Pharmaceutical Society of Great Britain,

17, BLOOMSBURY SQUARE, LONDON.

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March, 1875.

THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE:

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

A Journal of Practical Chemistry

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY

WILLIAM CROOKES, F.R.S.

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THE CHEMICAL NEWS

VOLUME XIII.

No. 318.—January 5, 1866.

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,—

$$(2\dot{\mathrm{C}}\mathrm{a}\,\dddot{\mathrm{S}}+\dot{\mathrm{H}})+2\dot{\mathrm{M}}\mathrm{g}\dot{\mathrm{H}}$$

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

$2\dot{\mathrm{C}}\mathrm{a}\,\dddot{\mathrm{S}}+\dot{\mathrm{H}}$ 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 Predazzite, 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 anticipate 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.

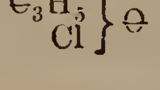
Dr. Crace Calvert sent a note "*On the Hydraulicity of Magnesian Limestones.*" The Great Dinorben Mining and Cement Company, it seems, work some magnesian limestones in Anglesea, and make excellent hydraulic cements and stucco. Dr. Calvert sent analyses of the rocks employed by the Company, which we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



$$\left.\begin{array}{r}\text{Ꞓ}_3H_5\\ Cl\end{array}\right\}\Theta$$

unites directly with acetic, butyric, valeric, and benzoic chlorides, and forms aceto-, butyro-, valero-, and benzodichlorhydrines. 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 substantially 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	0·96	12·08	6·10
West Middlesex . . .	21·14	1·02	0·69	13·00	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. Mitheil*, 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 recombine 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 permananently 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—

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

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—

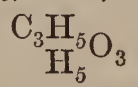
$$\begin{array}{c}H\\C_4H_4O_2\\H\end{array}\begin{array}{l}O\\O.\end{array}$$

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

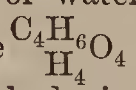
(C_3H_6), &c., are dyads, like zinc, barium, &c., and form chlorides, bromides, nitrates, &c., of which each molecule contains two atoms of chlorine, bromine (NO_3), &c., (such as $C_2H_4Br_2$,$C_3H_6Br_2$, like $ZnBr_2$ or $BaBr_2$). Nor does the analogy stop here, for there are also triatomic and tetratomic 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 weter. Its empirical formula is $C_3H_8O_3$, and its reactions and decompositions prove it to contain the triad glycerile C_3H_5, thus,—



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

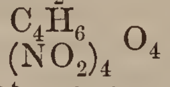
Erithrite is a compound of a tetratomic-radical of the composition C_4H_6. This radical replaces four atoms of hydrogen in four molecules of water, forming

Erithrite



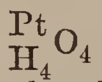
$$\begin{matrix}C_4H_6\\H_4\end{matrix}O_4$$

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



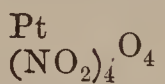
$$\begin{matrix}C_4H_6\\(NO_2)_4\end{matrix}O_4$$

just as platinic nitrate corresponds to the platinic hydrate



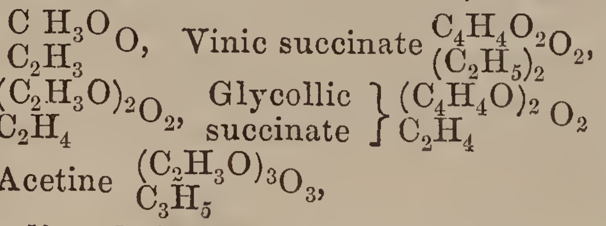
$$\begin{matrix}Pt\\H_4\end{matrix}O_4$$

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 $\begin{matrix}CH_3O\\C_2H_3\end{matrix}O$, 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 $\left.\begin{matrix}(C_4H_4O)_2\\C_2H_4\end{matrix}\right\}O_2$

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.K.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.

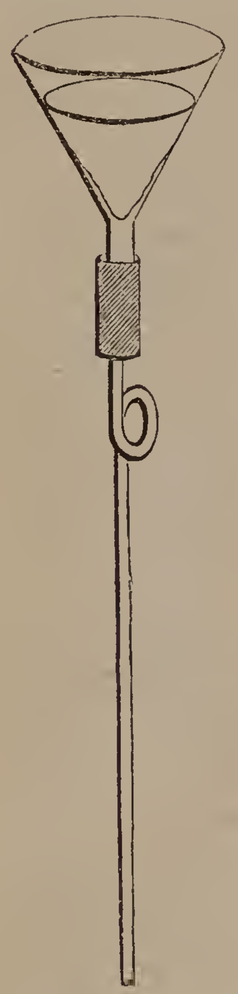
I am, &c.
C. H. Wood, F.C.S.

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	·1722	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	33·90	1·56	·1274	7·2	15·0	22·2
South Essex	38·10	0·86	·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 applied 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,

CHON, **CHON**, ~~CHON~~,

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 ($NO_4 = N\Theta_2$) 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—

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

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—

$$\text{Ꞓ}_2H_5.H.\Theta,$$

the second contains

$$(\text{Ꞓ}_2H_5)_2\Theta.$$

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.
	$\left.\begin{matrix}ꞒH_3\\H\end{matrix}\right\}\Theta$ Hydrate of methyle.	$\left.\begin{matrix}ꞒH_3\\ꞒH_3\end{matrix}\right\}\Theta$ Oxide of methyle.
	$\left.\begin{matrix}Ꞓ_2H_5\\H\end{matrix}\right\}\Theta$ Hydrate of ethyle.	$\left.\begin{matrix}Ꞓ_2H_5\\Ꞓ_2H_5\end{matrix}\right\}\Theta$ Oxide of ethyle.
		$\left.\begin{matrix}Ꞓ_2H_5\\Ꞓ\,H_3\end{matrix}\right\}\Theta$ 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 Nitrogen	1·02
	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.

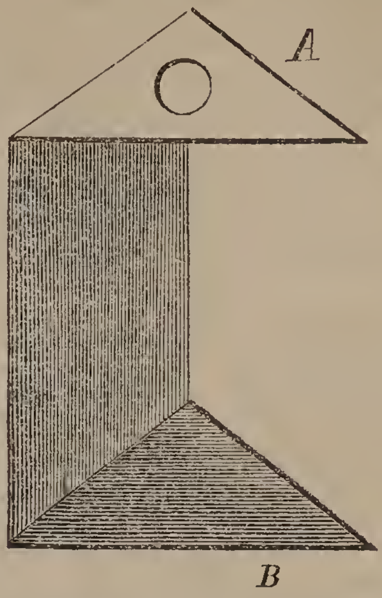
Bisulphide of Carbon Prism, by G. Marlow.

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 20.)

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, démonstrated 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 mhich 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.)

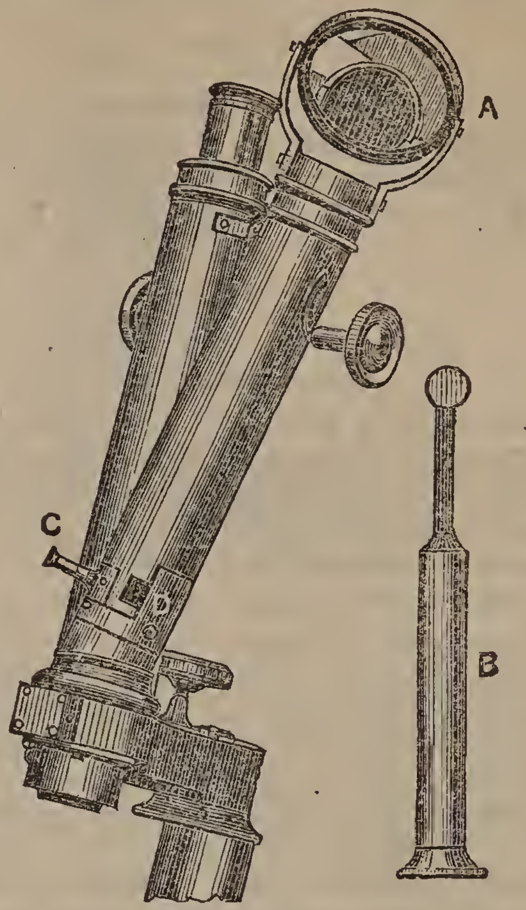
MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

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 $\frac{1}{6}$th 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. Nicklés 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 *faciles 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 deveveloped 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 ou 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.

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. Ritterbrandt, 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 $C_{40}H_{24}O_4$, it appears that C_4O_4,—that is to say, 2 equivalents of carbonic acid—are retained by the baryta, while $C_{36}H_{24}$ 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.
$\left.\begin{matrix}\mathrm{H}\\\mathrm{H}\end{matrix}\right\}\Theta$	$\left.\begin{matrix}\mathrm{N}\Theta_2\\\mathrm{H}\end{matrix}\right\}\Theta$	$\left.\begin{matrix}\mathrm{N}\Theta_2\\\mathrm{K}\end{matrix}\right\}\Theta$	$\left.\begin{matrix}\mathrm{N}\ \Theta_2\\\text{Ꞓ}_2\mathrm{H}_5\end{matrix}\right\}\Theta$
	Nitric acid.	Nitrate of potash.	Nitrate of ethyle.
	$\left.\begin{matrix}\text{Ꞓ}_2\mathrm{H}_5\Theta\\\mathrm{H}\end{matrix}\right\}\Theta$	$\left.\begin{matrix}\text{Ꞓ}_2\mathrm{H}_5\Theta\\\mathrm{Na}\end{matrix}\right\}\Theta$	$\left.\begin{matrix}\text{Ꞓ}_2\mathrm{H}_5\Theta\\\text{Ꞓ}_2\mathrm{H}_5\end{matrix}\right\}\Theta$
	Acetic acid.	Acetate of soda.	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.
$\left.\begin{matrix}\mathrm{H}\\\mathrm{H}\end{matrix}\right\}$	$\left.\begin{matrix}\mathrm{Cl}\\\mathrm{Cl}\end{matrix}\right\}$	$\left.\begin{matrix}\mathrm{Cy}\\\mathrm{Cy}\end{matrix}\right\}$	$\left.\begin{matrix}\text{Ꞓ}_2\mathrm{H}_3\Theta\\\mathrm{H}\end{matrix}\right\}$
Hydrogen.	Chlorine.	Cyanogen.	Hydride of acetyle (aldehyde).
	$\left.\begin{matrix}\mathrm{Br}\\\mathrm{Br}\end{matrix}\right\}$	$\left.\begin{matrix}\text{Ꞓ}\mathrm{H}_3\\\text{Ꞓ}\mathrm{H}_3\end{matrix}\right\}$	$\left.\begin{matrix}\text{Ꞓ}_2\mathrm{H}_3\Theta\\\text{Ꞓ}\mathrm{H}_3\end{matrix}\right\}$
	Bromine.	Methyle.	Methylide of acetyle (acetone).
	$\left.\begin{matrix}\mathrm{K}\\\mathrm{K}\end{matrix}\right\}$	$\left.\begin{matrix}\text{Ꞓ}\mathrm{H}_3\\\mathrm{H}\end{matrix}\right\}$	$\left.\begin{matrix}\text{Ꞓ}_7\mathrm{H}_5\Theta\\\mathrm{H}\end{matrix}\right\}$
	Potassium.	Hydride of methyle.	Hydride of benzoyle.
	$\left.\begin{matrix}\mathrm{Ag}\\\mathrm{Ag}\end{matrix}\right\}$	$\left.\begin{matrix}\text{Ꞓ}_2\mathrm{H}_5\\\text{Ꞓ}_2\mathrm{H}_5\end{matrix}\right\}$	$\left.\begin{matrix}\text{Ꞓ}_7\mathrm{H}_5\Theta\\\text{Ꞓ}_6\mathrm{H}_5\end{matrix}\right\}$
	Silver.	Ethyle.	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.

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

$$2\left[\left.\begin{matrix}\text{Ꞓ}_2\mathrm{H}_3\Theta\\\mathrm{H}\end{matrix}\right\}\Theta\right.=\left.\begin{matrix}\text{Ꞓ}_2\mathrm{H}_3\Theta\\\text{Ꞓ}_2\mathrm{H}_3\Theta\end{matrix}\right\}\Theta+\left.\begin{matrix}\mathrm{H}\\\mathrm{H}\end{matrix}\right\}\Theta$$

Acetic acid. Anhydrous acetic acid.

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.

$$\left.\begin{matrix}\mathrm{H}\\\mathrm{H}\end{matrix}\right\}\Theta+\left.\begin{matrix}\text{Ꞓ}_2\mathrm{H}_3\Theta\\\mathrm{Cl}\end{matrix}\right\}=\left.\begin{matrix}\mathrm{C}_2\mathrm{H}_3\Theta\\\mathrm{H}\end{matrix}\right\}+\left.\begin{matrix}\mathrm{H}\\\mathrm{Cl}\end{matrix}\right\}.$$

Water. Chloride of acetyle. Acetic acid. Hydrochloric acid.

$$\left.\begin{matrix}\text{Ꞓ}_2\mathrm{H}_3\Theta\\\mathrm{Na}\end{matrix}\right\}\Theta+\left.\begin{matrix}\text{Ꞓ}_2\mathrm{H}_3\Theta\\\mathrm{Cl}\end{matrix}\right\}=\left.\begin{matrix}\text{Ꞓ}_2\mathrm{H}_3\Theta\\\text{Ꞓ}_2\mathrm{H}_3\Theta\end{matrix}\right\}\Theta+\left.\begin{matrix}\mathrm{Na}\\\mathrm{Cl}\end{matrix}\right\}$$

Acetate of soda. Chloride of acetyle. Anhydrous acetic acid. Chloride of sodium.

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:—

$$\left.\begin{matrix}\text{Ꞓ}_2\mathrm{H}_3\Theta\\\mathrm{Cl}\end{matrix}\right\}+\left.\begin{matrix}\mathrm{H}\\\mathrm{H}\\\mathrm{H}\end{matrix}\right\}\mathrm{N}=\left.\begin{matrix}\text{Ꞓ}_2\mathrm{H}_3\Theta\\\mathrm{H}\\\mathrm{H}\end{matrix}\right\}\mathrm{N}+\mathrm{HCl}$$

Chloride of acetyle. Ammonia. Acetamide.

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.

$\left.\begin{matrix}\mathrm{H}\\\mathrm{H}\\\mathrm{H}\end{matrix}\right\}\mathrm{N}$	$\left.\begin{matrix}\text{Ꞓ}_2\mathrm{H}_5\\\mathrm{H}\\\mathrm{H}\end{matrix}\right\}\mathrm{N}$	$\left.\begin{matrix}\text{Ꞓ}_2\mathrm{H}_3\Theta\\\mathrm{H}\\\mathrm{H}\end{matrix}\right\}\mathrm{N}$
Type.	Ethylamine.	Acetamide.

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 . .	$\left.\begin{matrix}H\\H\end{matrix}\right\}Θ$	$\left.\begin{matrix}Ꞓ_2H_5\\H\end{matrix}\right\}Θ$ Alcohol	. . . . .	$\left.\begin{matrix}Ꞓ_2H_3Θ\\H\end{matrix}\right\}Θ$ Acetic acid
		$\left.\begin{matrix}Ꞓ_2H_5\\Ꞓ_2H_5\end{matrix}\right\}Θ$ Ether	. . . . .	$\left.\begin{matrix}Ꞓ_2H_3Θ\\Ꞓ_2H_3Θ\end{matrix}\right\}Θ$ Anhydrous acetic acid
		$\left.\begin{matrix}Ꞓ\,H_3\\Ꞓ_2H_5\end{matrix}\right\}Θ$ Ethylmethylic ether	. . . . .	$\left.\begin{matrix}Ꞓ_2H_3Θ\\Ꞓ_7H_5Θ\end{matrix}\right\}Θ$ Acetate of benzoyle
		. . . . .	$\left.\begin{matrix}Ꞓ_2H_3Θ\\Ꞓ_2H_5\end{matrix}\right\}Θ$ Acetic ether	. . . . .
Hydrogen type .	$\left.\begin{matrix}H\\H\end{matrix}\right\}$	$\left.\begin{matrix}Ꞓ_2H_5\\H\end{matrix}\right\}$ Hydride of ethyle	. . . . .	$\left.\begin{matrix}Ꞓ_2H_3Θ\\H\end{matrix}\right\}$ Aldehyde
		$\left.\begin{matrix}Ꞓ_2H_5\\Ꞓ_2H_5\end{matrix}\right\}$ Ethyle	. . . . .	$\left.\begin{matrix}Ꞓ_2H_3Θ\\Ꞓ_2H_3Θ\end{matrix}\right\}$ Acetyle
		. . . . .	$\left.\begin{matrix}Ꞓ\,H_3\\Ꞓ_2H_3Θ\end{matrix}\right\}$ Acetone.	. . . . .
Hydrochloric acid type . . .	$\left.\begin{matrix}H\\Cl\end{matrix}\right\}$	$\left.\begin{matrix}Ꞓ_2H_5\\Cl\end{matrix}\right\}$ Hydrochloric ether	. . . . .	$\left.\begin{matrix}Ꞓ_2H_3Θ\\Cl\end{matrix}\right\}$ Chloride of acetyle
Ammonia type .	$\left.\begin{matrix}H\\H\\H\end{matrix}\right\}N$	$\left.\begin{matrix}Ꞓ_2H_5\\H\\H\end{matrix}\right\}N$ Ethylamine	. . . . .	$\left.\begin{matrix}Ꞓ_2H_3Θ\\H\\H\end{matrix}\right\}N$ Acetamide
		$\left.\begin{matrix}Ꞓ_2H_5\\Ꞓ_2H_5\\H\end{matrix}\right\}N$ Diethylamine	. . . . .	. . . . .
		$\left.\begin{matrix}Ꞓ_2H_5\\Ꞓ_2H_5\\Ꞓ_2H_5\end{matrix}\right\}$ 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 Hydrocarcarbons, 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 $124{\cdot}5° + 30° = 154{\cdot}5°$, 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."

[††] "Bestimung 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 . .	$P_2 \quad H_4O_7$
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:—

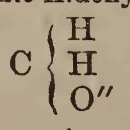
$$CO + 2NaC_2H_5 = Na_2 + CO(C_2H_5)_2.$$

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

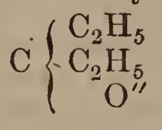
And its constitution must accordingly be as follows:—

Formic Aldehyde.



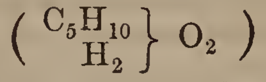
$$C\left\{\begin{array}{l}H\\H\\O''\end{array}\right.$$

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

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 :—

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

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 tapeworm, 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

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

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.

$$\underset{\text{Two molecules of acetate of silver.}}{\left.\begin{matrix}\left.\begin{matrix}\text{Ꞓ}_2H_3\Theta\\Ag\end{matrix}\right\}\Theta\\\left.\begin{matrix}Ag\\\text{Ꞓ}_2H_3\Theta\end{matrix}\right\}\Theta\end{matrix}\right.} + \underset{\text{Iodide of ethylene.}}{\text{Ꞓ}_2H_4I_2} = \underset{\text{Diacetic glycol.}}{\left.\begin{matrix}\text{Ꞓ}_2H_3\Theta\\(C_2H_4)\\\text{Ꞓ}_2H_3\Theta\end{matrix}\right\}\Theta_2} + 2AgI.$$

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.

$$\left.\begin{matrix}\left.\begin{matrix}H\\H_2\end{matrix}\right\}\Theta\\\left.\begin{matrix}H\end{matrix}\right\}\Theta\end{matrix}\right. \qquad \underset{\text{Glycol.}}{\left.\begin{matrix}\left.\begin{matrix}H\\(\text{Ꞓ}_2H_4)\end{matrix}\right\}\Theta\\\left.\begin{matrix}H\end{matrix}\right\}\Theta\end{matrix}\right.}$$

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 $(\text{Ꞓ}_3H_5)'''$.

$$\left.\begin{matrix}H_3\\H_3\end{matrix}\right\}\Theta_3 \qquad \underset{\text{Glycerine.}}{\left.\begin{matrix}(\text{Ꞓ}_3H_5)'''\\H_3\end{matrix}\right\}\Theta_3}$$

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.
$\left.\begin{matrix}H_2\\H_2\end{matrix}\right\}\Theta_2$	$\left.\begin{matrix}(\text{Ꞓ}a)''\\H_2\end{matrix}\right\}\Theta_2$ Hydrate of lime.	$\left.\begin{matrix}(\text{Ꞓ}_2H_4)''\\H_2\end{matrix}\right\}\Theta_2$ Glycol.	$\left.\begin{matrix}(\text{Ꞓ}\Theta)''\\H_2\end{matrix}\right\}\Theta_2$ Carbonic acid (hypothetical hydrate).	$\left.\begin{matrix}(\text{Ꞓ}_2H_2\Theta)''\\H_2\end{matrix}\right\}\Theta_2$ Glycolic acid.
	$\left.\begin{matrix}(Ba)''\\H_2\end{matrix}\right\}\Theta_2$ Hydrate of baryta.	$\left.\begin{matrix}(\text{Ꞓ}_3H_6)''\\H_2\end{matrix}\right\}\Theta_2$ Propoglycol.	$\left.\begin{matrix}(\text{Ꞩ}\Theta)''\\H_2\end{matrix}\right\}\Theta_2$ Sulphurous acid.	$\left.\begin{matrix}(\text{Ꞓ}_2\Theta_2)''\\H_2\end{matrix}\right\}\Theta_2$ Oxalic acid.
	$\left.\begin{matrix}(\text{Ꞓ}u'')\\H_2\end{matrix}\right\}\Theta_2$ Hydrate of copper.	$\left.\begin{matrix}(\text{Ꞓ}_5H_{10})''\\H_2\end{matrix}\right\}\Theta_2$ Amylglycol.	$\left.\begin{matrix}(\text{Ꞩ}\Theta_2)''\\H_2\end{matrix}\right\}\Theta_2$ Sulphuric acid.	$\left.\begin{matrix}(\text{Ꞓ}_4H_4\Theta_2)''\\H_2\end{matrix}\right\}\Theta_2$ 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.	$\left.\begin{matrix}(\text{Ꞓ}_3H_5)'''\\H_3\end{matrix}\right\}\Theta_3$ Glycerine.	$\left.\begin{matrix}P'''\\H_3\end{matrix}\right\}\Theta_3$ Phosphorous acid.	$\left.\begin{matrix}(\text{Ꞓ}_3H_3\Theta)'''\\H_3\end{matrix}\right\}\Theta_3$ Glyceric acid.
	$\left.\begin{matrix}(Bi)'''\\H_3\end{matrix}\right\}\Theta_3$ Hydrate of bismuth.	$\left.\begin{matrix}(\text{Ꞓ}_5H_9)'''\\H_3\end{matrix}\right\}\Theta_3$ Amylglycerine.	$\left.\begin{matrix}(P\Theta)'''\\H_3\end{matrix}\right\}\Theta_3$ 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.
$\left.\begin{matrix}H_2\\H_2\end{matrix}\right\} \text{ or } \left\{\begin{matrix}Cl_2\\H_2\end{matrix}\right.$	$\left.\begin{matrix}H_3\\H_3\end{matrix}\right\} \text{ or } \left\{\begin{matrix}Cl_3\\H_3\end{matrix}\right.$	$\left.\begin{matrix}H_2\\H_2\\H_2\end{matrix}\right\}N_2$	$\left.\begin{matrix}H_3\\H_3\\H_3\end{matrix}\right\}N_3$
$\left.\begin{matrix}(S\Theta_2)''\\Cl_2\end{matrix}\right\}$ Chloride of sulphuryle.	$\left.\begin{matrix}(P\Theta)'''\\Cl_3\end{matrix}\right\}$ Chloride of phosphoryle.	$\left.\begin{matrix}(\text{Ꞓ}\Theta)''\\H_2\\H_2\end{matrix}\right\}N_2$ Urea.	$\left.\begin{matrix}Cy_3\\H_3\\H_3\end{matrix}\right\}N_3$ Melamine.
$\left.\begin{matrix}(\text{Ꞓ}\Theta)''\\Cl_2\end{matrix}\right\}$ Chloride of carbonyle. (phosgen gas).	$\left.\begin{matrix}Bo'''\\Cl_3\end{matrix}\right\}$ Chloride of boron.	$\left.\begin{matrix}(\text{Ꞓ}_2\Theta_2)''\\H_2\\H_2\end{matrix}\right\}N_2$ Oxamide.	$\left.\begin{matrix}(\text{Ꞓ}\Theta)''\\(\text{Ꞓ}\Theta)''\\H_5\end{matrix}\right\}N_3$ Biuret.
$\left.\begin{matrix}\text{Ꞓ}a''\\Cl_2\end{matrix}\right\}$ Chloride of calcium.	$\left.\begin{matrix}Bi'''\\Cl_3\end{matrix}\right\}$ Chloride of bismuth.	$\left.\begin{matrix}(\text{Ꞓ}_2H_4)''\\H_2\\H_2\end{matrix}\right\}N_2$ Ethylene-diamine.	$\left.\begin{matrix}(\text{Ꞓ}_2H_4)''\\(\text{Ꞓ}_2H_4)''\\H_5\end{matrix}\right\}N_3$ Diethylene-triamine.
$\left.\begin{matrix}(\text{Ꞓ}_2H_4)''\\Cl_2\end{matrix}\right\}$ Chloride of ethylene.	$\left.\begin{matrix}(\text{Ꞓ}_3H_5)'''\\Cl_3\end{matrix}\right\}$ Trichloride of allyle.	$\left.\begin{matrix}(\text{Ꞓ}_6H_4)''\\H_2\\H_2\end{matrix}\right\}N_2$ Phenylene-diamine.	$\left.\begin{matrix}(\text{Ꞓ}_6H_3)''\\H_3\\H_3\end{matrix}\right\}N_3$ 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 :—

$\begin{array}{l}ClH\\ClH\end{array}$	$\left.\begin{array}{l}Cl\\Cl\end{array}\right\}Ca''$	$\left.\begin{array}{l}Cl\\Cl\end{array}\right\}(\text{Ȼ}_2H_4)''$	$\left.\begin{array}{l}Cl\\Cl\end{array}\right\}(\text{Ꞩ}\Theta_2)''$
	Chloride of calcium.	Chloride of ethylene.	Chloride of sulphuryle.
$\begin{array}{l}HHHN\\HHHN\end{array}$	$(\text{Ȼ}O)''\left\{\begin{array}{l}HHN\\HHN\end{array}\right.$	$(\text{Ȼ}_2H_4)''\left\}\begin{array}{l}HHN\\HHN\end{array}\right.$	
	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.
$\left.\begin{array}{l}H\\H\end{array}\right\}\Theta$ HCl	$\left.\begin{array}{l}H\\H\end{array}\right\}\Theta$ $\left.\begin{array}{l}H\\H\\H\end{array}\right\}N$	$\left.\begin{array}{l}H\\H\end{array}\right\}\Theta$ HCl $\left.\begin{array}{l}H\\H\end{array}\right\}\Theta$	HCl HCl $\left.\begin{array}{l}H\\H\end{array}\right\}\Theta$
$\left.\begin{array}{c}H\\(\text{Ȼ}_2H_4)''\end{array}\right\}\begin{array}{l}\Theta\\Cl\end{array}$	$\left.\begin{array}{c}H\\(\text{Ȼ}_2\Theta_2)''\\H\\H\end{array}\right\}\begin{array}{l}\Theta\\\\N\\\end{array}$	$\left.\begin{array}{c}H\\(\text{Ȼ}_3H_5)'''\\H\end{array}\right\}\begin{array}{l}\Theta\\Cl\\\Theta\end{array}$	$\left.\begin{array}{c}(\text{Ȼ}_3H_5)'''\\H\end{array}\right\}\begin{array}{l}Cl_2\\\Theta\end{array}$
Hydrochloric glycol.	Oxamic acid.	Monochlorhydrine.	Dichlorhydrine.
$\left.\begin{array}{c}H\\(\text{Ꞩ}\Theta_2)''\end{array}\right\}\begin{array}{l}\Theta\\Cl\end{array}$	$\left.\begin{array}{c}\text{Ȼ}_2H_5\\(\text{Ȼ}_2\Theta_2)''\\H\\H\end{array}\right\}\begin{array}{l}\Theta\\\\N\\\end{array}$	$\left.\begin{array}{c}H\\(\text{Ȼ}_3H_5)'''\\(\text{Ȼ}_2H_3\Theta)'\end{array}\right\}\begin{array}{l}\Theta\\Cl\\\Theta\end{array}$	$\left.\begin{array}{c}(\text{Ȼ}_2H_4)''\\(\text{Ȼ}_2H_4)''\end{array}\right\}\begin{array}{l}Cl_2\\\Theta\end{array}$
Chlorosulphuric acid of Dr. Williamson.	Oxamethane.	Monochloracetine.	Dichlorhydrine diethylenic.
$(\text{Ȼ}_3H_5)'''\left\}\begin{array}{l}\Theta\\Cl\end{array}\right.$	$\left.\begin{array}{c}(C_2H_5)'\\(\text{Ȼ}\Theta)''\\H\\H\end{array}\right\}\begin{array}{l}\Theta\\\\N\\\end{array}$	$\left.\begin{array}{c}H\\(\text{Ȼ}_2H_4)''\\(\text{Ȼ}_2H_4)''\end{array}\right\}\begin{array}{l}\Theta\\Cl\\\Theta\end{array}$	$\left.\begin{array}{c}(\text{Ȼ}_3H_5)'''\\(C_2H_3\Theta)'\end{array}\right\}\begin{array}{l}Cl_2\\\Theta\end{array}$
Epichlorhydrine 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 lampstand, 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 distil within the range of 1° of temperature, and not unfrequently within 0·5°. In a few cases, however, when the quantity of material at command would not permit of the attainment of so high a degree of purity, the distillation would range over two or three degrees; in 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.)

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.

[†] *Poggendorff's Annalen*, 1847, lxxii., 38.

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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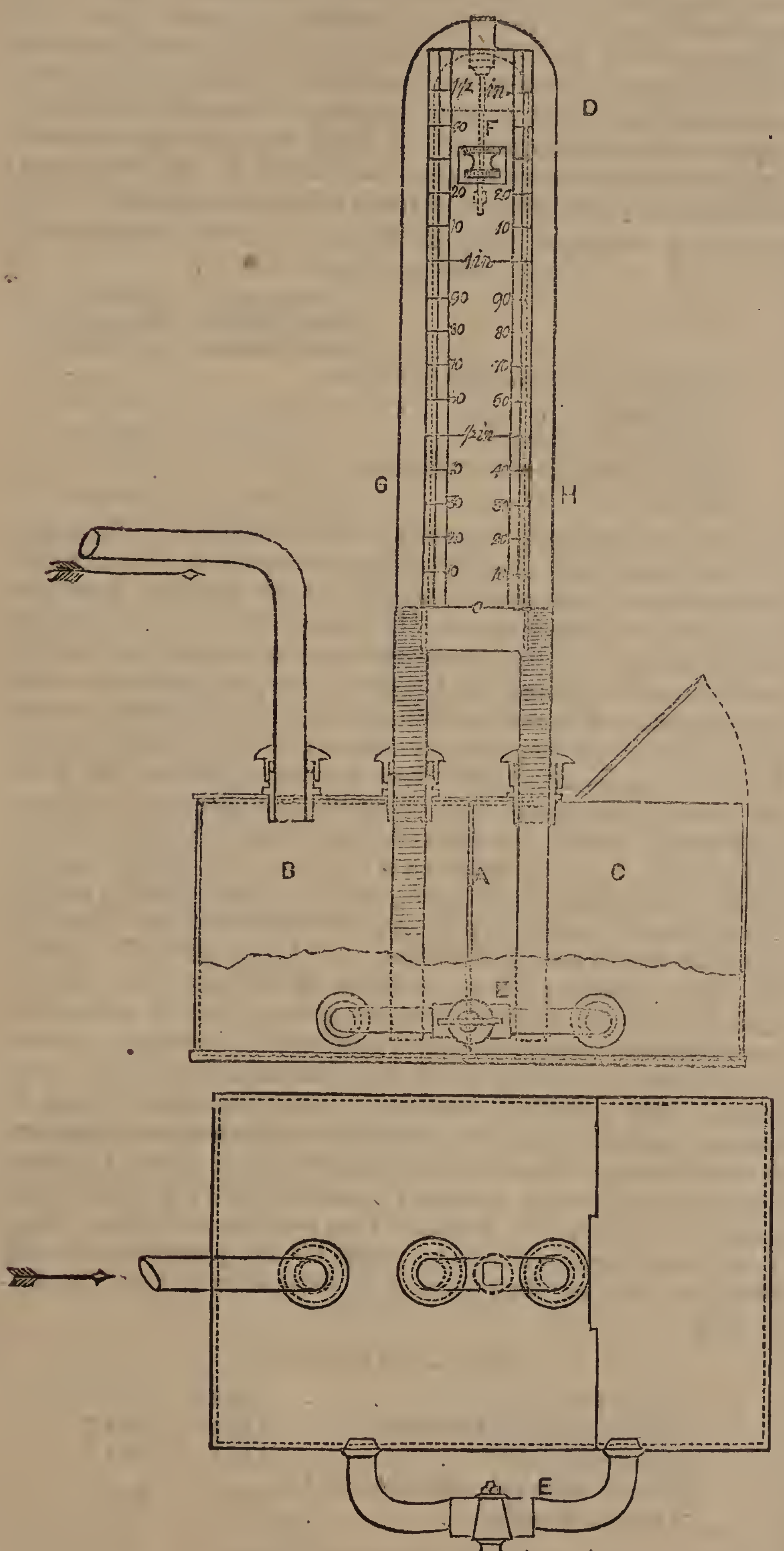
* Communicated by permission of Mr. Ramsbottom.

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.

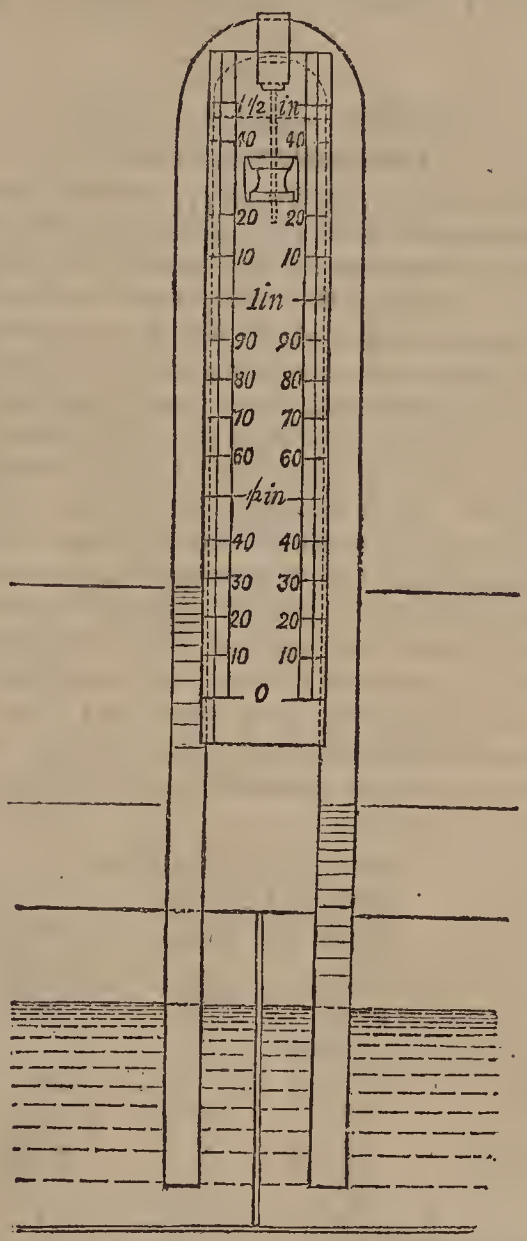
N° 1



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.	Tops.	Grain. 1920 lbs.	Straw. 3840 lbs.
	lbs.	lbs.	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, 24·24; chloride of sodium, 5·10; chloride of calcium, 2·62; 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 $\frac{1}{32}$ 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.

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 propertics, and only an insufficient onc of the reactions. When I adopt for the principal derivatives of acetic acid the formulæ,

$$\begin{array}{cccc}
\left.\begin{matrix}\text{Ꞓ}_2H_3\Theta\\ H\end{matrix}\right\}\Theta & \left.\begin{matrix}\text{Ꞓ}_2H_3\Theta\\ K\end{matrix}\right\}\Theta & \left.\begin{matrix}\text{Ꞓ}_2H_3\Theta\\ \text{Ꞓ}_2H_5\end{matrix}\right\}\Theta & \left.\begin{matrix}\text{Ꞓ}_2H_3\Theta\\ \text{Ꞓ}_2H_3\Theta\end{matrix}\right\}\Theta\\
\text{Acetic acid.} & \text{Acetate of potassium.} & \text{Acetic ether.} & \text{Anhydrous acetic acid.}\\
\left.\begin{matrix}\text{Ꞓ}_2H_3\Theta\\ H\end{matrix}\right\}S & \left.\begin{matrix}\text{Ꞓ}_2H_3\Theta\\ \text{Ꞓ}H_3\end{matrix}\right\} & \left.\begin{matrix}\text{Ꞓ}_2H_3\Theta\\ Cl\end{matrix}\right\} & \left.\begin{matrix}\text{Ꞓ}_2H_3\Theta\\ H\\ H\end{matrix}\right\}N\\
\text{Thiacetic acid.} & \text{Acetone.} & \text{Chloride of acetyle.} & \text{Acetamide.}
\end{array}$$

first observe that they all contain a common element: the acetyle radical $\text{Ꞓ}_2H_3\Theta$. 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

$$\left.\begin{matrix}\text{Ꞓ}_2H_3\Theta\\ H\end{matrix}\right\}\Theta$$

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

$$\left.\begin{matrix}\text{Ꞓ}_4H_4\Theta_2\\ H_2\end{matrix}\right\}\Theta_2$$

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—

$$\left.\begin{matrix}\text{Ꞓ}_4H_4\Theta_2\\ H\end{matrix}\right\}\begin{matrix}\Theta\\ Cl\end{matrix} \text{ and } \text{Ꞓ}_4H_4\Theta_2Cl_2$$

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

$$\left.\begin{matrix}(\text{Ꞓ}_3H_5)'''\\ H_3\end{matrix}\right\}\Theta_3$$

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

$$\text{Ꞓ}_2H_4\Theta_2 \text{ and } \text{Ꞓ}_4H_8\Theta_2$$

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

$$\underset{\text{Alcohol.}}{\text{Ꞓ}_2H_6\Theta} + \underset{\text{Acetic acid.}}{\text{Ꞓ}_2H_4\Theta_2} = \underset{\text{Acetic ether.}}{\text{Ꞓ}_4H_8\Theta_2} + H_2\Theta$$

---

* *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 :—

$$\left.\begin{matrix}\rlap{-}C_2H_3\Theta\\H\end{matrix}\right\}\Theta,\quad \left.\begin{matrix}\rlap{-}C_2H_3\Theta\\\rlap{-}C_2H_5\end{matrix}\right\}\Theta,\quad \left.\begin{matrix}\rlap{-}C_3H_5\Theta\\\rlap{-}CH_3\end{matrix}\right\}\Theta.$$

Acetic acid. Acetate of ethyle. Propionate of methyle.

$$\left.\begin{matrix}\rlap{-}CH\Theta\\\rlap{-}C_3H_7\end{matrix}\right\}\Theta,\qquad \left.\begin{matrix}\rlap{-}C_4H_7\Theta\\H\end{matrix}\right\}\Theta.$$

Formiate of propyle. Butyric acid.

Here is one of the typical equations,—

$$\left.\begin{matrix}\rlap{-}C_2H_3\Theta\\H\end{matrix}\right\}\Theta + \left.\begin{matrix}\rlap{-}C_2H_5\\H\end{matrix}\right\}\Theta = \left.\begin{matrix}H\\H\end{matrix}\right\}\Theta + \left.\begin{matrix}\rlap{-}C_2H_3\Theta\\\rlap{-}C_2H_5\end{matrix}\right\}\Theta$$

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 $2\frac{1}{2}$ and $15\frac{1}{2}$ grains in the gallon of sewage, or in value from $\frac{5}{8}$d. 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 $12\frac{1}{2}$ lbs. of ammonia, equivalent to $\frac{2}{3}$ cwt. of guano, and be worth 8s. 4d. per annum, or $1\frac{2}{3}$d. per ton; Mr. Way's and Mr. Ellis's estimates for the metropolis were 2d., and Dr. Hofmann's and Mr. Witt's $2\frac{1}{9}$d. 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 $10\frac{1}{2}$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* ($Ꞓ_6H_{12}O_6$), 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 $Ꞓ_6H_4Ɵ_2$. 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. Degs.	Elementary Difference.	Difference of boiling-point found. Degs.	Range of Temperature within which the Substance would all Distil.† Degs.
$C_8 H_{10}$	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.
$C_8 H_{10}$	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 3°°, 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 $C_n H_{n+2}$ 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.

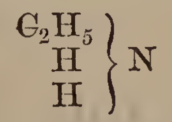
Museum of Irish Industry, January 26.

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.)

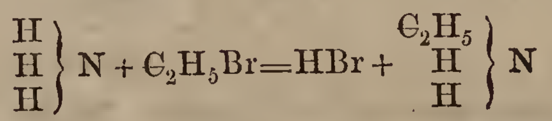
The molecules of compound bodies consist of an aggregation of atoms, which occupy a definite position in space. It is impossible to represent this arrangement by a formula or a plane figure, and the typical formulæ have no such pretension.* But experience and reason teach us that in a molecular system 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 C_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



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

shows the constitution of ethylamine only to the same extent that the reaction of bromide of ethyle with ammonia itself discloses.

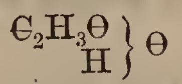


$$\left.\begin{matrix}H\\ H\\ H\end{matrix}\right\}N+\text{Ȼ}_2H_5Br=HBr+\left.\begin{matrix}\text{Ȼ}_2H_5\\ H\\ H\end{matrix}\right\}N$$

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.

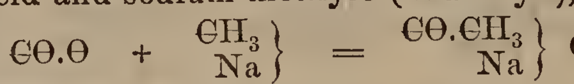
It may be seen, then, that this formula is only the expression of certain facts. It does not go beyond them; it only recalls the conclusions that we may draw from experiment, if not on the exact position of all the atoms, at least on the mutual relations, and the functions of some of them.

Can such a formula express all the facts? Evidently not. When I write acetic acid



$$\left.\begin{matrix}\text{Ȼ}_2H_3\text{Ɵ}\\ H\end{matrix}\right\}\text{Ɵ}$$

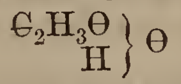
I recall its formation by chloride of acetyle and water, by the action of oxygen on aldehyde; but I do not foresee the possibility of forming acetate of sodium with carbonic acid and sodium methyle (Wanklyn),†



$$\text{ȻƟ.Ɵ}+\left.\begin{matrix}\text{Ȼ}H_3\\ Na\end{matrix}\right\}=\left.\begin{matrix}\text{ȻƟ.Ȼ}H_3\\ Na\end{matrix}\right\}\text{Ɵ}$$

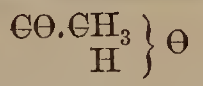
Carbonic acid. Sodium methyle. Acetate of sodium.

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 $\text{Ȼ}_2H_3\text{Ɵ}$, which is represented as a whole in the typical formula



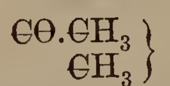
$$\left.\begin{matrix}\text{Ȼ}_2H_3\text{Ɵ}\\ H\end{matrix}\right\}\text{Ɵ}$$

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—$\text{Ȼ}H_3$ and ȻƟ—and to write this formula



$$\left.\begin{matrix}\text{ȻƟ.Ȼ}H_3\\ H\end{matrix}\right\}\text{Ɵ}$$

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



$$\left.\begin{matrix}\text{ȻƟ.Ȼ}H_3\\ \text{Ȼ}H_3\end{matrix}\right\}$$

We must remark that the molecule of acetic acid only contained two atoms of carbon, and that the groups ȻƟ and $\text{Ȼ}H_3$ 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

$$\left.\begin{array}{r}\text{Ꞓ}\Theta.C_2H_5\\ H\end{array}\right\}\Theta,\quad \left.\begin{array}{r}\text{Ꞓ}\Theta.\text{Ꞓ}_5H_7\\ H\end{array}\right\}\Theta,\quad \left.\begin{array}{r}\text{Ꞓ}\Theta.\text{Ꞓ}_4H_9\\ H\end{array}\right\}\Theta,$$

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

$$\left.\begin{array}{r}(\text{Ꞓ}_3H_4\Theta)''\\ H_2\end{array}\right\}\Theta_2$$

to show that this acid is derived from propylglycol,

$$\left.\begin{array}{r}(\text{Ꞓ}_3H_6)''\\ H_2\end{array}\right\}\Theta_2$$

that it is diatomic, and capable of forming a dichloride, $\text{Ꞓ}_3H_4\Theta.Cl_2$, and an anhydride $\text{Ꞓ}_3H_4\Theta.\Theta$. 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

$$\left.\begin{array}{r}\text{Ꞓ}_3H_4\Theta\\ H_2\end{array}\right\}\Theta_2$$

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 $\text{Ꞓ}_3H_4\Theta$ 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

$$\left.\begin{array}{r}[\text{Ꞓ}\Theta.\text{Ꞓ}_2H_4]''\\ H,H\end{array}\right\}\Theta_2$$

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—

$$\left.\begin{array}{r}(\text{Ꞓ}\Theta)''\qquad\qquad\\ \left.\begin{array}{r}(\text{Ꞓ}_2H_4)''\\ H\end{array}\right\}\Theta\ \Big]\\ H\end{array}\right\}\Theta$$

The two atoms of hydrogen here occupy perfectly distinct positions; one forms part of the group

$$\left.\begin{array}{r}\text{Ꞓ}_2H_4\\ H\end{array}\right\}\Theta$$

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,

$$\left.\begin{array}{r}\text{Ꞓ}_2H_4\\ H\end{array}\right\}\Theta$$

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

$$\left.\begin{array}{r}(\text{Ꞓ}\Theta.\text{Ꞓ}_2H_4)''\\ H.H\end{array}\right\}\Theta_2 \text{ and } \left.\begin{array}{r}\text{Ꞓ}_3H_4\Theta\\ H.H\end{array}\right\}\Theta_2$$

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.:

$$\left.\begin{array}{r}\text{Ꞓ}_2H_4\\ H\end{array}\right\}\begin{array}{l}\text{Ꞓ}N\\ \Theta\end{array} + 2H_2\Theta \qquad \left.\begin{array}{r}\left.\begin{array}{r}\text{Ꞓ}\Theta.\text{Ꞓ}_2H_4\\ H\end{array}\right\}\Theta\ \Big]\\ H\end{array}\right\}\Theta + NH_3$$

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.

[‖] $$\left.\begin{array}{r}\text{Ꞓ}_2H_5\\ Na\end{array}\right\}\Theta \quad + \text{Ꞓ}\Theta.\Theta = \text{Ꞓ}\Theta. \quad \left.\begin{array}{r}\text{Ꞓ}_2H_4\\ Na,H\end{array}\right\}\Theta_2$$

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 n 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 naphtaline, $C_{20}H_8$.

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 experiin 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.	Valice.	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. 386, 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, $Ꞓn\ H_2n-1ΘCl$, on zinc methyl, zinc ethyl, or zinc amyl, tertiary alcohols, $Ꞓn\ H_2n+2Θ$, 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* $Ꞓ_{16}H_{14}Θ$ isomeric with each other; and by the reaction of chloride of butyryl on zinc ethyl he has obtained a tertiary pseudo-cylic alcohol $Ꞓ_8H_{18}Θ$. 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—

$$2\overset{\prime\prime}{Cu}SO_4,5\overset{\prime}{Cu}H_2O_2,2\overset{\prime\prime\prime}{Al}_2H_6O_6,H_2O$$

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—

$$2\overset{\prime\prime}{Cu}SO_4,5\overset{\prime\prime}{Cu}H_2O_2,2\overset{\prime\prime\prime}{Al}_2H_6O_6,.$$

which may be written with the lower atomic weights in the following manner:—

$$2\dot{Cu}\dddot{S},5\dot{Cu}\dot{H},2(\dddot{Al}_3\dot{H}).$$

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,—

$$2\overset{\prime}{Cu}SO_4,S\overset{\prime\prime}{Cu}H_2O_2,2\overset{\prime\prime\prime}{Al}_2H_6O_6,2H_2O,$$

demands the following percentages:—

$7\overset{\prime\prime}{Cu}O$	48·12
$2\overset{\prime\prime\prime}{Al}_2O_3$	17·82
$2SO_3$	13·83
$13H_2O$	20·23
	100·00

The formula proposed for the mineral when dried at 100°, namely,—

$$2\overset{\prime\prime}{Cu}SO_4,5\overset{\prime\prime}{Cu}H_2O_2,2\overset{\prime\prime\prime}{Al}_2H_6O_6,$$

demands the following percentages:—

$7\overset{\prime\prime}{Cu}O$	49·65
$2\overset{\prime\prime\prime}{Al}_2O_3$	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.

Vol. XIII. No. 325.—February 23, 1866.

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 α 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 further 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.

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† *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 following facts presented in the following tables:—

6. *Of the Nitro-Compounds derived from the Hydrocarbons of the Benzole Series.*

Name of Substance.	For-mula.	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		
Nitro-isocumole .	$C_{18}H_{11}NO_4$	..	C_2H_2	

7. *Of the Alkaloids derived from the Hydrocarbons of the Benzole Series.*

Name of Substance.	For-mula.	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		
Xylidine .	$C_{16}H_{11}N$	216·0*	C_2H_2	
Iso-cumidine	$C_{18}H_{13}N$	..	C_2H_2	

* 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	$H_4\text{Ꞓ}^{\text{iv.}}$	Marsh gas.
H_5H_5	$HCl_5P^{\text{v.}}$	Perchloride of phosphorus.
H_6H_6	$Cl_6(Al^{\text{vi}}{}_2)$	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 $P=p3$ (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.	$\mathrm{H_2\Theta}''$ Water.	$\mathrm{H_3N}'''$ Ammonia.	$\overset{\text{iv}}{\mathrm{H_4Ꞓ}}$ Marsh gas.	$\overset{\text{v}}{\mathrm{Cl_5P}}$ Perchloride of phosphorus.	$\overset{\text{vi}}{\mathrm{Cl_6Al_2}}$ Chloride of aluminium.
HCl' Hydrochloric acid.	$\mathrm{H_2S}''$ Sulphuretted hydrogen	$\mathrm{H_3Ph}'''$ Phosphuretted hydrogen.	$\overset{\text{iv}}{\mathrm{Cl_4Ꞓ}}$ Perchloride of carbon.	$\overset{\text{v}}{\mathrm{ClH_4N}}$ Hydrochlorate of ammonia.	$\overset{\text{vi}}{\mathrm{\Theta_3Al_2}}$ Oxide of aluminium.
HBr' Hydrobromic acid.	$\mathrm{H_2Se}''$ Seleniuretted hydrogen	$\mathrm{H_3As}'''$ Arseniuretted hydrogen.	$\overset{\text{iv}}{\mathrm{\Theta''_2Ꞓ}}$ Carbonic acid.	$\overset{\text{v}}{\mathrm{IH_4P}}$ Hydriodide of phosphuretted hydrogen.	$\overset{\text{vi}}{\mathrm{Cl_6Fe_2}}$ Chloride of iron.
$\mathrm{K'Cl}$ Chloride of potassium.	$\mathrm{HK\Theta}''$ Hydrate of potassium.	$\mathrm{Et_3N}'''$ Triethylamine.	$\overset{\text{iv}}{\mathrm{Ꞩ''_2Ꞓ}}$ Sulphide of carbon.	$\overset{\text{v}}{\mathrm{Et_3PhꞨ}}$ Sulphide of triethyl phosphine.	$\overset{\text{vi}}{\mathrm{\Theta_3Fe_2}}$ Oxide of iron.
$\mathrm{Ag'Cl}$ Chloride of silver.	$\mathrm{Ag_2\Theta}''$ Oxide of silver.	$\mathrm{Et_3Ph}'''$ Triethyl-phosphine.	$\overset{\text{iv}}{\mathrm{Cl_4Ꞩi}}$ Chloride of silicium.	$\overset{\text{v}}{\mathrm{Cl_5Sb}}$ Perchloride of antimony.	$\overset{\text{vi}}{\mathrm{Cl_6(Ꞓ_6H_3)}}$ Trichlorated trichloride of benzine.
HEt' Hydride of ethyle.	$\mathrm{HEt\Theta}''$ Hydrate of ethyle.	$\mathrm{Cl_3As}'''$ Chloride of arsenic.	$\overset{\text{iv}}{\mathrm{\Theta_2Ꞩi}}$ Silicic acid.	$\overset{\text{v}}{\mathrm{I_2Et_3Sb}}$ Di-iodide of triethylstibine.	$\overset{\text{vi}}{\mathrm{Cl_6Ꞓ_2}}$ Sesquichloride of carbon.
EtEt' Ethyle.	$\mathrm{Et_2\Theta}''$ Oxide of ethyle.	$\mathrm{Cl_3Sb}'''$ Chloride of antimony.	$\overset{\text{iv}}{\mathrm{Et_4Ꞩi}}$ Silicium-ethyle.	$\overset{\text{v}}{\mathrm{ClEt_4As}}$ Chloride of tetriethylarsine	$\overset{\text{vi}}{\mathrm{H_6Ꞓ_2}}$ Hydride of ethyle.
$\mathrm{Et'Cl}$ Chloride of ethyle.	$\mathrm{Et_2S}''$ Sulphide of ethyle.	$\mathrm{Cl_3Bo}'''$ Chloride of boron.	$\overset{\text{iv}}{\mathrm{Cl_4Ꞩn}}$ Perchloride of tin.	$\overset{\text{v}}{\mathrm{Cl_2Et_3As}}$ Dichloride of triethylarsine.	$\overset{\text{vi}}{\mathrm{\Theta''H_4Ꞓ_2}}$ Aldehyde.
	$\mathrm{Ꞓa''\Theta''}$ Oxide of calcium.	$\mathrm{Cl_3Bi}'''$ Chloride of bismuth.	$\overset{\text{iv}}{\mathrm{Et_4Sn}}$ Stannethyle.	$\overset{\text{v}}{\mathrm{Cl_3Et_2As}}$ Trichloride of diethylarsine.	
	$\mathrm{(Ꞓ_2H_4)''\Theta''}$ Oxide of ethylene.	$\mathrm{Cl_3V}'''$ Chloride of vanadium.	$\overset{\text{iv}}{\mathrm{Cl_4Ti}}$ Chloride of titanium.	$\overset{\text{v}}{\mathrm{Cl_4EtAs}}$ Tetrachloride of monethylarsine.	
		$\mathrm{Cl_3(Ꞓ_3H_5)}'''$ Trichloride of allyle.	$\overset{\text{iv}}{\mathrm{Cl_4Zr}}$ Chloride of zirconium.		
			$\overset{\text{iv}}{\mathrm{Br_4\begin{bmatrix}Ꞓ_3H_3\\Ꞓ_3H_5\end{bmatrix}}}$ 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 $\mathrm{Al_2Cl6}$.

The organic combinations might all be derived from the type $\mathrm{ꞒH_4}$.[††]

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 $\mathrm{H_2\Theta}$ has this advantage over the type $\mathrm{(Ꞓ\Theta)'\Theta''}$ that it permits the in-

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[††] We should also have the following formulæ :—

$$\mathrm{Ꞓ}\left\{\begin{matrix}\mathrm{H}\\\mathrm{H}\\\mathrm{H}\\\mathrm{H}\end{matrix}\right.$$

Marsh gas.

$$\mathrm{Ꞓ}\left\{\begin{matrix}\mathrm{H}\\\mathrm{H}\\\mathrm{H}\\\mathrm{Cl}\end{matrix}\right.$$

Chloride of methyle.

$$\mathrm{Ꞓ}\left\{\begin{matrix}\mathrm{H}\\\mathrm{Cl}\\\mathrm{Cl}\\\mathrm{Cl}\end{matrix}\right.$$

Chloroform.

$$\mathrm{Ꞓ}\left\{\begin{matrix}\mathrm{H}\\\mathrm{H}\\\mathrm{H}\\\mathrm{(H\Theta)'}\end{matrix}\right.$$

Hydrate of methyle.

$$\mathrm{Ꞓ}\left\{\begin{matrix}\mathrm{H}\\\mathrm{H}\\\mathrm{H}\\\mathrm{(ꞒH_3.\Theta)'}\end{matrix}\right.$$

Oxide of methyle.

$$\mathrm{Ꞓ}\left\{\begin{matrix}\mathrm{H}\\\mathrm{\Theta''}\\\mathrm{(H\Theta)'}\end{matrix}\right.$$

Formic acid.

$$\mathrm{Ꞓ}\left\{\begin{matrix}\mathrm{N'''}\\\mathrm{H}\end{matrix}\right.$$

Hydrocyanic acid.

$$\mathrm{Ꞓ}\left\{\begin{matrix}\mathrm{N'''}\\\mathrm{(H\Theta)'}\ \&\mathrm{c}\end{matrix}\right.$$

Cyanic acid.

$$\mathrm{Ꞓ}\left\{\begin{matrix}\mathrm{(ꞒH_3)'}\\\mathrm{H}\\\mathrm{H}\\\mathrm{H}\end{matrix}\right.$$

Hydride of ethyle.

$$\mathrm{Ꞓ}\left\{\begin{matrix}\mathrm{(ꞒH_3)'}\\\mathrm{H}\\\mathrm{H}\\\mathrm{Cl}\end{matrix}\right.$$

Chloride of ethyle.

$$\mathrm{Ꞓ}\left\{\begin{matrix}\mathrm{(ꞒH_3)'}\\\mathrm{\Theta}\\\mathrm{H}\end{matrix}\right.$$

Aldehyde.

$$\mathrm{Ꞓ}\left\{\begin{matrix}\mathrm{(ꞒH_3)'}\\\mathrm{H}\\\mathrm{H}\\\mathrm{(H\Theta)'}\end{matrix}\right.$$

Hydrate of ethyle.

$$\mathrm{Ꞓ}\left\{\begin{matrix}\mathrm{ꞒH_3}\\\mathrm{H}\\\mathrm{H}\\\mathrm{(Ꞓ_2H_5.\Theta)'}\end{matrix}\right.$$

Oxyde of ethyle.

$$\mathrm{Ꞓ}\left\{\begin{matrix}\mathrm{ꞒH_3}\\\mathrm{\Theta''}\\\mathrm{(H\Theta)'}\end{matrix}\right.$$

Acetic acid.

$$\mathrm{Ꞓ}\left\{\begin{matrix}\mathrm{(H\Theta)'}\\\mathrm{H}\\\mathrm{(CH_3)'}\\\mathrm{(H\Theta)'}\end{matrix}\right.$$

Glycol.

$$\mathrm{C}\left\{\begin{matrix}\mathrm{(H\Theta)'}\\\mathrm{H}\\\mathrm{(ꞒH\Theta)'}\ \&\mathrm{c.}\\\mathrm{(H\Theta)'}\ \&\mathrm{c.}\end{matrix}\right.$$

Glycolic acid.

For the formulæ of the higher series it would be sufficient to replace the group $\mathrm{(ꞒH_3)}$ by the more complicated alcoholic groups; and nothing prevents us from decomposing the latter, and from writing ethyle—

$$\begin{bmatrix}\mathrm{ꞒH_2}\\\mathrm{ꞒH_3}\end{bmatrix} = \mathrm{Ꞓ_2H_6 - H}, \&\mathrm{c.}$$

The preceding compounds are saturated; they are derived from the saturated type $\mathrm{ꞒH_4}$. As for those that are not so, they may be referred to the type of carbonic oxide $\mathrm{Ꞓ\Theta}$, which is equal to $\mathrm{ꞒH_2}$.

$$\mathrm{Ꞓ\Theta}\text{ or }\mathrm{Ꞓ}\left\{\begin{matrix}\mathrm{H}\\\mathrm{H}\end{matrix}\right.$$

Type.

$$\mathrm{Ꞓ}\left\{\begin{matrix}\mathrm{(CH)'}\\\mathrm{H}\end{matrix}\right.$$

Acetylene.

$$\mathrm{C}\left\{\begin{matrix}\mathrm{(ꞒH_3)'}\\\mathrm{H}\end{matrix}\right.$$

Ethylene.[‡‡]

$$\mathrm{Ꞓ}\left\{\begin{matrix}\mathrm{(Ꞓ_2H_3)'}\\\mathrm{H}\end{matrix}\right.$$

Allylene.

$$\mathrm{Ꞓ}\left\{\begin{matrix}\mathrm{(Ꞓ_2H_5)'}\\\mathrm{H}\end{matrix}\right.$$

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

$$\left.\begin{matrix}\mathrm{Ꞓ\Theta,ꞒH_3}\\\mathrm{H}\end{matrix}\right\}\mathrm{\Theta}\text{ and }\mathrm{Ꞓ}\left\{\begin{matrix}\mathrm{ꞒH_3}\\\mathrm{\Theta}\\\mathrm{H\Theta}\end{matrix}\right.$$

do not differ essentially from each other; the group $\mathrm{H\Theta}$, which is shown there (as in those which M. Kolbe employs), only represents the typical residue $\mathrm{H_2\Theta - H}$. The group $\mathrm{ꞒH_3}$, 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 $\mathrm{ꞒH_4}$, 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.

[§§] $$\left.\begin{matrix}\mathrm{H_2}\\\mathrm{H_2}\end{matrix}\right\}\mathrm{\Theta_2}\quad\left.\begin{matrix}\mathrm{H_2}\\\mathrm{H_2}\end{matrix}\right\}\mathrm{Ꞓ}\quad\left.\begin{matrix}\mathrm{\Theta''}\\\mathrm{\Theta''}\end{matrix}\right\}\mathrm{Ꞓ};\quad\begin{matrix}\mathrm{Ꞓ}^{\text{iv.}}\text{ equals }\mathrm{\Theta_4}\\\mathrm{\Theta_2}\text{ equal }\mathrm{H_2}\end{matrix}$$

[‖‖] $\mathrm{[Ꞓ_2\Theta_2]\Theta_2}$ or $\mathrm{Ꞓ\Theta''.\Theta}$ equal $\mathrm{H_2\Theta''}$.

troduction of a single monoatomic group in place of an atom of hydrogen: H_2 is divisible, $(\text{ꞒΘ})''$ 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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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.

"*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.

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 36,364,327*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 be equal to $\frac{1}{525}$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. E.; 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 *p* 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.
$C_{8}H_{10}$	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.
$C_{8}H_{10}$	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.
$C_{8}H_{10}$	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.
$C_{8}H_{10}$	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 to 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 lemons, 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.

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* *Bulletin de la Société Chimique*, January, 1866.

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 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, Minorca honey absorbed only 3½ grains, and when the former weighed 103½ grains the latter had actually lost weight, the 100 grains being only 99½ 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 bottle 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 $\rlap{-}\mathrm{C}n\mathrm{H}_2n + 2\Theta$ by their action on boric anhydride formed three ethers with the general formulæ $\mathrm{BEt}\Theta_2$, $\mathrm{BEt}_3\Theta_3$, and $\mathrm{B}_3\mathrm{Et}\Theta_5$.

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 montha 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. E.—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.

Oz.—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 Chimi 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 calcic 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. 335, 1865.

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. Walenn 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:—

$$2\overset{''}{Cu}SO_4,5\overset{''}{Cu}H_2O_2,4\overset{'''}{Al}H_3O_3+4H_2O.$$

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 Cannizzarro'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 Cannizzarro.

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, electro-negative, 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 vegetation; 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 ime 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	7,657,423	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 .	22·81	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* "Portugalia," *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. 235.

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 (pistilate 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 dilute solution containing sulphate of magnesia, chloride of calcium, phosphate 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 Convolvulacæ, 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 *Convolvulacæ 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 20½° to the west of north, and 68° below the horizon, and a red pole 20½° 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.

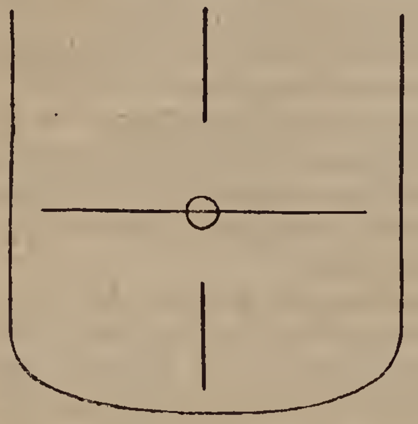
The effect of the two magnets and the one iron rod, which we have considered, make up the whole of what is called the "semicircular" deviation.

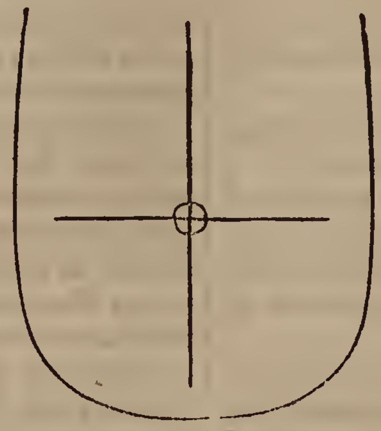
If we lay a horizontal soft iron rod, in front of and directed to the compass, it will easily be seen that when the ship's head is N., S., E., or W. it produces no deviation. When N.E. and S.W. it produces a deviation to the right hand or E., and when S.E. or N.W. a deviation to the left hand or W.; 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.

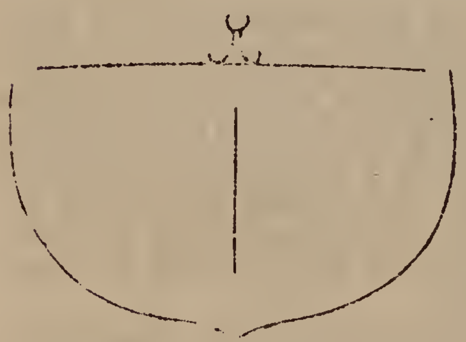
In almost all known ships the quadrantal deviation is what would be produced by two such rods—*i.e.*, rods of one or other of the following types:—

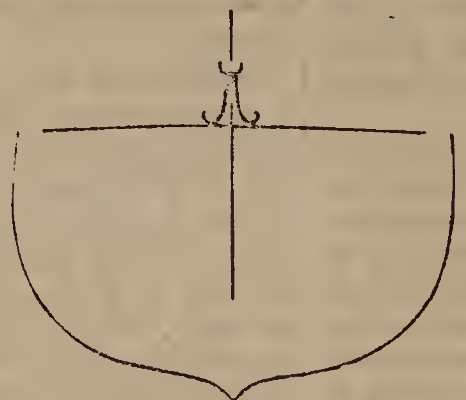




Between the two types there is an important difference, which will be easily traced out. The second type would always diminish the directive force of the needle, while the first type would increase or diminish it, according as the force of the fore and aft rods is greater or less than that of the transverse 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 Kett 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.

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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* *Bulletin de la Société Chimique*, February, p. 88.

† *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 112.)

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 associated with geology, but certainly there is no branch of inquiry which will better repay investigation than chemistry.

The first substance to which I shall direct your attention in speaking of the various bodies which concern the subject of chemical geology is silicon. This substance is one of the most abundant elements, if not the most abundant, composing the earth's crust. It is very widely diffused, and is a chief constituent in sand, in all clay, and in various kinds of igneous rocks. In combination with oxygen it forms the compound body known as silica, which exists in the form of quartz. An extraordinary exercise of force is required to separate silicon from its union with oxygen in the form of silica, and it is not long since silicon has been examined with anything like satisfactory results. It has been found to exist in three distinct conditions—in the amorphous 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 quarts 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 α 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.	4¼ 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	11.35
Starch (and dextrine) . .	80.42	81.12	74.72	72.16	70.73	70.09	72.03	43.68
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	8.40
	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:—

I.—$NaOSO_3 + 2\ C = CO_2 + NaS$.

II.—$CaOCO_2 + C\ = 2\ CO(*) + CaO$.

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:—

$$\begin{array}{ll} & 100\ NaOSO_3 \\ \text{Excess of chalk} & 94\ CaOCO_2 \\ \text{,,}\quad \text{carbon} & 44\ C \end{array} \Bigg\} = \left.\begin{array}{r} 64.20\ NaOCO_2 \\ 4.72\ NaO \end{array}\right\} = 72.2\ NaOCO_2$$

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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 *réve* 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 published 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_8NO_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 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 { 2 equivs. of SO_3HO . . . 98 grammes.
  { 1 equiv. alcohol $C_4H_6O_2$ . . 46 ,,

2 { 2 equivs. SO_3HO . . . . 98 ,,
  { 2 ,, alcohol . . . . 92 ,,

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 Ȼ H. 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 $KO2CrO_3$ 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 upon 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

$$Ꞓ_nH_{2n+2}.$$

Thus the carbides richest in hydrogen that are known are the following:—

$Ꞓ\,H_4$	Hydride of	methyl.
$Ꞓ_2H_6$	,,	ethyl.
$Ꞓ_3H_8$	,,	propyl.
$Ꞓ_4H_{10}$	,,	butyl.
$Ꞓ_5H_{12}$	,,	amyl.
$Ꞓ_6H_{14}$	,,	hexyl.
$Ꞓ_7H_{16}$	,,	heptyl.
$Ꞓ_8H_{18}$	,,	oxtyl.
$Ꞓ_9H_{20}$	,,	nonyl.
$Ꞓ_{10}H_{22}$	,,	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 $Ꞓ_3H_8$. Bromine can only react on this body on condition of taking away some of its hydrogen.

$$Ꞓ_3H_8 + Br_2 = Ꞓ_3H_7Br + BrH.$$

In this first reaction the body $Ꞓ_3H_8$ acts as an hydride $Ꞓ_3H_7H$; the group $Ꞓ_3H_7$ has passed intact from the primitive carbide of hydrogen into the brominated compound $Ꞓ_3H_7Br$. 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 $Ꞓ_3H_7$, and we see that this radical is derived from the saturated carbide $Ꞓ_3H_8$ by subtracting 1 atom of hydrogen. This being removed, the remainder, $Ꞓ_3H_7 = Ꞓ_3H_8 - H$, 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:—

$(Ꞓ_3H_7)'Cl$	Chloride of propyl.
$(Ꞓ_3H_7)'Br$	Bromide of propyl.
$(Ꞓ_3H_7)'I$	Iodide of propyl.
$(Ꞓ_3H_7)'(H\Theta)'$	Propylic alcohol.
$(Ꞓ_3H_7)'Cy$	Cyanide of propyl.
$(Ꞓ_3H_7)'(H_2N)'$	Propylamine.
$(Ꞓ_3H_7)'(Ꞓ_3H_7)'$	Free propyl.

The carbide $Ꞓ_3H_6$, propylene, differs from the saturated carbide $Ꞓ_3H_8$ 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

$(Ꞓ_3H_6)''$	Propylene.
$(Ꞓ_3H_6)''Cl_2$	Chloride of propylene.
$(Ꞓ_3H_6)''Br_2$	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.

$(Ꞓ_3H_6)''(H\Theta)_2$ Propylglycol.*

$(Ꞓ_3H_6)''(NH_2)_2$ Propylene-diamine.

Now, supposing the saturated carbide $Ꞓ_3H_8$ 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:—

$(Ꞓ_3H_5)'''Cl_3$ Trichlorhydrine.

$(Ꞓ_3H_5)'''Br_3$ Tribromhydrine.

$(Ꞓ_3H_5)'''(H\Theta)'Cl_2$ Dichlorhydrine.

$(Ꞓ_3H_5)'''2(H\Theta)'Cl$ Monochlorhydrine.

$(Ꞓ_3H_5)'''3(H\Theta)'$ 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.

$Ꞓ_3H_8$ Saturated hydrocarbon.

$Ꞓ_3H_8 - H = (Ꞓ_3H_7)'$ Monoatomic radical propyl.

$Ꞓ_3H_8 - H_2 = (Ꞓ_3H_6)''$ Diatomic radical propylene.

$Ꞓ_3H_8 - H_3 = (Ꞓ_3H_5)'''$ 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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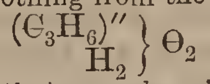
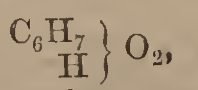
* This formula differs nothing from the typical formula



$$\left.\begin{matrix}(Ꞓ_3H_6)''\\ H_2\end{matrix}\right\}\Theta_2$$

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 $Ꞓ_3H_5$ 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."

$$NH\Theta_3 - (H\Theta)' = (N\Theta_2)'.$$
Nitric acid. Hyponitride.

$$C_2H_3Cl\Theta_2 - Cl = (C_2H_3\Theta_2)'.$$
Chloracetic acid. Oxacetyle.

$$C_2H_4\Theta_2 - (H\Theta)' = (C_2H_3\Theta)'.$$
Acetic acid. Acetyle.

$$C_2H_4Br_2 - Br = (C_2H_4Br)'.$$
Bromethyle.

$$C_2H_6\Theta_2 - (H\Theta)' = (C_2H_5\Theta)'.$$
Glycol. Oxethyle.

$$(C\Theta)Cl_2 - Cl_2 = (C\Theta)''.$$
Chloride of carbonyle. Carbonyle (carbonic oxide).

$$C_2H_2\Theta_4 - 2(H\Theta)' = (C_2\Theta_2)''.$$
Oxalic acid. Oxalyle.

$$C_4H_6\Theta_4 - 2(H\Theta)' = (C_4H_4\Theta_2)''.$$
Succinic acid. Succinyle.

$$C_4H_6\Theta_4 - H_2 = (C_4H_4\Theta_4)''.$$
Succinic acid. Fumaric and malic acids.

$$C_5H_8\Theta_4 - H_2 = (C_5H_6\Theta_4)''.$$
Pyro-tartaric acid. Citraconic acid and isometric forms.

$$C_2H_6\Theta - H_2 = (C_2H_4\Theta)''.$$
Alcohol. Aldehyde.

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.

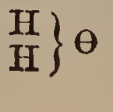
$$(C\Theta'' + H = (C\Theta H)'$$
$$(C_2H_4)'' + H = (C_2H_5)'$$
$$(C_2H_4)'' + Br = (C_2H_4Br)'$$
$$(C_2H_4)'' + (H\Theta)' = (C_2H_5\Theta)'$$
$$(C_2H_5)' + \Theta'' = (C_2H_5\Theta)'$$
$$(C_3H_5)''' + \Theta'' = (C_3H_5\Theta)'$$
$$(C_2H_2)^{\text{iv}} + Br_2 = (C_2H_2Br_2)''.$$

It will be useful to define the functions that these soformed 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 C_2H_6, we have a residue $(C_2H_5)'$ 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—

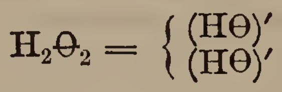
$$C_2H_5 + C_2H_5 = C_4H_{10},$$

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—



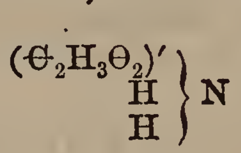
$$H_2\Theta_2 = \left\{\begin{matrix} (H\Theta)' \\ (H\Theta)' \end{matrix}\right.$$

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:

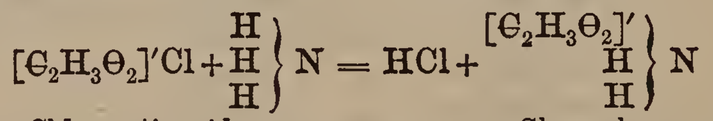
$$(C_2H_3\Theta_2)' = C_2H_3Cl\Theta_2 - Cl$$

which represents chloracetic acid minus chlorine, acts as a monoatomic radical; it enters as such into the formula—



$$\left.\begin{matrix} (C_2H_3\Theta_2)' \\ H \\ H \end{matrix}\right\} N$$

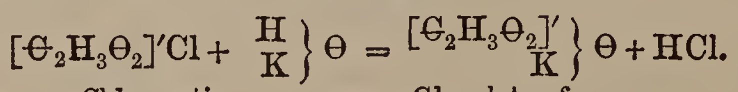
which expresses the composition of glycol. By producing this body under the influence of ammonia, according to the beautiful reaction discovered by M. Cahours, the chloracetic acid acts, in reality, like the chloride of the monoatomic radical oxyacetyle:



$$[C_2H_3\Theta_2]'Cl + \left.\begin{matrix} H \\ H \\ H \end{matrix}\right\} N = HCl + \left.\begin{matrix} [C_2H_3\Theta_2]' \\ H \\ H \end{matrix}\right\} N$$

Chloracetic acid. Glycocol.

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:



$$[C_2H_3\Theta_2]'Cl + \left.\begin{matrix} H \\ K \end{matrix}\right\} \Theta = \left.\begin{matrix} [C_2H_3\Theta_2]' \\ K \end{matrix}\right\} \Theta + HCl.$$

Chloracetic acid. Glycolate of potassium.

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.§

$$(C_4H_4\Theta_4)'' + Br_2 = C_4H_4\Theta_4Br_2$$
Fumaric acid. Dibromosuccinic acid.

$$(C_2H_4)'' + Br_2 = C_2H_4Br_2$$
Ethylene. Dibromide of ethylene.

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:

$$Ꞓ_2H_4 + H_2 = Ꞓ_2H_6 \text{ (Berthelot)}$$
$$Ꞓ_2H_4 + Br_2 = Ꞓ_2H_4Br_2$$
$$Ƶn + Br_2 = ƵnBr_2$$
$$Ꞓ_2H_4 + HBr = Ꞓ_2H_5Br \text{ (Berthelot)}$$
$$NH_3 + HBr = NH_4Br$$
$$PCl_3 + Cl_2 = PCl_5$$
$$\underset{\text{Aldehyde.}}{Ꞓ_2H_4Θ} + H_2 = \underset{\text{Alcohol.}}{Ꞓ_2H_6Θ} \text{ (A. Wurtz)}$$
$$\underset{\text{Allyle.}}{Ꞓ_6H_{10}} + H_2I_2 = \underset{\text{Dihydriodate of allyle.}}{Ꞓ_6H_{12}I_2} \text{ (A. Wurtz)}$$
$$\underset{\text{Acrolein.}}{Ꞓ_3H_4Θ} + H_4 = \underset{\text{Propylic Alcohol.}}{Ꞓ_3H_8Θ} \text{ (Linnemann)}$$
$$\underset{\text{Hydrocyanic acid.}}{Ꞓ_2NH} + H_4 = \underset{\text{Methyl-amine.}}{Ꞓ_2NH_5} \text{ (Mendius)}$$

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.

$$\left.\begin{matrix}(Ꞓ_3H_5)'\\(Ꞓ_3H_5)'\end{matrix}\right\}Ꞓ_6H_{10}$$

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, $Ꞓ_3H_6$, 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, $Ꞓ_3H_6 - H = Ꞓ_3H_5$, 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 $Ꞓ_3H_8$, 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:—

$ꞒH$ Formene.	$(Ꞓ_2H_3)$ Aldehydene.		$Ꞓ_3H_5$ Allyle.	
$(ꞒH)'''Cl_3$ Chloroform.	$(Ꞓ_2H_3)'Cl$ Chloride of aldehydene (chlorated ethylene).	$(Ꞓ_2H_3)'''Cl_3$ Trichloride of aldehydene (chlorated chloride of ethylene).	$(Ꞓ_3H_5)'Br$ Bromide of allyle.	$(Ꞓ_3H_5)'''Br_3$ Tribromide of allyle.
$\left.\begin{matrix}(ꞒH)'''\\(Ꞓ_2H_5)_3\end{matrix}\right\}Θ_3$ Ethylate of formene.	$\left.\begin{matrix}(Ꞓ_2H_3)'\\H\end{matrix}\right\}Θ$ Hydrate of aldehydene (acetyleuic alcohol).	$\left.\begin{matrix}(Ꞓ_2H_3)'''\\H_3\end{matrix}\right\}Θ_3$ Ethylic glycerine (unknown).	$\left.\begin{matrix}(Ꞓ_3H_5)'\\H\end{matrix}\right\}Θ$ Allylic alcohol.	$\left.\begin{matrix}(Ꞓ_3H_5)'''\\H_3\end{matrix}\right\}Θ_3$ 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 $Ꞓ_2H_2$ is diatomic with regard to ethylene $Ꞓ_2H_4$; it is tetratomic with regard to hydride of ethyl $Ꞓ_2H_6$. 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.

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:

$$Ꞙe + 3H_2Θ_2 = H_6ꞘeΘ_6\dagger$$

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:

$$6feꞨΘ_4 + 12KꞒNꞨ = 6feꞒ_2N_2Ꞩ_2, 6K_2ꞨO_4,$$
$$6feꞒ_2N_2Ꞩ_2 + 3H_2Θ_2 = 2ꞘeꞒ_6N_6Ꞩ_6 + H_6ꞘeO_6.$$

b. The addition of peroxide of hydrogen to a solution of ferrous iodide causes the formation of ferric hydrate, and the separation of iodine:

$$2feI_2 + 3H_2Θ_2 = H_6ꞘeΘ_6 + 2I_2.$$

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:

$$6feꞨΘ_4 + 3H_2Θ_2 + 5H_2Θ = Ꞙe_2SΘ_9 + 8H_2O + ꞘeꞨ_5Θ_{18}.$$

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:

$$Mg + H_2Θ_2 = H_2MgΘ_2.$$

IV. Action of Thallium on Peroxide of Hydrogen.—It causes the formation of thallous and thallic hydrates, and of water:

$$2Tl_2 + 4H_2Θ_2 = 2HTlO + H_2ŦlΘ_4 + 2H_2Θ,$$

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:—

$$2H_3AgN,NΘ_3 + H_2Θ_2 = 2H_4N,NΘ_3 + Ag_2Θ_2, Ag_2Θ_2 + 2H_2Θ_2$$
$$= Ag_2 + H_2Θ + 2Θ_2.$$

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; Ꞙe = 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:—

$$\begin{aligned} &\text{I.—}2\mathrm{KI}+\mathrm{H_2\Theta_2} = \mathrm{K_2\Theta_2}+2\mathrm{HI},\\ &\text{II.—}\mathrm{K_2\Theta_2}+\mathrm{H_2\Theta} = 2\mathrm{KH\Theta}+\Theta,\\ &\text{III.—}\quad 2\mathrm{HI}+\Theta = \mathrm{H_2\Theta}+\mathrm{I_2}. \end{aligned}$$

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:—

$$2\mathrm{Kmn\Theta_4}+2\mathrm{H_2\Theta_2}=2\mathrm{HK\Theta}+\mathrm{H_2mn\Theta_5}+5\Theta.$$

Were the hydrate of peroxide of manganese directly reducible by peroxide of hydrogen, five atoms of oxygen would be set at liberty.

$$\mathrm{H_2mn_2\Theta_5}+3\mathrm{H_2O_2}=2\mathrm{mn\Theta}+4\mathrm{H_2\Theta}+5\Theta.$$

By condensing the two equations into one, and getting rid of similar terms, the reaction may be represented by the following equation:—

$$2\mathrm{Kmn\Theta_4}+5\mathrm{H_2\Theta_2}=2\mathrm{HK\Theta}+2\mathrm{mn\Theta}+4\mathrm{H_2\Theta}+5\mathrm{\Theta_2}.$$

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.

$$2\mathrm{KfeCy_6}+\mathrm{H_2\Theta_2}=\mathrm{K_6ƑeCy_{12}}+2\mathrm{HK\Theta}.$$

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, $\mathrm{fe_3ƑeCy_{12}}$, 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.

$$\begin{aligned} &\mathrm{K_6ƑeCy_{12}}+\mathrm{H_2\Theta_2}=\mathrm{H_2K_2feCy_6}+\mathrm{K_4feCy_6}+\mathrm{\Theta_2},\\ &3\mathrm{H_2K_2feCy_6}+2\mathrm{ƑeCl_6}=\mathrm{fe_3Ƒe_2Cy_{18}}+6\mathrm{HCl}+6\mathrm{KCl}. \end{aligned}$$

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 with 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 $\text{Ꞓ}_6H_6^{\text{iv.}}$ We might, therefore, expect to find similar relations existing between this hypothetical radical and benzol Ꞓ_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.*

$$\text{Ꞓ}_6H_6 + \left[\Theta\left\{\begin{matrix}Cl\\H\end{matrix}\right.\right]^3 = \begin{matrix}\Theta_3\\Cl_3\end{matrix}\left\{\begin{matrix}\text{Ꞓ}_6H_6\\H_3\end{matrix}\right.$$

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.	$\text{Ꞓ}_6H_9Cl_3\Theta_3$.
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 :—

$$\begin{matrix}\Theta_3\\Cl_3\end{matrix}\left\{\begin{matrix}\text{Ꞓ}_6H_6\\H_3\end{matrix}\right. + 3\left[\Theta\left\{\begin{matrix}K\\H\end{matrix}\right.\right] = \Theta_6\left\{\begin{matrix}\text{Ꞓ}_6H_6\\H_6\end{matrix}\right. + 3KCl$$

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— $\Theta_6\left\{\begin{matrix}\text{Ꞓ}_6H_6\\H_6\end{matrix}\right.$

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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 $\text{Ȼ}_6H_{12}\Theta_6NaCl$.

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 $\text{Ȼ}_6H_{12}\Theta_6$.
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—

$$\Theta_6 \left\{ \begin{matrix} \text{Ȼ}_6H_6 \\ Pb_3, \end{matrix} \right.$$

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. Nicklés 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.	Hardness. 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 *meadowsweet 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, 5¼ 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 Dessaignes may 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.

$$\underset{\text{Orthocarbonate of Ethyl.}}{C(C_2H_5)_4O_4} + 3H_3N + H_2O = \underset{\text{Guanidine.}}{CH_5N_3,H_2O} + \underset{\text{Alcohol.}}{4(C_2H_5,HO)}$$

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.
$C\ N$	$C\ N$
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 $2\frac{1}{2}$ 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.

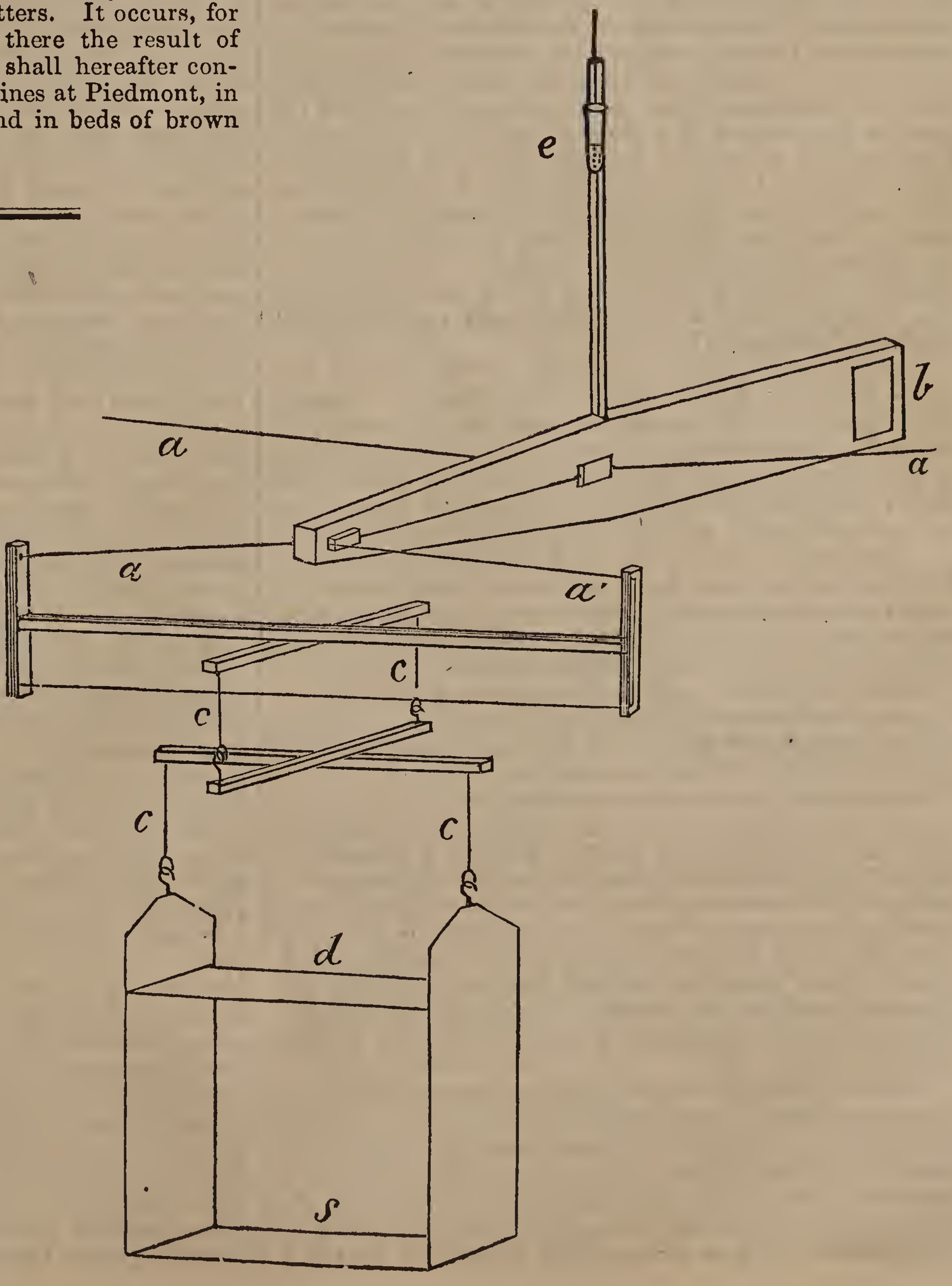
(To be continued.)

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 place 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 tea 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	½ part
Nitrate of potash	½ ,,
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 Streeet, 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.*

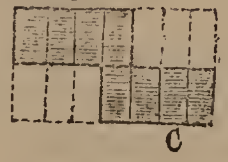
(Continued from page 159.)

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:

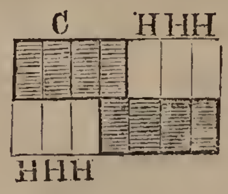
$\overset{\text{IV.}}{Ȼ}H_4$	Marsh gas.
$ȻCl_4$	Perchloride of carbon.
$ȻH_3Cl$	Chloride of methyl.
$ȻH_2Cl_2$	Chlorated chloride of methyl.
$ȻHCl_3$	Chloroform.
$Ȼ\overset{''}{Ɵ}_2$	Carbonic acid.
$Ȼ\overset{''}{Ɵ}Cl_2$	Chloride of carbonyl.
$Ȼ\overset{''}{S}_2$	Carbonic sulphide.

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 $Ȼ_2H_6$ 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:—



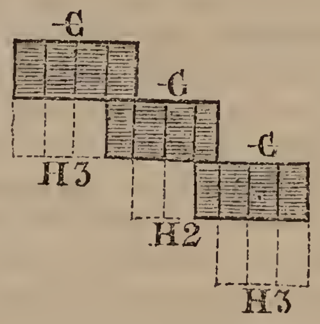
It will be seen that the two atoms of carbon are so placed that one overlaps the other. The two atoms are there made to touch for a quarter of their lengths, in order to indicate that they exchange a quarter of their affinities.

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 $Ȼ_nH_{2n+2}$. 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 $Ȼ_2H_6$ you do not make $Ȼ_2H_8$; you must necessarily make two molecules of $ȻH_4$, 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,

$$nȻH_4 - H_{(2n-2)}$$

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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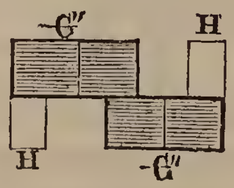
[*] Ueber die Constitution und die Metamorphosen der Chemischen Verbindungen und über die chemische Natur des Kohlenstoffs. *Annalen der Chemie und Pharmacie*, vol. cvi., p. 136.

[†] 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.

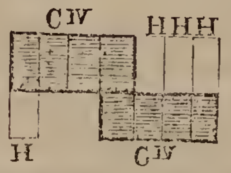
[‡] The idea that carbon can act sometimes as a tetratomic and sometimes as a diatomic elemement was first suggested by M. Couper.—*Annales de Chimie et de Physique*, 3rd series, vol. liii., p. 459.

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.

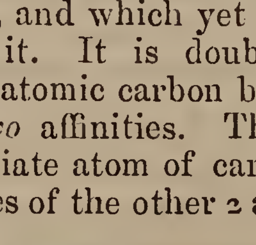


But we know that oxide of carbon can combine directly with oxygen and with chlorine; diatomic carbon passes then to the state of tetratomic carbon. Its affinities were, so to say, lying dormant; they awake, and we see them completely satisfied in carbonic acid and in chloride of carbonyle (chloroxycarbonic 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—

$$\underbrace{C_2H_5N\Theta_3}_{\text{Nitric ether.}} + 6H = \underbrace{NH_3\Theta}_{\text{Hydroxylamine.}} + H_2\Theta + \underbrace{C_2H_5,H\Theta}_{\text{Alcohol.}}$$

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 quantities 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—

$$3NH_3\Theta = NH_3 + 2N + 3H_2\Theta.$$

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 ammonieo-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.

39, 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.

. . . .

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.

. . . .

(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 $48\frac{1}{2}$ 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 redried 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 $Na_2ȻΘ_3$, and sesquicarbonate of ammonia as $2[(H_4N)_2ȻΘ_3]ȻΘ_2$ 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."

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"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."

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"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 re-distillation 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 the 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.

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,

$$\left\{\begin{matrix}\mathrm{COHo}\\ \mathrm{COHo},\end{matrix}\right.$$

in proof of which they show that when oxalic ether is acted upon by nascent amyl, it is converted into caproic ether—

$$\underset{\text{Oxalic ether.}}{\left\{\begin{matrix}\mathrm{COEto}\\ \mathrm{COEto}\end{matrix}\right.} + \underset{\text{Amyl.}}{\left\{\begin{matrix}\mathrm{CBuH_2}\\ \mathrm{CBuH_2}\end{matrix}\right.} = 2\ \underset{\text{Caproic ether.}}{\left\{\begin{matrix}\mathrm{CBuH_2}\\ \mathrm{COEto}.\end{matrix}\right.}$$

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‖.

$$\underset{\text{Cyanogen.}}{\left\{\begin{matrix}\mathrm{CN'''}\\ \mathrm{CN'''}\end{matrix}\right.} \qquad \underset{\text{Oxalyl.}}{\left\{\begin{matrix}\mathrm{COHo}\\ \mathrm{COHo}.\end{matrix}\right.}$$

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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* *Comptes-Rendus*, vol. lxii., p. 829.

† 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	$\left\{\begin{array}{l} C\overset{+}{R}HHo \\ COHo \end{array}\right.$
2. Etheric normal acids . . .	$\left\{\begin{array}{l} C\overset{+}{R}H\overset{+}{\bar{R}}o \\ COHo \end{array}\right.$
3. Secondary acids	$\left\{\begin{array}{l} C\overset{+}{R}_2Ho \\ COHO \end{array}\right.$
4. Etheric secondary acids . . .	$\left\{\begin{array}{l} C\overset{+}{R}_2\overset{+}{\bar{R}}o \\ COHo \end{array}\right.$
5. Normal olefine acids . . .	$\left\{\begin{array}{l} C\overset{+}{R}HHo \\ (CH_2)_n \\ COHo \end{array}\right.$
6. Etheric normal olefine acids . .	$\left\{\begin{array}{l} C\overset{+}{R}H\overset{+}{\bar{R}}o \\ (CH_2)_n \\ COHo \end{array}\right.$
7. Secondary olefine acids . . .	$\left\{\begin{array}{l} C\overset{+}{R}_2Ho \\ (CH_2)_n \\ COHo \end{array}\right.$
8. Etheric secondary olefine acids . .	$\left\{\begin{array}{l} C\overset{+}{R}_2\overset{+}{\bar{R}}o \\ (CH_2)_n \\ COHo. \end{array}\right.$

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:—

$\left\{\begin{array}{l} C(CH_3)HHo \\ COHo \end{array}\right.$	$\left\{\begin{array}{l} C(CH_2)''H \\ COHo. \end{array}\right.$
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 . . .	¼ 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 . . .	¼ 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 . . .	¼ 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 ¼-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—$C_6N_3O_7H_2,C_2H_5$.

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—

$$\left.\begin{matrix}C_6N_3O_6H\\2C_2H_5\end{matrix}\right\}O_2.$$

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.

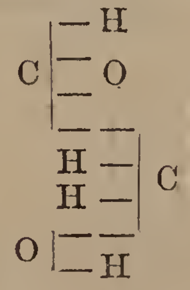
III. The thermal effect of a reversal of a given chemical change is equal and opposite to the thermal effect of that change.

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.

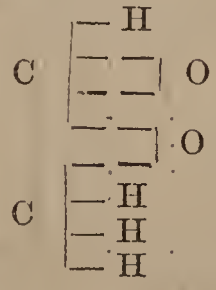
	Units.
Carbon as charcoal	8080
Carbon as graphite	7797
Carbon as diamond	7770
Sulphur, native	2220
Sulphur, plastic	2260
Isomeric hydrocarbons—	
Oil of turpentine	10852
Oil of lemons	10959
Terebine	10662

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 $\frac{1}{360000}$ of a grain was present.

Sulphate of quinine gave feeble fluorescence when $\frac{1}{330000}$ 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	,,	,,
1¼	,,	,,	,,	=1·6	,,	,,
2	,,	,,	,,	=1·6	,,	,,
2¼	,,	,,	,,	=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 $Ȼ_{5}H_{10}\Theta_{3}$. 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*—$Ȼ_{12}H_{11}\Theta_{3}$—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—

$$\left.\begin{array}{l} Ȼ_{10}H_{9}N \\ Ȼ_{10}H_{6}N_{2} \end{array}\right\}$$

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 semi-transparent 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.; "Pantechnicon."

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

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

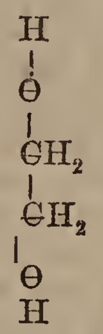
PART II.

THEORY OF TYPES AND ATOMICITY.

SECTION IV.—*Atomicity of the Elements.*

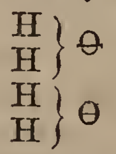
(*Continued from page* 182.)

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:—

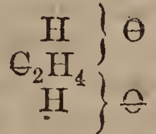


$$\begin{array}{c} H \\ | \\ \Theta \\ | \\ ꞒH_2 \\ | \\ ꞒH_2 \\ | \\ \Theta \\ H \end{array}$$

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?

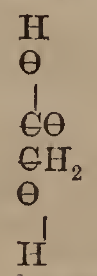


$$\left.\begin{array}{c} H \\ H \end{array}\right\}\Theta \quad \left.\begin{array}{c} H \\ H \end{array}\right\}\Theta$$



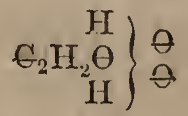
$$\left.\begin{array}{r} H \\ Ꞓ_2H_4 \\ H \end{array}\right\}\begin{array}{c} \Theta \\ \Theta \end{array}$$

The same remark applies to the formula of glycolic acid, $Ꞓ_2H_4\Theta_3$—one of the products of the oxidation of glycol. Whether we seek to express the relations existing between the atoms by the formula



$$\begin{array}{c} H \\ \Theta \\ | \\ Ꞓ\Theta \\ ꞒH_2 \\ \Theta \\ | \\ H \end{array}$$

or whether we adopt the typical for mula*



$$\left.\begin{array}{r} H \\ Ꞓ_2H_2\Theta \\ H \end{array}\right\}\begin{array}{c} \Theta \\ \Theta \end{array}$$

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:

$$\left\{\begin{array}{l} Ꞓ\Theta \\ ꞒH_2 \end{array}\right. \text{ or } Ꞓ_2H_2\Theta,$$

which is shown in the formula of glycolic acid, and which results from the oxidation of the ethylene group

$$\left\{\begin{array}{l} ꞒH_2 \\ ꞒH_2 \end{array}\right.$$

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:—

$$\left.\begin{array}{c} Cl \\ H \end{array}\right\rangle\Theta \quad \left.\begin{array}{c} K \\ H \end{array}\right\rangle\Theta \quad \left.\begin{array}{c} Ꞓ_2H_5 \\ Ꞓ_2H_5 \end{array}\right\rangle\Theta \quad \left.\begin{array}{c} Ꞓ_2H_3\Theta \\ Ꞓ_2H_3\Theta \end{array}\right\rangle\Theta \quad \left.\begin{array}{c} Ꞓ_2H_5 \\ Ꞓ_2H_5 \\ Ꞓ_2H_5 \end{array}\right\rangle N$$

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 $ꞒH_2$, 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 $nꞒ$ 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 $ꞒH_2$. 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—

$$\left.\begin{array}{r} Ꞓ_2H_3\Theta \\ ꞒH_3 \end{array}\right\} = Ꞓ_3H_6\Theta(77{\cdot}3 - 77{\cdot}6)$$

that of the carbide—

$$Ꞓ_3H_6(66),$$

he found for the specific volume of Θ the number 11·3–11·6. By subtracting from the specific volume of the aldehyde—

$$\left.\begin{array}{r} Ꞓ_2H_3O \\ H \end{array}\right\} = Ꞓ_2H_4\Theta(56{\cdot}0 - 56{\cdot}9)$$

that of

$$Ꞓ_2H_4(44),$$

he found for the specific volume of Θ the numbers 12·0–12·9. 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 $Ꞓ_aH_b(\Theta_c)\Theta_d$‡ by means of the formula—

$$a.11 + b.5{\cdot}5 + c.12{\cdot}2 + d.7{\cdot}8.$$

In the formula $Ꞓ_aH_b(\Theta)_c\Theta_d$, (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:—

$$\begin{matrix} H \\ \Theta \\ \text{Ꞓ}_2H_4 \\ \text{Ꞓ}_2H_4 \\ \Theta \\ \Theta \\ H \end{matrix}$$

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:—

$$\begin{matrix} H \\ \Theta \\ \text{Ꞓ}_2H_4 \\ \Theta \\ \text{Ꞓ}_2H_4 \\ \Theta \\ H \end{matrix}$$

This corresponds to the typical formula:—

$$\left.\begin{matrix} \left[\left.\begin{matrix} \text{Ꞓ}_2H_4 \\ \text{Ꞓ}_2H \end{matrix}\right\} \Theta \right]'' \\ H_2 \end{matrix}\right\} O_2$$

The more simple formula

$$\left.\begin{matrix} (\text{Ꞓ}_2H_4) \\ (\text{Ꞓ}_2H_4) \\ H_2 \end{matrix}\right\} O_3$$

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

$$\left.\begin{matrix} \text{Ꞓ}_5H_{11} \\ H \end{matrix}\right\} \Theta$$

the eleven atoms of hydrogen are in direct connexion with the carbon. We may suppose that in the hydrate of amylene

$$\left.\begin{matrix} [(\text{Ꞓ}_5H_{10})''H]' \\ H \end{matrix}\right\} \Theta$$

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.

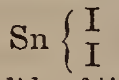
¶ To pursue this point would lead us beyond the plan we have laid down for this work. On this subject should be consulted an important article published by M. Kekulé under the title "Considérations sur quelques cas d'isomérie" (*Annales de Chimie et de Physique*, 3rd series, vol. lxvi., page 482); the 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.

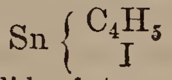
In that which precedes we have considered the atomicity of the principal elements of organic compounds, especially that of carbon. But it is evident that the reasoning we have pursued would apply to the other chemical elements, metalloids, and metals. Among the works which have helped to generalise these 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:



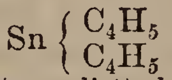
$$Sn\begin{cases} I \\ I \end{cases}$$

Diiodide of tin.



$$Sn\begin{cases} C_4H_5 \\ I \end{cases}$$

Iodide of stannethyl.



$$Sn\begin{cases} C_4H_5 \\ C_4H_5 \end{cases}$$

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'isomerie (*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 Chemie 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 Swansea 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 $\frac{1}{2}$ to 1 ladle, according to the valuation; tartar $\frac{1}{4}$ to $\frac{1}{2}$ 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:** $\frac{2}{3}$ sulphuret copper, $\frac{1}{3}$ 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 $\frac{1}{2}$ 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 dolemite. 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 limestome, 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."

952. 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.

992. 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 $\frac{1}{114,400,000}$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.

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*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, $C_4\mathit{Cu}_2H$, 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, $(C_4\mathit{Cu}_2H)O$ or $(C_4\mathit{Cu}_2H)_2O_2$, 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-acetyle 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	$(C_4H_5)_3Sb$	,, ,,	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 ½ 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 213.)

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 3, 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 $\frac{1}{4}$ 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.—Schwartz'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.

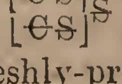
It therefore appears that the apparent quantivalence of an element affords no absolute proof of the real, or maximum, quantivalence which it would exhibit were its atoms in a thoroughly free condition. We have, in fact, no absolute proof that one atom of an element can exist entirely apart from its fellow 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,



$$\left.\begin{matrix}[\bar{C}\bar{S}]\\ [\bar{C}\bar{S}]\end{matrix}\right.\bar{S}$$

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

$$\left[\begin{array}{c}\text{ꞒS̶}\\ \text{ꞒS̶}\end{array}\right]\Theta,\mathrm{H_2}\Theta.,$$

which forms a tolerably soluble salt with baryta, and with lead and silver less soluble reddish salts.

Hydro-sesquisulphide of Carbon—

$$\mathrm{H_2}\left[\begin{array}{c}\text{ꞒS̶}\\ \text{ꞒS̶}\end{array}\right]\text{S̶}.$$

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 aurosacetyle.

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:

$$C_6H_4 + 2Cr_2O_3 + H_2O_2 = C_6H_6 + 2Cr_2O_3.$$

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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 argentallylene.

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—

$$C_6H_3Ag + NH_3HCl = C_6H_4 + AgCl + NH_3.\text{‡}$$

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 Thênard'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:—

C_4H_2		C_6H_4	NH_3
C_4HNa	C_4HAg	C_6H_3Ag	
C_4Na_2			

and corresponding to ammonia NH_3, the others by substitution and simultaneous addition,—

$C_4HAg.AgCl$	$NH_3.HCl$
$C_4HAg.AgO$	$NH_3.HO$
$C_4H\text{Ꞓ}u.\text{Ꞓ}uO$	

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,—

$$\text{Ꞓ}uO + (O) = \text{Ꞓ}uO(O)$$
$$\text{Ꞓ}uO + (C_4H\text{Ꞓ}u) = \text{Ꞓ}uO(C_4H\text{Ꞓ}u).$$

[†] Corresponding to the second acetylmetallic series
$[C_4HAg.(C_4HAg,Ag)]O$,
to the base $[NH_3(NH_3Pt)]O$, and finally to the ammoniacal oxide of silver $[NH_3(NH_3Ag)]O$.

[‡] 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, acetylene 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

$$C_4HAg + AgCl . C_4H\bar{C}u + \bar{C}uO.$$

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 $1\frac{3}{8}$ 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 wlth 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 Diff. M. & S.
II.	Coarse metal (fusion of poor minerals, raw or calcined) $3Cu_2S+Fe_2S_3+4(\text{Fe. dif. met})S$	34·6	34·1	1·5	29·8	31·3
V.	Blue metal (fusion of the calcined coarse metal with minerals of mean richness) $0{\cdot}8Cu+3Cu_2S+2(\text{Fe. dm.})S$	57·2	18·5	1·0	23·3	24·3
	Reddish variety, *matte mince* $1{\cdot}3Cu+3Cu_2S+2(\text{Fe. dm.})S$	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 $\frac{1}{10}$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_2, 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.

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 *ῥιγος*, 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 electromagnetic 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 horseshoe 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 red 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:—

$$\text{I.}\ \left\{\begin{array}{l} CH_3 \\ COMe \end{array}\right.$$

$$\text{II.}\ \left\{\begin{array}{l} CH_3 \\ C(CH_2)''(HO) \end{array}\right.$$

$$\text{III.}\ \left\{\begin{array}{l} CMeH \\ CH(HO) \end{array}\right.$$

"*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.	*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.	*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., 420.

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 fermention. 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· αυτὰρ 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 crepuseula lustra.
Uda prius spargat, virgaque verrat humum.
Frondibus, et fixis decorentur ovilia ramis;
Et tegat ornatas longa eorona 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 *miner* 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}, $\mathrm{N}^{\mathrm{III}}$, 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 $\mathrm{N}^{\mathrm{III}}_{2}\cdot\mathrm{O}^{\mathrm{II}}_{3}$, 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 ($\mathrm{N}^{\mathrm{III}}_{2}\cdot\mathrm{O}^{\mathrm{II}}_{5}$); nor, again, is the most hypo-oxygenic compound of the series ($\mathrm{N}^{\mathrm{III}}_{2}\cdot\mathrm{O}$) 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.

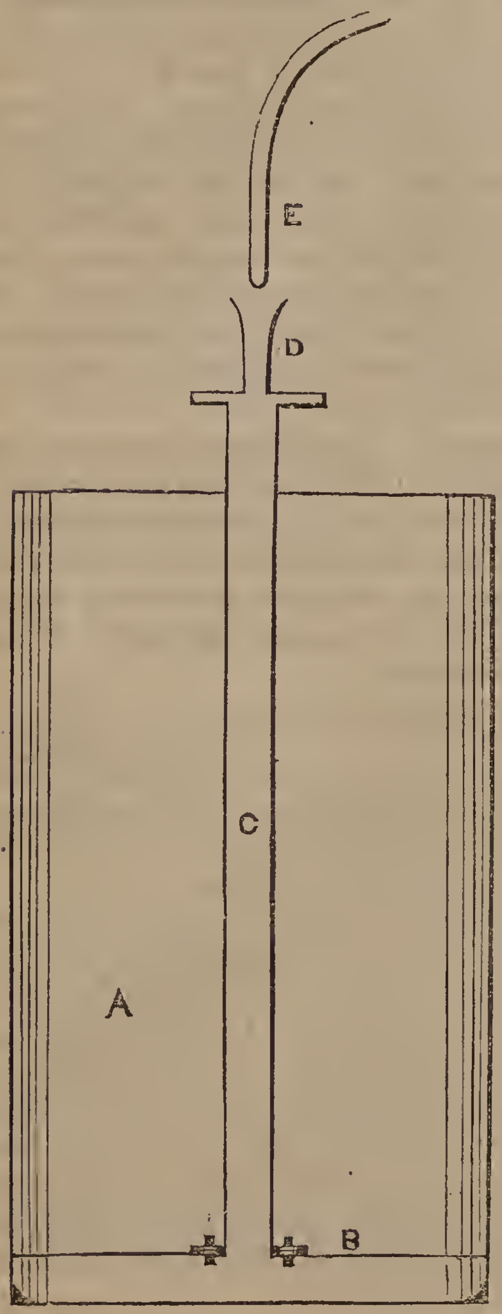
Received.—X. B.; A Young Chemist; E. A. H.

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 $\frac{1}{2}$ 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 Chili.—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	$56\frac{1}{4}=56{\cdot}250$	58·40	2·150
Green carbonate copper of Castile	$9\frac{3}{4}=9{\cdot}750$	11·52	1·770
Variegated copper, Huel Damsel	$10\frac{1}{5}=10{\cdot}500$	11·30	0·800
Pyrites, West Wheal Seton ..	$8\frac{3}{8}=8{\cdot}375$	8·40	0·025
,, United Mines	$8=8{\cdot}000$	10·38	2·380
,, Devon Great Consols ..	$4\frac{5}{8}=4{\cdot}625$	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

$$\Sigma D = 41{\cdot}25,\ \Sigma(W-D) = 5{\cdot}95,\ \Sigma W = 47{\cdot}20, \text{ and } \frac{\Sigma W}{5} = 9{\cdot}44.$$

By taking the ratio

$$\frac{\Sigma(W-D)}{\Sigma D} = 14{\cdot}42,$$

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

$$\frac{\Sigma(W-D)}{\Sigma W} = 12{\cdot}60$$

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 20 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

$$\text{Є}_9H_{11}Ba\text{S}\text{Ѳ}_3 + \tfrac{1}{2}H_2\text{Ѳ},$$

which only loses its water when heated to 150°C.

Cumol gives a well crystallised bromated compound $\text{Є}_9H_{11}Br$, 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 twofold 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 fœtid 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 wineglassful 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.

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† 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 1028·5—80·5 = 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. 80·5 ÷ 52 = 1·548 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:—

$$\underbrace{\cancel{C}_{10}H_{11}Br\cancel{O}_2}_{\text{Bromo-cuminic acid.}} \qquad \underbrace{\cancel{C}_{20}H_{24}N_2\cancel{O}_2}_{\text{Quinine.}}$$

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 at 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.

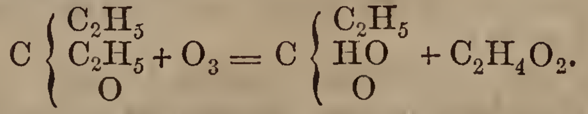
CHEMICAL SOCIETY.

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:—



$$C\left\{\begin{matrix}C_2H_5\\C_2H_5\\O\end{matrix}\right.+O_3=C\left\{\begin{matrix}C_2H_5\\HO\\O\end{matrix}\right.+C_2H_4O_2.$$

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 firstnamed 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;

$$N_4H_{12}Pt_2ClO_3,2NO_5+HO.$$

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 awhile 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 ⅓ 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 arc 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

$$\text{Ꞩn}X_4.$$

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 $\text{Ꞩn}Cl_2$, 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 arscnic, when they are saturated, belong to the type

$$AsX_5.$$

The following arc 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—

$$N''\text{Ɵ}''$$
$$N'''H_3$$
$$N^{v\cdot}(H_4Cl)$$

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.

$$\overset{''}{\text{Ᵽb}}Cl_2$$
$$\overset{iv.}{\text{Ᵽb}}Et_4$$
$$\overset{iv.}{\text{Ᵽb}}Me_4$$

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 ($\text{Ꞩn}Cl_2$ = stannous chloride). Shall we say, as a final instance, that iron is hexatomic or tetratomic or triatomic?[||]

We do not consider its part in the ferrous compounds where it equals 2 atoms of hydrogen or chlorine

($\text{Ꞙe}Cl_2$ = 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 (C_2H_6 and C_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 C_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.

$$\overset{\text{iv.}}{C}\overset{\prime\prime}{\Theta}_2 \qquad \left.\begin{matrix}\overset{\text{v.}}{P}\\ \overset{\text{v.}}{P}\end{matrix}\right\}\overset{\prime\prime}{\Theta}_5$$

$$\overset{\text{iv.}}{Si}\overset{\prime\prime}{\Theta}_2$$

$$\overset{\text{iv.}}{Sn}\overset{\prime\prime}{\Theta}_2 \qquad \left.\begin{matrix}Bo'''\\ Bo'''\end{matrix}\right\}\overset{\prime\prime}{\Theta}_3$$

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.

$$\overset{\prime}{Cl}\text{-}\overset{\prime\prime}{\Theta}\text{-}\overset{\prime\prime}{\Theta}\text{-}\overset{\prime\prime}{\Theta}\text{-}\overset{\prime\prime}{\Theta}\text{-}\overset{\prime\prime}{\Theta}\text{-}\overset{\prime\prime}{\Theta}\text{-}\overset{\prime\prime}{\Theta}\text{-}\overset{\prime}{Cl}$$

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 1026) a combination containing

$$\left.\begin{matrix}(C_2H_3\Theta)_3\\ I'''\end{matrix}\right\}\Theta_3$$

in which the triatomic iodine of the chloride Cl_3I, by replacing 3 atoms of the hydrogen of 3 molecules of acetic acid

$$3\left[\left.\begin{matrix}C_2H_3\Theta\\ H\end{matrix}\right\}\Theta\right]$$

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

$$[\overset{\prime\prime}{\mathrm{S}}-\overset{\prime\prime}{\mathrm{S}}]^{\prime\prime}$$

might saturate

$$\mathrm{Fe}^{\prime\prime}$$

in pyrites, or else that the group

$$[\mathrm{Fe}^{\prime\prime}-\mathrm{S}^{\prime\prime}]^{\prime\prime}$$

might combine with $\mathrm{S}^{\prime\prime}$.

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 Resul's of Injecting Sulphite and Bisulphite of Soda into the Blo:d 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	26½	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 o 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. x	Percentage of residue. y	Percentage of chemical change. $100-y$
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. x	Percentage of residue. y	Percentage of chemical change. $100-y$
·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: $2\ (3\ CaO, SiO_3) + Al_2O_3SiO_3$. 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 C. 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—

$$\begin{matrix}H^6\\H_6\end{matrix}\Theta_6$$

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 :—

$$\left.\begin{matrix}H_6\\H_6\end{matrix}\right\}\Theta_6 \qquad\qquad \left.\begin{matrix}\overset{\text{vi.}}{\text{Ffe}}\\H_6\end{matrix}\right\}\Theta_6$$

Type. Normal ferric hydrate.

$$\left.\begin{matrix}\overset{\text{vi.}}{\text{Ffe}}\\4(Ꞓ_2H_3\Theta)'\\(N\Theta_2)'\\H\end{matrix}\right\}\Theta_6+4H_2\Theta \qquad \left.\begin{matrix}\overset{\text{vi.}}{\text{Ffe}}\\3(Ꞓ_2H_3\Theta)'\\(N\Theta_2)'\\H_2\end{matrix}\right\}\Theta_6+2H_2\Theta.$$

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—

$$\text{Ꞙe}.$$

Ferricum, then, is formed by the union of two atoms of ferrosum, and in the preceding formulæ we may replace the sign—

$$\overset{\text{vi.}}{\text{Fe}} \text{ by the sign } \overset{\text{vi.}}{\text{Ꞙe}_2}.$$

But here there is a difficulty. How can two atoms of diatomic ferrosum form, by uniting, a hexatomic couple

$$Fe_2\,?$$

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§—

$$\text{Ꞙe}S_2.$$

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—

$$\overset{\text{vi.}}{\text{Ꞙe}_2Cl_6} \qquad \overset{\text{vi.}}{Ꞓ_2Cl_6}.$$

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

$$\text{Ꞙe}_2$$

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 $\overset{\text{vi.}}{\text{Ⱥl}_2} = 54$, 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—

$$\text{Ꞙe}Cl_3=2 \text{ volumes.}$$
$$\text{Ⱥl}Cl_3=2 \text{ volumes.}$$

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* *Comptes Rendus*, vol. liii., p. 653.

† *Bulletin de la Société Chimique*, vol. v. p. 202.

‡ With the reservations expressed (p. 751), since the tetrachloride, FeCl4, 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 $Fe_2\Theta$ and $fe_2\Theta$. 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, $\overset{\text{vi.}}{Nb_2}$, 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—

$$\mathrm{Cu}_2 \quad \mathrm{Hg}_2.$$

are diatomic. The cuprous and mercurous chlorides are then represented by the formulæ—

$$\mathrm{Cu_2Cl_2} \text{ and } \mathrm{Hg_2Cl_2}.$$

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 $\mathrm{Hg_2Cl_2}$. 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 $\mathrm{Cu_2S}$ of cuprous sulphide harmonises with the well-known fact of the isomorphism of this sulphide with sulphide of silver—

$$\mathrm{Ag_2S}.$$

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—

$$\mathrm{HgCl}.$$

The density of the vapour calculated according to the formula—

$$\mathrm{Hg_2Cl_2} = 16{\cdot}308.$$

* 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 20.

MISCELLANEOUS.

University of London.—The following are lists of candidates who passed the respective examinations incated:—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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