly a subject of the first importance in geological philosophy.

Now, the first kind of metamorphism is that which is due to heat alone. Suppose the deposition of a sandstone rock, owing to fine grains of sand slowly subsiding during a long period of time, and then consolidating into a bed of sandstone. Now, what change will such a bed undergo by exposure to heat alone? Well, we have on the table one or two apt illustrations taken from furnaces, which I think you will say are somewhat striking in their character. If you take a piece of common sandstone and expose it for a long time to a high temperature—say to a bright red heat or even higher than that, as at the bottom of a blast furnace—you will find it very much changed in character. By a long time I mean some years. It will become harder and more firmly consolidated, and frequently split up into basaltic-like columns. Here is a specimen which has been so altered, simply, as far as we know, by the direct action of heat. Here is another specimen, which is, perhaps, still more striking, taken from the bed at the bottom of a blast furnace, where it was exposed to long-continued heat for some years. Here is a portion of common sandstone which has been employed for the bed of this furnace. Molten iron has lain on this year after year. That implies, you know, a pretty high temperature. Any geologist comparing this with the same rock before it has been exposed to the action of heat would be inclined to conclude that it was impossible that the one could be derived from the other by the simple action of heat alone. At all events, he might be sceptical about it. This is a very beautiful illustration. The sandstone has become converted into a hard, compact mass, quite different in appearance from the unchanged rock. You must be so good as to examine these two specimens side by side, and then you will be able to judge for yourselves of the alteration effected by the operation of heat alone. But bear in mind that in this particular case it is just possible—I admit that—that the change may, to a certain extent, have been brought about by means of alkaline vapour. We know that there is such vapour always in our blast furnaces, especially in the lower part, and it is possible to conceive that that has permeated the walls of the furnace and got down into the bed, and so transformed, or tended to transform, that sandstone into the metamorphic rock, if I may use the expression; but I do not think it probable that that has been formed in that way. There are certain difficulties in the vapour penetrating to the bottom of the furnace through the molten iron, but still it is a possibility. Here is another specimen. It is a piece of mica schist from Norway—palpably, unmistakably, mica schist. There is the same rock which has been exposed to the action of heat in a furnace, and you see in many respects it has undergone a striking change. Here is another worthy of your attention. It is from the same rock in Norway, and is similarly changed. Nothing can have undergone a more decided transformation than this rock, and apparently by the action of heat alone. Here are other specimens telling the same story. This is a simple change by heat, whereby the particles are made to cohere more firmly together.

But there may be metamorphic action by heat in which there is a chemical rearrangement of the particles. That is a matter of great importance to bear in mind. We may take a rock having a certain chemical composition, and we may trace this rock out over a large area, and see it undergo a clear, unmistakable change in character, being transformed into another kind of rock apparently quite different in composition from the original, but still possessing the same percentage composition. This would show that heat has effected a transformation in the properties of the rock, its constituent proportions remaining the same. There is a very interesting paper bearing on this point lately published in the *Comptes Rendus*, which deserves attention. This rearrangement of particles is a very curious thing. Something of the same kind takes place in the devitrification of glass. There you may have a rearrangement of the particles simply by the operation of heat alone. Take a piece of common window glass, and expose it to a red heat: the glass shall become opaque, as you have seen, and highly crystallised, and the crystals so produced shall not be different from the "mother liquor," if I may so speak, or the matter in which they are embedded, as regards their ultimate chemical composition. That has been proved by analysis. Here is a change effected without fusion. Understand that distinctly. There are numbers of changes of this kind which take place entirely without fusion. That is a matter of great interest for geologists. There is no necessity for the theory of fusion in this matter. The rock may remain solid, and yet the action of the heat shall just remove the particles, so to speak, from one another, and allow them to rearrange themselves in different chemical groups.

I may give you an illustration of this in the common metal zinc. Various other metals give the same illustration. If I take a piece of common sheet zinc, of which chimneypots are made, I can bend it backwards and forwards without breaking it, and on putting it to my ear I do not hear any cracking sound when it is bent; but if I gently heat it sensibly below its fusing point, I can then break it immediately, and on bending it I hear a distinct crackling sound just like that which is produced when tin is bent. Well, what has taken place? Simply by heating the metal below the fusing point, the particles are set free, to a certain extent, to vibrate, and they rearrange themselves in a crystalline form. The metal becomes highly crystalline in structure. I might give you illustrations of similar changes taking place without the application of heat. There are numbers of instances of that sort; but I should be going too far out of my subject to mention them. These facts derived from the metals give a very simple evidence of the changes which may occur by the operation of heat alone at very gentle temperatures—temperatures less than the fusing point of the substances. The transformation of clay slate into the stratified rock called gneiss is an illustration of this. The transition in some cases is most gradual. There is one result which we owe our knowledge of to Carius. He analysed six different specimens from Löhen, in Saxony, illustrating the gradual passage of clay slate into gneiss, clay slate being distinct at one end and gneiss at the other. He did not succeed in detecting any appreciable difference in ultimate chemical composition in any part, and yet there was the most marked alteration in the physical characters of the rock, and also evidently in the chemical constitution. Approximately, each bit of the rock contained exactly the same proportion of elements per cent. No doubt in one part of the rock there was a rearrangement of these particles so as to constitute specific mineral compounds which did not exist in the other. I may here call your attention to a fine geological rock which plays a very important part in this country. It is slate which has been exposed to the action of intense heat. You see it has become exactly like a porous mass of pumice.

This metamorphism due to a rearrangement of particles, without loss or without addition of matter, is a very wide subject, and one which deserves to have constant attention, and to be taken up more than it has hitherto been. There is no doubt that heat is one of the most fertile or one of the chief causes of effecting such a rearrangement.

The next kind of metamorphism is that which takes place with a loss of matter. Now I might give you many examples of this. There is the well-known mineral occurring abundantly in nature called porcelainite, or porcelain jasper. It is nothing more than a kind of clay which has been exposed to a pretty good heat for a long time. We can imitate this action. It has been burned into a sort of brick. The natural mineral is very pretty, but we can rival it by the artificial one. On examining a pit-mound, you will most likely discover beautiful specimens of shale which has been exposed to a long-continued heat, and as the result of that exposure you will see the shale beautifully marked with alternate bands of green and red. If we apply the term metamorphism to this action, this would be a change by the loss of matter. The clay has become simply dehydrated by the action of heat, and we get this pretty thing called porcelain jasper.

There may be a metamorphism by intermixture with contiguous matter. This is a point requiring very close examination. To illustrate this sort of change, I may refer to a case cited by Bunsen, where what he calls a pyroxenic rock, that is a volcanic rock containing about 50 per cent of silica, is traversed by a dyke of trachyte—that is, a rock containing a much larger quantity of silica—say about 80 per cent.—and represented by obsidian, of which you have a specimen before you. He took specimens and analysed them from the interior of the dyke, from the cheek of the dyke, and also from a part of the surrounding rock. Here he found there was a gradual transition from one into the other, showing this change in the walls of this fissure or dyke by the intermixture of contiguous matter. That is a kind of metamorphism which I think deserves attention. I need not trouble you with the exact numerical details of the analysis. I shall confine myself now to the general result. These details may be found in the admirable paper written by Bunsen—one of the best ever written on the subject—published in the "Cabinet of Sciences," first volume.

Then there is a metamorphism due to the action of water at a high temperature — that is, hydrothermic action. I have already given you many examples of this action. Here is a remarkable class of examples from Daubrée's researches on the action of water at a high temperature upon various silicates, especially kaolin and obsidian, and particularly with waters containing a certain amount of alkali in solution. You will remember the action of water at 400° C. on glass. That was well deserving of attention. You remember how the glass was decomposed and so forth, and what the products were. We can decompose this obsidian or trachyte rock readily enough by the action of hot water or by superheated steam alone under great pressure; and there is no doubt that the natural volcanic rock has been so acted upon and decomposed in many instances. It thus loses completely its glassy character, and becomes changed into a crystalline fine-grained trachyte. The powder so formed presents under the microscope all the characters of felspar. Obsidian differs from felspar in containing a little more silica, and this is easily removed along with the alkaline silicate dissolved out of the glass, the residue consisting of felspar. Then, again, I may recall your attention to the fact that china clay, common silicate of alumina, when treated in a similar manner, produces felspar. It was changed into a confusedly crystalline substance, and the crystals were small prisms which cut glass. They were not acted upon by hydrochloric acid. Daubrée asserts that it was a double silicate of alumina and alkali, having all the properties of felspar, and was mixed with a little crystallised quartz. Now, that is a curious point. I told you we could transform felspar into kaolin. We know that is a fact, because we see it done every day in Cornwall and elsewhere when granite is undergoing decomposition. Here, on the other hand, we can reconstruct the felspar by acting upon that kaolin with silicate of alumina and hot water. Now, that is a very beautiful consideration. We cannot only obtain clay from the destruction of felspar, but we can recompose our felspar from the clay so obtained by the action of hot alkaline water. Simple as these experiments of Daubrée and others are, it appears to me that they have marvellous significance with respect to the great phenomena of chemical geology, and they cannot be too closely studied. Here, again, Daubrée has made some very important observations upon this hydrothermic action at Rothan, in the Vosges. I think I can hardly do better than give you his words:—"Syenitic granite has penetrated Devonian beds which, even to the distance of several hundreds of metres from the point of contact, are entirely modified. In certain points the rock is wholly formed of a mixture of lamellar augite, epidote, and compact garnet, with some galena." In the middle of the rock formed of these silicates, Daubrée found numerous polypes perfectly well preserved. Even the cavities left by the partial disappearance of the calcareous substances of these polypes were studded over with crystals of the same mineral as formed the matrix. The most abundant was black hornblende, in elongated perfectly defined crystals, penetrating nearly into the crystals of quartz, as is frequently seen in the middle of rocks having lost all traces of fossils. Grass-green garnet also occurs, completely recalling that of Morzoni in the Tyrol and of Drammen in Norway. Large crystals of axinite were also discovered by Daubrée, of which the presence had not been previously recognised under similar conditions in fossiliferous rocks. It is clear that these changes—and very marvellous changes they are—are all effected by the percolating action of water upon these rocks. Daubrée concludes (these are his own words):—"The organic remains so well preserved at Rothan deserve to be regarded as classical monuments of metamorphosis. They teach us, in fact, that a rock, incontestably of sedimentary origin, is now formed of anhydrous and crystallised silicates, such as augite, hornblende, garnet, epidote, and axinite; and further, that this rock has been profoundly transformed without notably softening, since the *délicatesses* [that is his own word] of the surface of the polypes are well preserved in it." Well, that is an important point, and it appears well worthy of your careful reflection. "Metamorphism of this kind," he goes on to say, "explains how the angular edges of numerous fragments which are very often met with in granites from the most different localities should have been preserved." Daubrée insists upon the connexion between the metamorphism of stratified beds and dislocation, and the connexion of dislocation with the occurrence of thermal waters. All that you require is immense pressure at great depths and comsponding degrees of temperature. He has calculated that over three-quarters of the globe thermal waters cannot rise except by overcoming the pressure of the water of the ocean, which on the average may be taken at 200 atmospheres.

Another kind of metamorphism is that which takes place by the removal of part of the constituents of a rock by the mechanical action of water—not by its chemical action. Take, for example, the washing out of argillaceous, or ferruginous, or other mechanically mixed matter from a sandstone rock. That such transformations have taken place we have abundant proof; and the rock so deprived of its ingredients by the mechanical operation of washing is transformed into quartzite—that is, a metamorphosed sandstone.

Itacolumite, on which I dwelt so long when speaking of the diamond, is a kind of quartzite. This is a metamorphism entirely due to the washing action of water, some of the constituents of the original rock being washed out, and other matters being left in their place, without disturbing the form of the rock.

There is a metamorphism due to the solvent action of liquids. I have already considered this metamorphism as regards the possible formation of dolomite. I need not recur to that again. This solvent action may take place in nature on a very large scale, upon our so-called igneous rocks containing silicates, which are slowly decomposed by water, especially when that water contains carbonic acid in solution. It then becomes slowly decomposed and disintegrated, and the matter so dissolved out is thrown down in different states of combination. We spoke especially in a former lecture of the decomposition of silicate of lime by this means.

Metamorphism may take place by the deposition of matter from solution. Silicification may be taken as an example of this kind of metamorphism. At Kolman, in Alsace, mischelkalk in contact with granite is changed into hornstone from the action of springs containing silica. There is the positive fact. The same thing is observed in Kentucky on a large scale. This is a point which we have investigated with reference to the theories of the formation of dolomite. It is a matter which requires much further work on the part of chemists and geologists combined.

There is metamorphism by the addition of water, and of this I can give a most capital example in the gradual conversion of anhydride—that is, an anhydrous sulphate of lime—into the hydrated gypsum or common gypsum. This may be seen at St. Gothard in every stage of conversion.

Then there is a metamorphism by oxidation and hydration. I think we are justified in applying the term metamorphism to this change. Take the two actions together, and as an example we have the conversion of beds of carbonate of iron into peroxide. Surely that is worthy of the name of metamorphism. It is a change which may occur on these beds of carbonate of iron to a very great depth, and on that account I maintain that the term metamorphism may be properly applied to a change of this kind. No doubt that this Northampton iron ore has been derived from the carbonate entirely through the weathering action of air and the addition of water in combination. Understand what takes place. The carbonate of iron loses its carbonic acid, which escapes wholly; and the protoxide of iron takes up oxygen from the air and becomes converted into peroxide, and that peroxide enters into combination with water and becomes hydrated, and thus you get these brown iron ores formed.

Now we come to metamorphism as the result of volcanic exhalations. This is a subject especially worthy of study, Bunsen especially has examined it with great care, and directed the attention of geologists to it. All these points are matters of great interest for the chemist and geologist in unison, and they constitute an important part of the glorious science of the history of our globe or of its formation. Now, the agents which seem to have played an important part in this action are steam, hydrochloric acid, sulphuretted hydrogen, and carbonic acid. This action is very properly termed by Bunsen "pneumatolytic" action. As an illustration of the action, take the case of obsidian, which may be decomposed by the action of hydrochloric acid vapour. Bunsen has given us a clear demonstration of this change. There is no difficulty whatever in accounting for the formation of clay by this kind of action—namely, by the disintegration and decomposition of obsidian by the vapour of hydrochloric acid. It is not a question of doubt; it is a question of fact, established by observation. No doubt there are other sources of clay, but this is one, and a source which may have existed to a very large extent for aught we know. There is a volcano in Java the whole crater of which is filled with boiling mud, from which hydrochloric acid is evolved. We are told in connexion with this volcano that it is dangerous even to approach it, in consequence of the changes produced by the action of the acid. In Ireland, too, gypsum is produced by the action of sulphurous acid on a particular rock called palagonite. Then we have, too, sulphuretted hydrogen and carbonic acid resulting from volcanic action. These may have played an important part in bringing about many changes. The hydrogen may have become oxidised and the sulphur thrown down in combination with a metal; and in this way we could account for the formation of many sulphides if we only admit the presence of sulphuretted hydrogen.

The last kind of metamorphism is one which has been mentioned of late by Bischoff, and is worthy of the especial attention of geologists. There seems to be good reason for supposing—though I cannot go into the proofs now—that carbonic acid existed in former ages to a much greater extent than now, and this is supposed to have played a very important part in the weathering action of rocks, silicates having been decomposed, and carbonates being the result of such decomposition. But the question to which I refer now is the relative volumes of the rock thus acted upon, and the products of the rock in which we find the carbonic acid contained. That is the point. We will take, for example, basalt; that is one which Bunsen gives. It has, we will say, a volume of 33·33—the third of a hundred. Very well, on weathering by the influence of carbonic acid and water, that basalt becomes converted into quartz and kaolin and carbonate of lime, and carbonate of magnesia, and carbonate of potash, and so on, and the volume increases to 70·93. Thus, admitting this action, the volume of the rocks, you see, has been largely augmented by the abstraction of the carbonic acid from the air. Now, that is a matter of necessity. Hence this kind of action may have taken a prominent part in determining the conformation of land. Imagine a great rock, consisting of silicates, thus decomposed and converted into these substances—quartz, kaolin, and so on—by the action of carbonic acid, and then see what an enormous increase of volume must have taken place. This is a very important subject, and one well worthy of investigation.

I think I have laid before you all the main facts, generalised as far as possible, that pertain to metamorphism. Of course, to properly discuss the matter in its geological bearings would require several lectures. I am now speaking of the essential chemical nature of those changes which, as far as we know, may be classed properly under the head of metamorphism.

The next subject on which we shall treat is fossilisation. This will not occupy so long. By fossilisation I mean the change of the remains of animals and plants into stone-like matter, commonly called "petrification." We must be careful to distinguish here between this and the common petrification, which is nothing more than an incrustation, such as we see on birds' nests and other things at Matlock Bath, in Derbyshire, where the water contains carbonate of lime held in solution by carbonic acid. When articles are exposed to the action of this water, carbonic acid escapes, and they are incrusted most beautifully with a deposit of carbonate of lime. That, however, is simply incrustation, and not fossilisation, and is similar to the incrustation of copper, which is deposited in the electrotype process. We have very fine specimens of this deposition of carbonate of lime at Carlsbad, which I have no doubt many persons here present know. Silica we frequently find incrusting as well as carbonate of lime. At St. Michael's, in the Azores, for example, it is stated that there is a stream containing so much silica that plants in it are said to have their tissues replaced entirely by silica. The organic part is gradually removed, and, *pari passu*, the silica is deposited. Then we find other substances, capable of being separated from solution by exposure to the air, acting as incrusting agents.

In the process of fossilisation, we have first of all the filling up of the casts or fossils of organic bodies by various means. The original substance has been removed, and left a mould, and the mould is filled up by some deposit. This is one kind of fossilisation. It is sometimes filled up with the same kind of matter as the stuff in which it occurred—sometimes with another. Thus we may have casts in sandstone filled up with sand, and sometimes with different kinds of matter. In the common echinus in the chalk, the interior is filled with flint, while the shell is changed into calcspar; yet all this has occurred in the chalk itself.

We have fossilisation by carbonate of lime. In the shells of living animals the carbonate of lime is either amorphous or in the state of arragonite. Now, in the crinoids the stems break with a very curious rhombic fracture, and each joint seems to form a distinct crystal, and the internal alimentary canal is always the main axis of the crystal. If we break a series of these joints in succession, we find that the crystals are all turned at a certain angle, but we do not find that the cleavage planes are parallel. That is a very curious point.

Next, there is fossilisation by means of silica, of which we have some very fine specimens. For example, here is one—fossil wood. That is a very interesting kind of fossilisation. No doubt that wood has been exposed for a very long period of time to the action of water containing silica in solution, and in proportion as the vegetable matter has been removed, particles of silica have been deposited, and so we gradually get a compact mass in which the whole structure of the wood has been preserved. It is one of the most beautiful kinds of fossilisation we meet with.

Sometimes we find that iron pyrites replaces organic remains. Some of the most beautiful specimens which we obtain, and which are really ornamental to a geological cabinet, are some of these exquisite little ammonites. They are most beautiful things when cut. It is stated that in bivalve shells—and this is an interesting point—we do not meet with this replacement, and the reason for it seems to be satisfactory. The iron pyrites seems to be generated by the action of decomposing organic matter upon sulphates in solution in water. I think there is no doubt about that in the majority of cases. Of course there must also be iron present at the time. Well, in the case of bivalve shells this decomposing matter readily escapes and flows away, or is otherwise removed, and therefore we do not find replacement by pyrites as we do in those shells where the matter is retained. That is the explanation that is given, but whether it is altogether satisfactory to you it is not for me to say. I ought, perhaps, to have spoken with a little more reserve. I think a little more investigation is required before the explanation can be established as a fact.

Then we have replacement by means of hydrated sesquioxide of iron, pseudomorphous after pyrites. I mentioned that on a former occasion. I might go on amplifying very much on this part of our subject.

For fossilisation all we want is the replacement of the organic matter, which is removed, *pari passu*, by some other matter, and that may be done with almost any substance. For instance, fossilisation may occur from red iron ore, from sparry iron ore, and even from specular iron ore. Gypsum is also an agent in fossilisation. This is shown in the stratum of fossiliferous gypsum in the Keuper formation in Wirtemberg. There are also gypsum casts of shells at Montmartre, near Paris.

Then we find vivianite, or blue phosphate of iron, in fossil shells in the Black Sea.

Fluor spar is sometimes an agent of fossilisation. There is no difficulty whatever in accounting for this, because we find fluor spar almost everywhere. It exists in sea water, and in certain mineral springs in small quantity. I might have given you positive proof of this if I had gone into that subject. The quantity, as I have said, is small; but still, when we come to consider the operation of water like that through ages—not only thousands of years, but tens of thousands of years—we can readily understand how this small quantity may in time produce vast results.

Fossils in sulphate of baryta are sometimes found. I have seen several such in the lias of France, and in ammonites at Whitby. This sulphate has gone down from water. We know that it exists in water, and in sea water, and in our clay iron ores. I might have shown you specimens of these clay iron ores containing sulphate of baryta in their fissures.

Then, again, sulphate of strontia is another substance of which fossils are formed. Here are specimens in which replacement by that compound has occurred.

Sulphate of lead has also been found in fossils in France. Carbonate of lead has also formed fossils.

Again, fossils have been found to consist of blende, or sulphate of zinc. This is another proof of its aqueous formation.

Carbonate of copper and green silicate of copper may be mentioned as agents in fossilisation, besides many other mineral substances which I need not enumerate.

Before touching the last subject of our lecture, I must just say what I intended to say upon mineral veins and lodes; and I shall do this as briefly as I can. Of course the subject of these lodes, to be treated properly, would require a very long time—a course of a dozen lectures, or even more than that; but to treat it at great length is quite out of the question on the present occasion, and I shall hence try to generalise as much as possible.

Now, a metalliferous lode is nothing more, really, than a great crack in the earth, formed in some way or other, and filled in gradually by metalliferous matter. That is certain. Let us, then, consider the principle which applies to the mode of filling up. I shall do no more than that on the present occasion.

Before you are several specimens illustrating the mode of filling up, and very fine specimens they are. In the museum above are other specimens illustrating the same point. You could not have a finer series than is there found.

Now let us suppose a great crack in the earth. This crack becomes filled in in course of time, and if the matter filling it be metalliferous, it will constitute a metalliferous lode—a lode properly so called, or a vein. These metalliferous matters occur here as strings. Here is some galena intermixed with other kinds of matter which are called "vein stuff," or the matrix, or it may be that it is intermixed with the cheek or wall of the vein, which is more properly called "vein stuff."

Now, let us see how this filling up may occur. Various theories may be put forth; but there is no doubt, considering all the facts which we have now passed in review with regard to the formation of sulphides and so forth, and other facts, that all these metalliferous veins have been produced by aqueous action, and not by igneous action, as one might have supposed. Look at the metals occurring in them—galena, carbonate of iron, and other things which never could have been produced at a high temperature, in that condition at all events—and then say whether it is possible to arrive at any other conclusion.

Now, we may have a fissure in a rock, for example, filled up from the side uniformly by lateral accretion or growth of the side. There shall be a substance added nearly equally to each side, the fissure being supposed to be filled with water. You may assume that there may be a free percolation of water, containing sulphate of baryta, from above or below. Thus you may get a deposit of sulphate of baryta. That is very sparingly soluble in water, it is true, but still it is soluble; and by the action of such water year after year and age after age, we get a distinct deposit of sulphate of baryta. Then, perhaps, the nature of the water may change, and we may get galena deposited on the side, the proportion varying in different parts of the vein, and so on. Then, again, possibly you may get fluor spar, or something of the same sort. Then you may get a quantity of iron pyrites deposited in the same way, till at length we have the whole vein filled up with various kinds of matter, sometimes beautifully distributed in symmetrical bands, and existing on each side of the medial or central line which you will find in some of these specimens. There is no difficulty at all in accounting for the formation of these veins in that way. We know that water is at hand, and is easily accessible to these veins, and must, and does, convey the matter of which these veins are composed. We have seen from the observations of Daubrée how water percolating through a fissure in a rock may by its action change the rock for many metres. You will see this illustrated here in this specimen. These cracks have been filled in with copper pyrites, and you see how the matter contiguous to the copper pyrites has been gradually changed.

Secondly, there is the theory of the formation of lodes by infiltration. It is possible—nay, it is more than possible, it is certain in some cases—that hot springs arising from below have contributed to the formation of veins. There is no doubt whatever on the matter. The metalliferous matter (and this is a point which has often struck me as interesting) may have gone down from water from above, or may have come up from below. We do not find in many cases this metalliferous matter extending equally through a great depth of the vein. Sometimes it stops at one place, and sometimes at another. We know perfectly well that water does contain these matters. Take the fact that I mentioned to you with regard to copper in anthracite coal, and silver in clay iron ores. These must have gone down from water, showing the certainty of the occurrence of metals of this kind in solution at some former time, and extending over a large area. All we want is some solvent of these bodies, and that water should get access to the veins, and then we can easily understand how a deposition may have taken place, first of one substance and then of another. It is perfectly possible that electro-chemical action may have taken place as some suppose; but we know so little about that, that it is vain to speculate further about it.

Then, again, it has been suggested that sublimation may have played some part in the production of mineral lodes. This is a favourite theory of some persons, but it is one, I think, which will not bear much investigation. I am not prepared to say that sublimation may not have been the cause in some cases, but I state most unhesitatingly that in many cases, at all events—in the majority of cases—that theory will not explain what we observe in the veins themselves; and if the theory be of any account it is not one of much importance, seeing that this action must have been very limited as far as we can make out. I could give you many facts in support of what I am saying.

We have also the theory of the injection of molten matter. Well, that will not apply in many cases to metalliferous veins. It is perfectly certain that this could not produce a vein like that containing galena, baryta, and so on—simply the pouring in of molten matter. There are known metalliferous veins which have been produced undoubtedly by injection. Take, for instance, the veins of trachyte or basalt going through rocks, or take the veins which, I am sorry to say, we not unfrequently find in Staffordshire, where we meet with an igneous rock running through the coal. But cases of this kind are comparatively limited.

(To be continued.)

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 27, 1866.

E. W. Binney, *F.R.S., F.G.S., Vice-President, in the Chair.*

Among the donations announced was a beautiful series of preparations of the spores of fungi on glass, from Sir J. F. W. Herschel, Bart., M. A., F.R S., &c. &c.

On the motion of Mr. Spence, seconded by Dr. Joule, the thanks of the Society were unanimously voted to Sir John Herschel for his valuable donation.

"*Observations of the Meteoric Shower of November* 13-14, 1866," by Joseph Baxendell, F.R.A.S.

The early part of the night of November 13 was very squally and cloudy, with showers of rain and hail and occasional flashes of lightning. At about 12h. 15m. a break occurred near the zenith, and in a few minutes the clouds had almost entirely disappeared. My observations of the meteors commenced at 12h. 16m. Greenwich mean time, and were directed principally to the determination of the time of maximum frequency, and the position of the radiant point. The observations of frequency were as follows:—

				Number of Meteors Observed.
From 12h.	16m.	to 12h.	32m.	60
	32		48	153
	48	13	4	287
13	4		20	378
	20		26	122
	26		42	316
14	19	14	42	54
15	20	15	35	6

From 13h. 42m. to 14h. 19m., and again from 14h. 42m. to 15h. 20m., the observations were interrupted by clouds and rain, and only 73 meteors were counted during the two intervals. At 15h. 35m. clouds came on again very suddenly, and the sky remained obscured at 16h. 5m., when I ceased to watch.

During the whole time of observation the sky was rarely entirely free from clouds for more than two or three minutes, but the errors arising from this cause are probably pretty evenly distributed through the intervals above given, and cannot therefore materially affect the final determination of the time of maximum frequency. The results of the observations are as follows:—

		Average Number of Meteors per Minute.
At 12h.	24m.	3·7
	40	9·5
	56	17·9
13	12	23·6
	23	20·3
	34	19·7
14	30½	2·3
15	27½	0·4

The curve formed by a projection of these numbers gives 13h. 12m. as the time of maximum frequency. The probable error of this result can hardly exceed one minute.

In order to determine the position of the radiant point, the positions of the intersecting points of the paths, continued backwards, of a great number of pairs of meteors were noted. By far the greater number of these points fell on a space bounded by lines joining the stars γ, ζ, μ, ε, and η Leonis, and, allowing equal weights to all the observations, the mean position was found to be R. A. 9h. 58m. 12s. = 149° 33′; Dec. 22° 57·5′ North. Calculating the position referred to the ecliptic, we have Long. = 143° 41·0′; Lat. = 9° 54·5′ North.

At the time of maximum frequency the earth was advancing in the direction of a point on the ecliptic, the longitude of which was 141° 28·3′, or 2° 12·7′ less than that of the radiant. It appears, therefore, that the meteors were crossing the earth's orbit from within outwards, and that their aphelion distance is very sensibly greater than the earth's radius vector on November 13.

The velocity of the earth in its orbit on November 13 is 18·38 miles per second, and the velocity of the November meteors when they enter the earth's atmosphere has been found to be forty miles per second. With these data and the latitude of the radiant point as given above, 9° 54·5′ N., we find that the inclination of the orbit of the mass of meteors to the plane of the ecliptic is 17° 59′, and that their orbital velocity at the time they encounter the earth is 22·31 miles per second. The excess of this velocity over that due to their distance from the sun arises, in part at least, from the accelerating effect of the earth's attraction.

An attempt was made to estimate roughly the relative numbers of meteors of different magnitudes, and it was found that they occurred in about the following proportions:—

Out of every 100 meteors,
10 were above the 1st mag.; the brightest of these were 2 to 3 times brighter than Sirius;
15 were between the 1st and 2nd mag.
25 ,, ,, ,, 2nd and 3rd mag.
30 ,, ,, ,, 3rd and 4th mag.
15 ,, ,, ,, 4th and 5th mag.
5 ,, below ,, 5th mag.

The average magnitude was 3·0.

The trains left by many of the larger meteors had a beautiful emerald-green colour, others were of an ashy grey, and the remainder white. The meteors themselves were mostly white or bluish white, but many were of a fine golden colour.

In order to give some idea of the great velocity with which the meteors enter the earth's atmosphere, it may be remarked that it would be sufficient to carry a body through the entire circuit of the earth in an interval of less than ten and a half minutes.

As I had the good fortune to witness the great meteoric shower which occurred on the morning of Nov. 13, 1833, I may state that the late display was far inferior to it both in the number of meteors seen and in the brilliancy of the larger ones, and I am therefore inclined to think that a much finer display may be expected to occur in November next. At the time of the 1833 great shower I was at sea off the west coast of central America, and although I then knew little about meteors, and the idea of a radiant point had not, so far as I am aware, ever occurred to any astronomer or meteorologist, the tendency of the great majority of the meteors to diverge from a particular region of the heavens was so strongly marked that it at once engaged my attention, and I find on referring to my notes that I fixed the central point of this region in the constellation Cancer, a few degrees east of the stars δ and γ, and not in Leo, as observed by Professor Olmstead and others, in the north-western portion of the North American continent. A great number of the meteors, however, had other radiant points, and some of the finest moved in long horizontal arcs, or in directions nearly perpendicular to that of the main stream. This fact seems to me to be strongly opposed to the cosmical theory of meteorites, except on the rather improbable supposition that the earth, on that occasion, encountered two or more groups, all, at the same time, crossing each other's orbits, as well as the orbit of the earth. It may, however, be urged that such a supposition is hardly more unlikely than that which ascribes the November meteors to a ring of small bodies moving round the sun in an orbit differing little in magnitude from the earth's orbit, but the motion being retrograde, or contrary to that of the earth, and therefore inconsistent with the general analogies of the solar system, and opposed to Laplace's almost universally received nebular hypothesis.

ACADEMY OF SCIENCES.

December 3.

"*On Endosmose and Dialysis,*" by T. Graham. In this paper Professor Graham comments upon a paper by M. Dubrunfaut, which was read at a recent meeting of the Academy. In April, 1854, M. Dubrunfaut patented a method of removing salts from beetroot sugar by an osmometric process, and claimed this as an anticipation of Professor Graham's work on Osmose, published in June, 1864. Professor Graham now reminds him that what M. Dubrunfaut patented in 1854 had been fully described in principle in the Professor's principal memoir on the Diffusion of Liquids, published in 1849.

"*Comparative Experiments on the Vital Resistance of certain Vegetable Embryos,*" by M. F. A. Pouchet. The author finds that the seeds of the *Medicago* (American) will germinate after having been boiled in water for four hours. Other seeds would not, however, bear 15 minutes' boiling.

"*On the Action of Aqua Regia on Silver: New Battery,*" by M. Roullion. A mixture consisting of two-thirds hydrochloric and one-third nitric, or three-fifths hydrochloric and two-fifths nitric acids, will easily dissolve gold and platinum, but will only superficially attack pure unalloyed silver; a superficial chloride being formed, which protects the rest of the silver like an impermeable varnish, however long it may remain in the aqua regia. If copper be present, the metal is attacked. M. Roullion has utilised this fact to make a new battery in which pure silver in aqua regia replaces the platinum or carbon in the nitric acid of a Grove's or Bunsen's cell. He says that after several months' use the silver has not sensibly diminished in volume, and no chloride of silver has been found in the porous cell. He considers this battery more constant than Bunsen's battery.

"*Sixth Memoir on the Mechanical Theory of Heat,*" by M. A. Dupré.

"*On the Shooting Stars on the Night of November* 13-14," by M. Phipson.

The same subject by M. E. Guillemin.

The same subject by MM. J. Silbermann and A. Guillemin.

"*Facts relating to Coal-tar Colours,*" by MM. G. de Laire, C. Girard, and P. Chapoteaut. This paper is an important one, and will be published in full in an early number.

"*On the Alloying Tungsten with Iron by the Wilkinson Furnace,*" by M. P. Leguen.

"*On Hypoiodous Acid and its direct Combinations with Hydrocarbons,*" by M. E. Lippmann. When iodine, oxide of mercury, and amylene are mixed in the presence of water, iodide of mercury is formed, and hypoiodous acid, which combines with the amylene to form iodhydrine, heavier than water. When this iodhydrine is treated with acetate of silver, there are formed acetic acid, iodide of silver, and oxide of amylene, which boils between 95° and 100°. When alcohol or chloroform is employed instead of water in the initial reaction, other products are formed which have not yet been fully examined.

"*On the Action of Reducing Agents on Nitric Acid and Nitrates,*" by M. A. Terreio. The author finds that the reduction of nitric acid into ammonia under the influence of nascent hydrogen, sulphuretted hydrogen, sulphurous acid, and sulphites, takes place with excessive slowness. When, to a mixture of zinc and acidulated water, a trace of nitric acid or a nitrate is added, and when the liquid is decanted, after a few minutes it will be found that the solution possesses the property of decolorising a large quantity of permanganate solution. This shows that very serious errors will be committed in the volumetric estimation of iron with permanganate if all traces of nitric acid are not removed before reduction with zinc. It has been found that chlorates, or chloric acid, do not produce this phenomenon of decoloration; the employment of these oxidising compounds should, therefore, be preferred in the estimation of iron by Margueritte's method. The author proposes to use this decoloration reaction as a test for the presence of nitrates.

CONTEMPORARY SCIENTIFIC PRESS.

[Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the Chemical News.]

Annalen der Chemie und Pharmacie. October.

"*Researches on the Derivatives of Indigo Blue,*" by A. Baeyer and C. A. Knop.—"*On the Derivatives of Oleic Acid,*" by O. Overbeck.—"*On the Action of Oxychloride of Sulphuric Acid on certain Organic Compounds,*" by F. Baumstark.—"*On some Sulphuretted Derivatives of Toluol, and on Toluylene,*" by C. Maerker.—"*On a New Series of Organic Diamines,*" by H. Schiff.—"*On the Oxidation of Cuminol and Cymol,*" by Buliginsky and Erlenmeyer.—"*On Kynurenate of Baryta,*" by J. von Liebig.—"*On the Separation of Copper and Palladium,*" by F. Wohler.

Annales de Chimie et de Physique. November.

"*Researches on the Tantalum Compounds*" (continuation), by C. Marignac.—"*Fifth Memoir on the Mechanical Theory of Heat*" (third part), by A. and P. Dupre.

Poggendorff's Annalen. October.

"*Optical Researches: 6. On Newton's Rings, and on the Total Reflection of Light by Metals,*" by G. Quincke.—"*On the Computation of the Results of T. Kupffer's Experiments on the Elasticity of Heavy Metal Bars,*" by K. Zoeppritz.—"*On an Instrument for Measuring the Horizontal Distance and Difference of Level of an Object,*" by C. Bohn.—"*On the Estimation of the Heat-conducting Powers of Thin Metal Bars,*" by W. Dumas.—"*On Supersaturated Solutions,*" by H. Schiff.—"*On the Expansion of Water at Temperatures below 4° Reaumur,*" by Weidner.—"*On the Vibrations of a Glass Thread, one end of which is fixed,*" by H. Valbrius.—"*Note on the Theory of the Spectrum Apparatus,*" by L. Ditscheiner.—"*New Meteorites,*" by O. Buchner.—"*On the Priority of the Author's Claim with respect to Negative Fluorescence, Calorescence, or Calcescence,*" by H. Emmsmann.

Bulletin de la Société d'Encouragement. No. 165. September.

"*Report on MM. Naudet and Hulot's Improved Aneroid Barometer,*" by M. le Roux.—"*On the Drainage of London, and on the Utilisation of Sewage in England*" (extract from a report presented to the Prefect of the Seine), by M. Mille.—"*On the Geographical Distribution of Deposits of Native Gold, especially in the Equatorial Regions.*"—"*On the Properties and Applications of Ozokerite,*" by J. Fuchs.—"*On the Utilisation of Scrap Tin Plate,*" by J. Fuchs.—"*Results of Experiments on the Quantity of Starch contained in Potatoes,*" by M. Nobbe.

Fresenius' Zeitschrift für Analytische Chemie. Second Part. 1866.

"*On the Elementary Analysis of Organic Bodies,*" by E. H. v. Baumhauer.—"*On the Analysis of Alkaline Silicates with Chloride of Calcium,*" by L. R. v. Fellenberg.—"*On a Simple Method of Volumetric Gas Analysis,*" by O. Zabel.—"*On the Determination of Loose Earth in Agricultural Soils,*" by A. Cossa.—"*On a Pipette for Strong Smelling Liquids,*" by E. Jacob.—"*On the Division of Hydrometer Tubes with a Scale of Equal Degrees,*" by Dr. Gerlach.—"*On a New Method of Estimating Fluorine,*" by R. Fresenius.—"*On the Applicability of Varrentrap and Wills' Nitrogen Process to the Cinchona Bases,*" by E. Meusel.—"*On the Chemical Analysis of Inorganic Bodies,*" by R. Fresenius.—"*Difference between Antimoniuretted and Arseniuretted Hydrogen,*" by H. Dragendorff.—"*On the Limit to some Arsenic Reactions,*" by J. Franck.—"*On the Deportment of Copper and Silver to Solutions of Arsenious, Sulphurous, Selenious, and Phosphorous Acids,*" by H. Reinsch.—"*On the Estimation of Phosphoric Acid,*" by HH. Brassier, Fischer, and Pribram.—"*On the Reaction of Hydrocyanic Acid on Picric Acid,*" by A. Vogel.—"*On the Detection of Morphia,*" by H. Frohde.—"*Correction of one of the Reactions ascribed to Morphia,*" by H. Dragendorff.—"*On the Application of Hydrate of Baryta to Elementary Analysis,*" by Kreusler.—"*On the Quantitative Estimation of Strychnine and Brucine,*" by H. Dragendorff.—"*On the Estimation of Bismuth in Lead,*" by A. Patera.—"*On the Volumetric Determination of Silver for Photographic Purposes,*" by A. Vogel.—"*On the Estimation of Uranium in its Ores,*" by A. Patera.—"*On the Detection of Nitric Acid in English Sulphuric Acid,*" by A. Vogel.—"*On the Estimation of Tannic Acid,*" by W. Hallwachs and Th. Koller.—"*Inquiry into the different Kinds of Leather,*" by E. Marquis.—"*On the Purification of Sugar for the Polariscope,*" by H. Scheibler.—"*On the Volumetric Trial of Colouring Matters,*" by H. Pons.—"*On Photometry,*" by HH. Leblanc and Bothe.—"*On a Tangent Photometer,*" by F. Bothe.—"*On Testing Petroleum,*" by HH. Hager, Urbain, and Salleron.—"*On the Estimation of Oily Matter in Vegetable Bodies,*" by H. Münch.—"*On the Detection of Cottonseed Oil in Olive Oil,*" by R. Reynolds.—"*On the Detection of the Adulteration of Volatile Oils with Alcohol,*" by H. Puscher.—"*On the Action of Commercial Benzoic Acid on Cynamic Acid,*" by H. Bottcher.—"*On the Action of Chloroform on Alcohol and Alcohol-Ether,*" by HH. Otto and Braun.—"*On the Estimation of Amygdalin in Bitter Almonds,*" by H. Rieckher.—"*On the various Methods of Estimating Morphia in Opium,*" by H. Schacht.—"*Estimation of Santonin,*" by H. Rieckher.—"*On the Occurrence of Copper in the Animal Economy,*" by HH. Ulex and Lossen.—"*On the Behaviour of Blood Corpuscles with Cyanin,*" by H. Schönbein.—"*On the Application of a Solution of Bismuth to the Detection of Sugar in Urine,*" by HH. Franqui and Van der Vyvere.—"*On the Analysis of Blood,*" by H. Zawarykin.—"*On the Application of Chloroform to the Detection of Bile in Urine,*" by H. Cunisset.—"*On the Quantitative Estimation of Sugar in Urine,*" by H. Bergeron.—"*On the Detection of Strychnine in the Bodies of Animals,*" by H. Cloetta.

NOTICES OF PATENTS.

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

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2825. J. H. Shorthouse and J. Ferguson, Birmingham, "An improved process for recovering and utilising certain waste metallic products."—Petition recorded October 31, 1866.

2909. G. Shaw, Birmingham, "Improvements in the manufacture of coke, and the small coke called breeze, and in the manufacture of coal gas." A communication from A. and C. Davies, Liége, Belgium.—November 8, 1866.

2947. G. Crawshay, Gateshead-on-Tyne, and J. Thomas, Newcastle-on-Tyne, "Improvements in the treatment of scoria or slag of copper ores, or scoria from other ores containing iron, in order to extract the iron therefrom, and in refining pig or cast iron to improve the quality of wrought or cast iron."—November 10, 1866.

2957. G. Crawshay, Gateshead-on-Tyne, and J. Thomas, Newcastle-on-Tyne, "Improvements in the treatment of titaniferous iron ores, and in extracting iron therefrom, also for utilising the scoria produced."—November 12, 1866.

3060. E. Morewood, Cheam, Surrey, "Improvements in coating plates or sheets of metal."—November 21, 1866.

3066. P. R. M. Le Guen, Rue Voltaire, Brest, France, "An improved process for combining tungsten with cast-iron by conglomerating reduced wolfram."—November 22, 1866.

3086. J. J. Coleman and T. H. Coleman, Pontblyddyn, Mold, North Wales, "Improvements in the manufacture of hydraulic cements."—November 23, 1866.

3104. W. E. Gedge, Wellington Street, Strand, "Improved apparatus for evaporating the juices of various substances." A communication from J. L. L. Dumont, Faubourg St. Martin, Paris.

3106. W. E. Newton, Chancery Lane, "An improved process for extracting oil and paraffin from bituminous substances, such as peat or coal." A communication from S. L. Wiegand, Philadelphia, Penn, U.S.A.

3112. N. S. Shaler, Cambridge, Mass, U.S.A., "Improvements in preserving animal and vegetable substances."

3114. W. Clark, Chancery Lane, "Improvements in the manufacture or preparation of leather and other materials." A communication from J. F. Pichallu, Boulevart St. Martin.—November 26, 1866.

Invention protected by the Deposit of a Complete Specification.

3131. W. Bidding, Kensing on Palace Avenue, Middlesex, "An improved method or methods of treating coffee and tea for general uses."—Petition recorded November 28, 1866.

Notices to Proceed.

1948. W. Weldon, West Hill, Highgate, Middlesex, "Improvements in the manufacture of chlorine."—Petition recorded July 26, 1866.

1950. A. V. Mathieu, Passages des Petites Ecuries, Paris, "An improved apparatus for irrigating the intestines, the vagina, the bladder, the brain, the eyes, and eyelids."—July 27, 1866.

2066. W. Clark, Chancery Lane, "Improvements in the utilisation of chloride of manganese (residue of the manufacture of chlorine) and hydrochloric acid, and in apparatus for the same." A communication from E. A. Cotelle, Boulevart St. Martin, Paris.—August 11, 1866.

2298. J. Schneider, Williamsburg, New York, U. S. A., "A process of making improved beer and ale."—September 7, 1866.

2788. C. McBeath, Blackburn, Linlithgow, N.B., "Improvements in the treatment or distillation of shale, coal, and other bituminous substances, and in the means or apparatus employed therefor."—October 29, 1866.

CORRESPONDENCE.

The Endurance of the Atlantic Cables.

To the Editor of the Chemical News.

Sir,—Your correspondent "T. B." does not coincide in my opinion respecting the necessity of preserving the outer strands of iron wire upon the cables of 1865 and 1866, deeming them of no importance whatever, now that the submarine lines have been successfully laid, and he ignores altogether the question of maintenance and repair. But will it be possible to guarantee the perfection of the insulation for all time to come? If not—and the general experience of submarine cables up to the present day contradicts it*—it would certainly be desirable to have the means of raising them again for the purpose of cutting out a fault and making a new splice; hence it is necessary that the mechanical strength of the cable should remain unimpaired.

My remarks were intended for the future rather than directed to the condemnation of that which has been universally considered a success. I raised the question as to whether the best construction of submarine cable had yet been arrived at, and your correspondent even admits that the use of tarred hemp in 1865 should have been continued in 1866. In the event of another Atlantic cable being manufactured as a reserve for meeting contingencies, this, as well as the other point referred to in my letter of the 19th ult., should receive attention. With regard to the protection afforded by a galvanised coating, I have lately inspected a small piece of the Persian Gulf cable, which, without having been laid in the sea, has all the zinc removed from the inside of the binding wires in consequence of the employment of hemp saturated with salt water as an intermediate wrapping between the cable proper and its outer strands. The soluble chloride of zinc thus formed is a powerful corrosive agent, ready to exert a further influence upon the iron wire in its immediate neighbourhood; and I would venture to submit this also as another instance of a want of foresight in the manufacture of electric cables. I am, &c.

John Spiller.

Chemical Department, Woolwich, December 12.

MISCELLANEOUS.

Meetings for the Week.

Monday, December 24.

Medical Society, 8 p.m.

Thursday, December 27.

Royal Institution, 3 p.m. Professor Frankland "*On the Chemistry of Gases.*" (Juvenile Lectures.)

Friday, December 28.

Quekett Microscopical Club, University College. Paper by Mr. M. C. Cooke on "*Contributions to Microscopical Science during 1866.*"

Saturday, December 29.

Royal Institution, 3 p.m. Professor Frankland "*On the Chemistry of Gases.*" (Juvenile Lectures.)

ANSWERS TO CORRESPONDENTS.

Chemical Society.—The observations ascribed to Mr. Tarner in our report of the last meeting were made by Mr. W. H. Walenn.

Ilex.—The presence of tannin increases the solubility of iodine in water to a considerable extent.

W. M.—Essence of lemon can be prepared artificially from oil of turpentine by acting on the hydrate of the oil, first with hydrochloric acid, and then with potassium.

E. B.—Tincture of iodine is a very good application for chilblains before they have broken.

Evans and Jones.—The address of this firm of analytical chemists is 106, Leadenhall-street, E.C.

An Assistant.—Our correspondent has scarcely made out a sufficient case why we should exert our influence with the Government to obtain the repeal of the duty on tobacco for the benefit of chemical assistants.

R. S.—We do not think our correspondents would wish the Chemical News to be enlarged and the price raised. The lectures were promised to us by the authors, and as soon as we receive the manuscripts they shall be printed.

Received.—B. J. G.; T. A. P.

Books Received.—"The Management of Steel," by George Ede; "The Pill Book," by Arnold J. Cooley; "On Uncontrollable Drunkenness," by Forbes Winslow, M.D.; Report of the British Association—Nottingham Meeting, August, 1866.

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* Vide report of the rupture of the Malta and Alexandria line in to-day's papers.

PROCEEDINGS OF SOCIETIES.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, by Dr. Percy, F.R.S.

Lecture No. XII.

(Concluded from page 297.)

The last subject we arrive at is volcanic action; and here I do not wish to be misinterpreted. It is not my intention to attack the whole range of the history of volcanoes, and the consideration of their structure and of all the points relating to volcanoes. This would demand a course of a dozen lectures, or more than that. What I purpose to do on the present occasion is simply to direct your attention to one or two, as I conceive, important chemical points bearing on the subject of the chemical geology of volcanoes, and nothing more.

A great deal has been done in this part of our subject, but vastly more remains to be accomplished. Of all the observers who have dealt with it in a chemical point of view, I think, certainly, that no one has been more competent than, or so competent as Bunsen. You will find one of his papers in the Cavendish Society's Reports, 1st vol. Another paper, and a very elaborate one, appeared some time after in the "Scientific Memoirs." Bunsen studied the phenomena in Iceland. I will endeavour to give you, free from all technicalities as far as possible, the essence of those papers.

First, as to the matters which we find in volcanoes. We ought to attend to that point especially—the matters which we find evacuated or expelled from volcanoes. What are they? Well, I have here a list of them as far as I have been able to make one out, and it is a pretty complete one. There may be some deficiencies, but not as far as I know. I will speak of the substances as elements. We have oxygen, silicon, aluminium, iron, calcium, magnesium, sodium, potassium, and I suppose now we shall have to add rubidium and cæsium. Then we have zirconium—(called zircon, as in the lava of Vesuvius)—lithium (in a variety of palagonite), boron (in the state of boracic acid, in the crater of Vulcano, in the Lipari islands, and also evolved with steam in the fumeroles of Tuscany), and chlorine and fluorine. We have also phosphorus in cavities in the lavas of Etna, as phosphate of protoxide of iron; arsenic in combination with sulphur; selenium in association with sulphur from Etna; sulphur in all craters, and in the Solfataras; manganese, titanium, copper, nickel, cobalt, chromium, vanadium, traces of zinc, tin, lead (as galena and chloride), and traces of silver. It is possible there may be a few more bodies, but that is a pretty comprehensive list. No doubt, if further search were made, we should find other matters in small quantities.

Now let us consider the conclusions to which Bunsen arrived. He examined the structure of Iceland especially with a view to trace out the chemical geology of the subject, and I have collected together his most important conclusions.

There are two kinds of igneous rocks which have been ejected, and which compose substantially that island. The one he represents by what he terms the normal pyroxenic rock, containing about 50 per cent. of silica, and the other the normal trachytic rock, which, he says, contains about 80 per cent. of silica. Then, by weathering action upon these rocks, or by the action of certain volcanic exhalations, various products are easily obtained. His theory is that with these rocks, and possibly a third rock rich in chlorine, you may explain the formation of all similar rocks in the whole world; or, to make the proposition still clearer, it is this: take a volcanic rock in any part of the world you please—no matter what it is; analyse it, and you may then represent its composition by an admixture of these two kinds of rocks in certain proportions with each other. He concludes, no doubt properly, that these rocks, at all events in Iceland, have been ejected at different times; and I say he is obliged to assume a third centre of volcanic action vomiting forth another rock rich in chlorine. If this conclusion be true, it is one of great importance. He has given facts to establish this, which I must say, with regard to Iceland, seem indisputable. I need not give you the analyses of these two typical rocks; only remember, the proportions of silica are 50 and 80 per cent respectively. Then he says (and perhaps I had better give you his own words)—"The flow from the two volcanic foci which maintained the activity of the volcano is as irregular as the activity itself." He extends his observations beyond Iceland, and, in proof of the correctness of his theory, adduces the results of analyses of non-metamorphosed volcanic products from various parts of the world. He says that, from a special investigation of the volcanic system forming the high table-land of Armenia, he concludes that the matters composing these rocks have flowed from sources chemically identical with those of Iceland. Chemically identical—that is the point. Nature generally does vary in a very small way. He suggests the idea that all the volcanic formations on the earth's surface have resulted from chemically identical sources. This is a large deduction, and it requires a very large series of observations to establish it. It is hardly established yet, but still the facts, as far as they go, render it highly probable.

Another matter with which we have to deal is the volcanic tuff or tufa. This substance is the result of the agglutination of volcanic ash. In Iceland the celebrated palagonite tuff is stated to be the most ancient of the volcanic series there. Its formation was immediately followed by the elevation of trachyte and clinkstone. Then comes the penetration of the older amygdaloidal trap, which appears in large veins far extending laterally through the tufaceous masses. Next the olivine and basaltic masses penetrated the trap formations in systems of veins of different ages. The series of plutonic elevations, it is stated, closes with the fifth period of the older or more recent lavas.

Palagonite is now recognised as a distinct mineral species. Its mineralogical characters are stated to be as follows:—Its colour varies from amber yellow to colophany brown; it is composed essentially of silicates decomposable by acids, and of others which are not so decomposable. In fact, it may be represented as containing a silicate of the lime series of bases, in the same proportion as the silica and lime exist in wollastonite. It consists of three atoms of silicate of lime, and two of silicate of alumina, the oxygen of the silica being equal to that of the alumina, plus nine of water; that has been found upon analysis, or several analyses. This palagonite rock is derived entirely from metamorphic action, and it is curious and deserving of note that the analyses give iron in the state of peroxide. Now that iron, no doubt, was in the state of protoxide in combination, but during this metamorphic action it has undergone peroxidation. The palagonite tuff consists of a mixture of anhydrous and hydrated silicates. The hydrated silicates which usually cement together the fragmentary rock may be regarded as a mixture or combination of two silicates. The palagonite substance, as Bunsen terms it, appears to occur everywhere as a characteristic constituent of tuff when the pyroxenic rocks are especially well developed. It is met with in the higher basaltic elevations of Germany and France, at Etna, in the Azores, the Cape de Verde Islands, and elsewhere. Bunsen gives analyses of the palagonite, or the cementing matter of the tuff, from various parts of Iceland, from which it appears that the composition is very uniform, the oxygen of the alumina series of bases being about half that of the silica, and the oxygen of the lime series of bases being about half that of the alumina.

Its composition is deduced from a great variety of analyses. Several analyses of the material from various parts of the world lead to the conclusion—this is a general conclusion, of course—that its composition may be precisely represented as a hydrated pyroxenic rock, or that, given the hydrated pyroxenic rock to which I adverted a short time ago, and succeed in combining that with water, you get this palagonite. Now, this is a beautiful conclusion, and one, I think, well established, as to the combined effect of metamorphic action, volcanic action, and water. Bunsen arrived at the conclusion that a palagonite substance may result from the action of lime on pyroxenic rock at a high temperature, and he cites the observation of Darwin on basaltic lava which had run over a recent deposit of limestone. Then he says the product of this mutual action is described as a breccia-like conglomerate in which the altered lava is mixed with a very pure mass of carbonate of lime. The mixture, he says, had the appearance of having been kneaded in a pasty state, which, according to Bunsen, excludes the possibility of supposing that fragments of the limestone accompanying the lava had originated from subsequent infiltration. "The chemical change," he says, "which has resulted from the contact of limestone with the lava, does not leave any doubt as to the nature of the process by which the palagonite has been formed. Wherever the lava is in contact with the limestone, it is converted into a mass presenting all the mineralogical characters and chemical reactions of palagonite; and this metamorphism, characterised by a gradual transition into the unaltered rock, is more fully developed where the calcareous substance preponderates over the constituents of the mass." Then he goes on and presents us with numerous theoretical considerations about this matter, which I do not think are altogether satisfactory. It is a generalisation which is deserving more and more of the attention of geologists, either for its confutation or confirmation. It relates to the common origin of all the rocks composing the crust of the earth, or the possibility of referring them to two typical rocks. We must assume the agglomeration of the normal trachytic and the normal pyroxenic, and there must be a third. For reasons which I cannot now enter into, this subject has not received the attention of geologists to the extent it deserves. It is an essentially chemical matter.

Now as to the gases evolved from volcanoes. Let us look at these for a moment or two. There is a very large amount of gaseous emanations or exhalations of some kind or other. There is no doubt about that; and a very large proportion of this matter is certainly steam or the vapour of water. It is very difficult indeed, if not impossible, to collect gases from the active volcano for examination, and we can get facts concerning them only inferentially by collecting the gases from small cracks or fissures called fumeroles.

We know that liquid water has been thrown out in torrents from volcanoes, and dead fish are said to have been ejected also, showing the access of sea-water into the interior.

One of the gases ejected is free hydrogen, which appears as a constituent in many analyses. A very large proportion was found by Bunsen in the gas from the smoking muddy soil of a large fumerole in the far north of Iceland. That would argue the presence of some matter in water far down in the deep earth. That matter would appear to be protoxide of iron which becomes peroxide. Then carburetted hydrogen or marsh gas occurs. Bunsen sought for it very carefully, but he could not find it in the gases of Iceland. Deville, however, tells us that he found marsh gas in the gas evolved from the liquid lava of Vesuvius thrown out in 1861, and also a very large proportion in the gas of fumeroles near Etna—as much as 90 per cent. in this instance. Carbonic acid is a general constituent of volcanic gases. Then comes hydrochloric acid, which is very commonly found, and which may have a very important action in developing various secondary products—as clay, for example, from obsidian and the like. Then there is sulphurous acid, which may also act in a very powerful way upon many rocks with which it may come in contact. Sulphuretted hydrogen also occurs. Sometimes we get this and sulphurous acid both together, which in contact decompose each other with the separation of sulphur, and this may be one way in which sulphur occurs in volcanoes. Sulphurous acid is sometimes found to the extent of 15 per cent. Sulphuretted hydrogen appears to play an important part in the transition of certain rocks. I will give you Bunsen's words:—"As the resulting products have an acid reaction, owing to the oxidation of the sulphuretted hydrogen and the formation of sulphuric acid, they can contain neither carbonate of lime nor silica, and accordingly these bodies are never found in them. The acid would, of course, dissolve out the carbonate of lime, and as there is no acid there to decompose the silicates formed there would be no separation of silica." That is obvious enough. Then sulphuric acid proceeds from the oxidation of the sulphuretted hydrogen, which therefore rapidly decreases, while the carbonic acid does not. Bunsen gives us facts to prove that. Thus we get, you see, sulphuric acid easily as a separate product from the oxidation of the sulphuretted hydrogen, and with the sulphuric acid we can of course effect great changes. Thus we can easily account for the formation of sulphate of lime under certain conditions, and there is no doubt that in some cases it has been so formed. There has been some difficulty in accounting for it or for the presence of sulphuric acid.

You must not suppose that I bring this forward as an exhaustion of the whole subject. We have only trenched on the subject. We shall require many years to understand right well the chemistry of volcanoes. There are many points exceedingly difficult of solution, and requiring great attention.

Sulphur is a substance occurring continually in our volcanoes—in fact, volcanic sulphur used to be our chief supply for the manufacture of sulphuric acid. There is always a sublimation of sulphur in volcanoes. Now, if we admit the presence of masses of that substance down below, and heat sufficient to sublime it, of course there is no difficulty in understanding how we meet with it; but I am afraid we cannot resort to that assumption. Then Bunsen suggests that there are sulphides from which sulphur could easily be eliminated by heat alone; but, as far as I know, there is only one sulphide, that of iron, which can be supposed to exist in a sufficiently large quantity to give forth this sulphur. About half its weight of sulphur would be given off by heat. But then, again, we require proof of the presence of that bisulphide down below, and, as far as I know at present, no proof has been given.

Perhaps one of the most interesting parts of the paper by Bunsen, with regard to volcanic action, is this—namely, the influence of gases penetrating through a rock along with aqueous vapour, and changing the constitution of that rock without the addition of anything to it or the subtraction of anything from it—a gaseous metamorphism, so to speak, of these rocks. I should say that this pneumatolytic action on rocks is one of the most important matters to geologists. He says that even the zeolitic amygdaloid which occurs abundantly in Iceland is only a variety of trap metamorphosed on the spot without the removal or deposition of any matter whatever. In support of this he advances the fact that one passes by insensible gradations into the other, and that the average composition of the amygdaloidal rock, abstracting the water, is identical with that of the trap. Then he gives us several experiments; and I have given you several statements which prove indisputably that all zeolites may be so produced under the action of water, especially at a high temperature.

We find nitrogen as a constituent of volcanic gases, and it is probable that that nitrogen comes from atmospheric air. We may assume that to be correct, but I must here refer to a conjecture put forth by Deville and Wöhler with regard to the formation of ammonia. They suppose that at one time a nitride of silicon largely composed the crust of the earth. This nitride, remaining for a long time in contact with the vapour of water, would generate silica on the one hand, and ammonia on the other. We have no proof whatever of the existence of such a compound as nitride of silicon in the bowels of the earth, though we can make it in the laboratory without difficulty; but, still, this is one of those theoretical considerations which it is well to bear in mind. With regard to ammonia as a volcanic exhalation, it is found in combination with hydrochloric acid. It may often be found in the form of sal-ammoniac, which may be found in almost every geological cabinet. Bunsen tells us that, some months after the eruption of 1846, he observed the lower part of the lava stream studded over with smoking fumeroles, in which, he says, so large a quantity of beautifully crystallised muriate of ammonia was undergoing a process of sublimation, that, notwithstanding the incessant torrents of rain, hundreds of pounds' worth of this valuable salt might have been collected. Its production was limited to the zone in which meadow land had been overflowed with lava, and higher up the muriate of ammonia and the last traces of vegetation ceased together. Hence he concludes that the ammonia is derived entirely from the organic matter of the soil. Then Liebig, on the other hand, believes that the ammonia has not organic origin. However, that is a point about which we know very little for certain, and it must be left for still further investigation.

There is still a question whether flame is ever really seen in volcanic eruptions. I know that, in newspaper reports of eruptions, flame is stated to be seen, but there may not be flame notwithstanding. What is supposed to be so may be merely the vapour of water illuminated by incandescent matter below, and it is not very easy to distinguish between the two. Still, if hydrogen be evolved, which there is no ground for disputing, there is no reason, considering the high temperature, why flame should not be produced.

Well, these are the chief points to which I would direct your attention. The great question of all is, how we can account for the great heat manifested by volcanoes. At one time the theory was put forth, by Davy especially, that metallic bases existed very deep down in an unoxidised state, and that these bases, coming in contact with water, decompose it, and we get, in consequence, a large quantity of the alkaline earths produced; and this theory would of necessity involve the elimination at the same time of a corresponding amount of hydrogen gas. The amount must have been enormous; that is certain. Now we do not get any proof of this hydrogen gas, as far as I know, to account for the production of these alkaline bases on this wholesale scale, and that theory has been abandoned. Then comes the question—What is the cause of the heat? How are we to account for the generation of that enormous amount of heat? It is not, I believe, a very intense heat. I think there is often a mistake on that point. We are apt to imagine that when there is a very large mass of matter molten, that implies of necessity a very intense heat; but I do not think it does. We can melt lava or any kind of volcanic matter you like without a very intense heat. We do not want intense heat; we want the long-continued action of heat. The question is whether the heat we find here developed is the result of long-continued chemical action. Have we any facts on the subject? Well, I think at present there is nothing satisfactory known about it. How can we explain this production of heat by chemical phenomena? What phenomena are there in volcanoes to justify the belief that the heat does arise from chemical changes? Is there any sulphur, for instance, burnt by the access of oxygen? Well, as far as I know, there is not; and at present I think we must, as far as facts furnish us with any information on the subject, keep in abeyance the theory of the production of heat in volcanoes by chemical action. It may be due to the continued refrigeration of our globe, and the contraction of the exterior upon the still molten interior. It may be that that theory is the correct one.

In concluding this series of lectures, I beg to thank you for your attention. I regret that I have been obliged to hurry over this great subject. It is impossible to present you with anything very satisfactory in the first or second series of lectures on such a subject as this. If I have the pleasure of meeting you again, I hope to be able to present you with something more worthy of your attention.

CONTEMPORARY SCIENTIFIC PRESS.

[Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the Chemical News.]

Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften zu Wien (Mathematical and Natural History Section). Vol. 53, div. 1.

No. 5. May.

"*On the Preparation of Hæmin from Blood, and on Detecting the Presence of small Quantities of Blood,*" by J. Gwosdew.—"*On the Action of Chlorine on Amylene,*" by A. Bauer.

Monatsbericht der königlich-Preussischen Akademie der Wissenschaften. June.

"*On the Decomposition of Bisulphide of Carbon by Chloride of Iodine, and on the Products obtained thereby,*" by R. Weber.—"*On the Spectrum of the Electric Brush and Glow Discharge in Air,*" by A. Schimkow.—"*Supplement to a Memoir on the Electricity of the Muscles,*" by Du Bois-Reymond.—"*A Method of taking Continuous Observations of the Temperature of the Sea during Sounding Operations,*" by W. Siemens.

Annalen der Chemie und Pharmacie. November.

"*On Rhœadin, an Alkaloid obtained from Papaver Rhœas,*" by O. Hesse.—"*On the Action of Bromine on Propionic Acid,*" by H. L. Buff.—"*On the Transformation of Peroxide of Propylene into Acetone;*" "*On a Convenient Method of Preparing Diallyl,*" by E. Linnemann.—"*Analysis of the 'Raw Steel Iron'* (Rohstahleisen) *produced at Biber, Hesse-Cassel,*" by A. Bagh.—"*On the Quantitative Estimation of the Colouring Matter of Blood by Means of the Spectroscope,*" by W. Preyer.—"*On Hyposulphite of Platinum and Sodium* (Platinür-Natrium-Hyposulphit)," by P. Schottlander.—"*On Hydrated Protoxide of Copper,*" by C. Weltzien.—"*On Diethylglycoll and some of its Compounds;*" "*Contributions to the Knowledge of Thiodiglycollic Acid,*" by W. Heintz.—"*On a Compound of Phosphate of Potash and Soda, analogous to the Double Salt of Ammonia and Magnesia,*" by MM. Schröcker and Violet.—"*On Sulphide and Disulphide of Benzylene,*" by M. Fleischer.—"*On Ethylidene,*" by B. Tollens.—"*On the Presence of Indium in Wolfram,*" by F. Hoppe-Seyler.—"*On the Assumed Presence of Salt in Extract of Meat from South America,*" by J. von Liebig.—"*Contributions to the Knowledge of Osmium,*" by F. Wöhler.

Dingler's Polytechnisches Journal. October.

"*On the Radiation of Heat from the Walls of Furnaces,*" by C. Schinz.—"*On the Bessemer Process with Reference to the Methods of Producing Steel hitherto in use, and to the Puddling Process,*" by Krieger.—"*On the Behaviour of Silicium during the Puddling Process,*" by List.—"*On C. Lesimple's Explosive Compound,*" by H. Vohl.—"*A*

New Process for Ascertaining the Quantity of Tanning Matters in Bark," by F. Schulze.—"*On an Optical Saccharometer suitable for Testing very Dilute Solutions of Sugar,*" by C. Stammer.—"*Zymotechnical Miscellanies. 8. On the Composition of the Deposit formed in Tubes used for Conveying Wort,*" by J. C. Lermer.—"*Analysis of the Crude Boracic Acid of Tuscany,*" by H. Vohl.—"*On a Specimen of Bauxite from Feistritz,*" by H. Wedding.—"*Analysis of the Pottery Manufactured at the Royal Works at Charlottenbury,*" by Kolbe.—"*On the Preparation of Pure Acetic Acid and Acetates from Pyroligneous Acid by means of Baryta,*" by C. R. Richter.—"*Lucifer Matches without Phosphorus,*" by C. Liebig.

Revue Universelle des Mines. July-August.

"*Experiments on Heating Water by Means of Steam,*" by P. Havrez.—"*On the Extraction of Nickel in Nassau,*" by Schnabel.—"*On the Production of Graphite in Austria.*"—"*Aluminium Solder,*" by Mourey.—"*Analysis of Lead and Copper Ores made in the Laboratory of the School of Arts, Manufactures, and Mines at Liége,*" by J. Kupferschlager.

Annales des Mines. No. 2.

"*Memoir on the Deposits of Iron Ore on the South-west Coast of Norway,*" by T. Kjerulf and T. Dahll.—"*Memoir on the Regulation of Chronometers and Watches in Vertical and Inclined Positions,*" by Phillips.

CORRESPONDENCE.

Organic Matter in Water.

To the Editor of the Chemical News.

Sir,—Under the head of "Composition and Quality of the Metropolitan Waters in November, 1866," in your last number, a statement is made by Dr. Letheby of very great importance to chemists, and especially to water-analysts.

The words to which I refer are the following:—"It (the organic matter in the waters) is entirely of a vegetable nature."

A process that would enable us to fix the "composition and quality" of the organic matter in water in this indubitable way has long been wished for; and Dr. Letheby will not, I trust, hesitate to make known the means by which he has arrived at the above most interesting result.

I am, &c.

B. J. G.

London, December 18, 1866.

MISCELLANEOUS.

Chemical Society.—The limited space at our disposal this week compels us to defer a full report of the proceedings transacted at the meeting of the 20th inst. We simply announce the election of Messrs. John Broughton, Watson Smith, and W. N. Hartley, as Fellows of the Society, and enumerate the papers read. These were—"On the Basicity of Tartaric Acid," by Mr. W. H. Perkin, F.R.S.; "On the Absorption of Vapours by Charcoal," by Mr. John Hunter, M.A.; "On Some Reactions of Hydriodic Acid," by Mr. E. T. Chapman. Mr. MacLeod exhibited and described an ingenious "Continuous Aspirator." The meeting was adjourned until 17th January.

Royal Polytechnic Institution.—The Christmas entertainments at the Polytechnic include a new optical illusion, the "Decapitated Head" (or rather the Trunkless Head) which was briefly noticed in our columns on the 7th inst. To this has just now been added, at the suggestion of Professor Wheatstone, an exhibition of his new discovery, the Eidoscope, which consists of a series of pleasing effects produced upon a screen by the slow motion of variously perforated plates, which, by overlapping, allow of the passage of light only in symmetrical figures, and these are sometimes coloured for the purpose of heightening the general effect. The Cherubs in the Air have given way to an elegant modification, in which the Shakspearian characters of Ariel and Lance make their appearance in mid-air, in obedience to the summons of the immortal bard, who is admirably impersonated by Mr. F. Damer Cape. A mechanical life-sized figure of great merit, called the Automatic Leotard, performs several athletic feats on a trapeze suspended in the Great Hall; whether actuated by clockwork, or by electric or magnetic agency, is a problem which will tax the ingenuity even of the scientific to solve. This patented invention is the joint effort of Messrs. J. H. Pepper and S. F. Pichler. Mr. George Buckland gives a new musical entertainment founded on the story of Whittington and his Cat, the leading incidents of which are shown in the way of dissolving views and ghostly apparitions, resources which seem both destined to outlive the existence even of the Institution itself. We can only briefly allude to an admirable rendering of Mr. Charles Dickens's Christmas Carol, which likewise gives an opportunity for the display of some clever ghostly illusions. The whole programme seems appropriate to this festive season, and provides for the entertainment of the public whilst administering in some degree to their instruction.

Meetings for the Week.

Tuesday, January 1, 1867.

Royal Institution, 3 p.m. Professor Frankland "*On the Chemistry of Gases.*" (Juvenile Lectures.)

Pathological Society (anniversary), 8 p.m.

Wednesday, January 2.

Pharmaceutical Society, 8 p.m.

Obstetrical Society (anniversary), 8 p.m.

Thursday, January 3.

Royal Institution, 3 p.m. Professor Frankland "*On the Chemistry of Gases.*" (Juvenile Lectures.)

Saturday, January 5.

Royal Institution, 3 p.m. Professor Frankland "*On the Chemistry of Gases.*" (Juvenile Lectures.)

ANSWERS TO CORRESPONDENTS.

IMPORTANT NOTICE.

With the next volume of the Chemical News *will be immediately commenced an illustrated series of papers on the Application of the Blowpipe to Quantitative Analysis and Assaying, by David Forbes, F.R.S. Also, a full account of Professor Stas's recent Memoir on Atomic Weights, with a detailed description of the processes employed. An entirely new and complete set of Tables for Qualitative Analysis, by Dr. Hofmann, F.R.S., and some articles on Cyanogen, by Dr. Odling, F.R.S., are also in preparation, and will appear as soon as ready.*

⁂ 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. XIII. 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., II., and VII. are out of print. All the others are kept in stock. Vol. XIV. commenced on July 6, and will be complete in 26 numbers.

J. C., *C S.*, *J. Noble*, *J. Simpson*, *Smatterer*, *F. Y.*, *Anxious Inquirer*, *Q. Q. Q.*, *Mathematicus*, and other correspondents, are informed that, owing to the unusual length of the Index, we are compelled to defer answering their queries, &c., till next week.

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