The Pharmaceutical Soc. of Great Britain
HARPENDA MALETUDINIS RATIO

LIBRARY

OF

The Pharmaceutical Society of Great Britain.

REGULATIONS

FOR

THE CIRCULATION OF BOOKS.

1. The Library shall be open from NINE until SIX o'clock daily. Saturdays from NINE until THREE o'clock.

2. Members of the Society, whether residing in London or the country,* may obtain books on making personal or written application for them; but no Member shall have more than two volumes at a time, nor shall he keep any book for a longer period than fourteen days. But when a book is returned by a Member it may be borrowed by him again, provided it has not been bespoken by any other Member. Books which have been bespoken shall circulate in rotation according to priority of application.

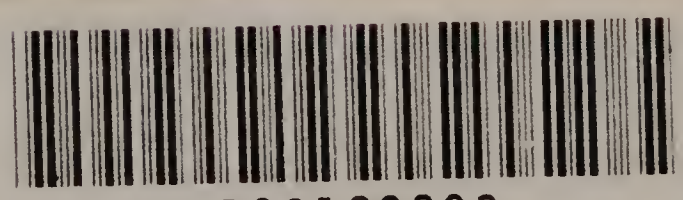
3. Associates, Apprentices, and Students of the Society may obtain books on presenting an order from a Member, who shall in all cases be responsible for their safe keeping and return. A form of order may be obtained on application.

4. The scientific journals shall not be circulated until the expiration of the month of publication. Works containing valuable plates, and a few standard works of reference, which are distinguished in the Catalogue by a mark (*), shall not be circulated.

5. If any book be retained by a Member for one month, and be not returned after written application has been made for it, the Council may order it to be replaced, and charge the Member in default with the amount thus incurred. If any book, when returned by a Member, is found to have been damaged during the period such Member has had it, a fine equivalent to the injury shall be paid by the Member.

6. The Library shall be closed during the first fortnight in September, to admit of the examination of the books.

* Country Members, etc., must bear the expense of carriage of books.



22102180803

PHARMACEUTICAL SOCIETY
CANCELLED
OF GREAT BRITAIN

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., &c.

VOLUME XXIV.—1871.

LONDON:
HENRY GILLMAN, BOY COURT, LUDGATE HILL, E.C.
AND SOLD BY ALL BOOKSELLERS.

MDCCCLXXI.

3706

LONDON:

PRINTED BY WILLIAM CROOKES, CHEMICAL NEWS OFFICE,

BOY COURT, LUDGATE HILL, E.C.

WELLCOME INSTITUTE LIBRARY

Coll. welMOmec

Call No.

THE CHEMICAL NEWS.

VOLUME XXIV.

EDITED BY WILLIAM CROOKES, F.R.S., &c.

No. 606.—FRIDAY, JULY 7, 1871.

ON THE GASEOUS AND LIQUID STATES OF MATTER.*

By THOMAS ANDREWS, M.D., F.R.S.,
Vice-President of Queen's College, Belfast.

The liquid state of matter forms a link between the solid and gaseous states. This link is, however, often suppressed, and the solid passes directly into the gaseous or vaporous form. In the intense cold of an Arctic winter hard ice will gradually change into transparent vapour without previously assuming the form of water. Carbonic acid snow passes rapidly into gas when exposed to the air, and can with difficulty be liquefied in open tubes. Its boiling-point, as Faraday has shown, presents the apparent anomaly of being lower in the thermometric scale than its melting-point; a statement less paradoxical than it may at first appear, if we remember that water can exist as vapour at temperatures far lower than those at which it can exist as liquid. Whether the transition be directly from solid to gaseous, or from solid to liquid, and from liquid to gaseous, a marked change of physical properties occurs at each step or break, and heat is absorbed, as was proved long ago by Black, without producing elevation of temperature. Many solids and liquids will for this reason maintain a low temperature, even when surrounded by a white-hot atmosphere, and the remarkable experiment of solidifying water, and even mercury, on a red-hot plate, finds thus an easy explanation. The term spheroidal state, when applied to water floating on a cushion of vapour over a red-hot plate, is, however, apt to mislead. The water is not here in any peculiar state. It is simply water evaporating rapidly at a few degrees below its boiling-point, and all its properties, even those of capillarity, are the properties of ordinary water at 96·5° C. The interesting phenomena exhibited under these conditions are due to other causes, and not to any new or peculiar state of the liquid itself. The fine researches of Dalton upon vapours, and the memorable discovery by Faraday of the liquefaction of gases by pressure alone, finished the work which Black had begun. Our knowledge of the conditions under which matter passes abruptly from the gaseous to the liquid, and from the liquid to the solid state, may now be regarded as almost complete.

In 1822, Cagniard de La Tour made some remarkable experiments, which still bear his name, and may be regarded as the starting-point of the investigations which form the chief subject of this address. Cagniard de La Tour's first experiments were made in a small Papin's digester, constructed from the thick end of a gun-barrel, into which he introduced a little alcohol and also a small quartz ball, and firmly closed the whole. On heating the gun-barrel with its contents over an open fire, and observing from time to time the sound produced by the ball when the apparatus was shaken, he inferred that after a certain temperature was attained the liquid had disappeared. He afterwards succeeded in repeating the experiment in glass tubes, and obtained the following results:—An hermetically-sealed glass tube, containing sufficient alcohol to occupy two-fifths of its capacity, was gradually heated, when the liquid was seen to dilate, and its mobility at the same time to become gradually greater. After attaining to nearly twice its original volume, the liquid completely disappeared, and was converted into a vapour so transparent that the tube appeared to be quite empty. On allowing the tube to cool, a very thick cloud was formed, after which the liquid reappeared in its former state.

It is singular that in this otherwise accurate description, Cagniard de La Tour should have overlooked the most remarkable appearance of all, the moving or flickering striæ, which fill the tube when, after heating it considerably, the temperature is quickly lowered. This phenomenon was first described by myself in 1863, as it it is seen in carbonic acid, which has been partially liquefied by pressure, and afterwards heated a little above 31°. It may be observed on a larger scale and to great advantage by heating such liquids as sulphurous acid or ether in hermetically-sealed tubes.

The experiments whose results I am about to describe have occupied me for a period of fully ten years; they involved the construction of novel forms of apparatus, in which the properties of matter might be studied under varied conditions of temperature and pressure, such as had never been realised before. In my earlier attempts I endeavoured, as others had already done, to use the expansive force of the mixed gases which are disengaged in the electrolysis of water; and I was able in this way to obtain pressures of 150 atmospheres and even more in glass tubes; but the method was in many respects defective, and more than one dangerous explosion occurred, so that I eventually abandoned it.

In the apparatus finally adopted, the gas to be compressed is enclosed in a long glass tube, of which the greater part of the length, or about 450 millimetres, has a capillary bore, and the remainder, about 150 millimetres, an internal diameter of 2 millimetres. The free capillary end is sealed, while the gas in a pure and dry state is passing through; while at the other end the gas is confined by a movable column of mercury. The details of the method by which this is accomplished will be found in the Bakerian lecture for 1869, to which I must also refer for an account of the process by which the original volume of the gas at the freezing-point of water, and under one atmosphere of pressure was determined, and also the volumes of the same gas deduced from the observed measurements when it was compressed at different pressures in the capillary tube.

A conical protuberance on the capillary part of the tube, a little above its junction with the wider part, corresponded as nearly as possible with a hollow cone in a stout brass flange, the joint being rendered perfectly tight by careful packing. The body of the apparatus consisted of two

* Read before the Royal Institution of Great Britain, June 2, 1871.

cold-drawn copper tubes of great strength, to the ends of which four massive brass flanges were firmly attached. Two corresponding flanges or end pieces, each carrying a fine steel screw packed with great care, were bolted on the lower flanges. The success of the experiments depended greatly on the packing of this screw. It was effected by means of a number of leather washers, tightly pressed down and saturated *in vacuo* with melted lard. The apparatus was now filled with water; the flanges with the glass tubes, one containing the gas to be examined, the other air or hydrogen to act as a manometer or measure of the pressure, were bolted down upon the upper flanges of the copper tubes. The joints had always leather washers interposed; and when sufficiently tightened, they resisted any pressure which could be applied, even for an indefinite time. The two copper tubes were connected by a fine horizontal tube, so that the whole of the interior of the apparatus was in free communication. The pressure was obtained by screwing one or other of the steel screws into the water. I have recently had the apparatus constructed of iron and filled with mercury. As mercury is much less compressible than water, the same length of screw produces a greater pressure on the interior of the apparatus, even with a larger cavity. There are other advantages in this form of the apparatus which I hope will facilitate future research. The objection to it is its extreme sensitiveness to changes of temperature, so that a variation of $\frac{1}{100}$th of a degree alters the internal pressure by several atmospheres.

In the actual experiments the gas under examination does not come into view till it has entered the capillary tube, and is exposed to a pressure of thirty or forty atmospheres. The limit of the pressure which can be obtained has hitherto been the capacity of resistance of the glass tubes to bursting. Fine thermometer glass tubes of white glass will frequently burst when exposed to a pressure of little more than 100 atmospheres; but green glass tubes of good quality are much stronger, and will easily bear a pressure of 300 atmospheres. One of the strongest forms of glass capillary tube for resisting internal pressure is obtained by drawing out a thick green glass tube, heated to softening, till it becomes so fine as to be flexible. Tubes of this kind can easily be drawn out at the blowpipe table, and obtained of very uniform bore. I have compressed air in such tubes to $\frac{1}{400}$th of its ordinary volume without bursting the tubes.

Two rectangular brass cases, closed before and behind with plate-glass, surround, one the manometer, and the other the tube containing the gas to be examined, and allow them to be maintained at any required temperature by the flow of a stream of water. The manometer was maintained as nearly as possible at the temperature of the apartment; the tube containing the gas, on the contrary, was maintained at different temperatures, according to the object in view. The following observations, published in 1863, contain the results of my earliest experiments on this subject:—"On partially liquefying carbonic acid by pressure alone, and gradually raising the temperature at the same time to 88° F., the surface of demarcation between the liquid and gas becomes fainter, loses its curvature, and at last disappears. The space is then occupied by a homogeneous fluid, which exhibits when the pressure is suddenly diminished or the temperature slightly lowered, a peculiar appearance of moving or flickering striæ throughout its entire mass. At temperatures above 88° no apparent liquefaction, or separation into two distinct forms of matter could be effected, even when a pressure of 300 or 400 atmospheres was applied. Nitrous oxide gave analogous results."

The flickering striæ referred to can be admirably shown, as I mentioned before, in hermetically sealed tubes of strong glass, partially filled with such liquids as sulphurous acid or ether. The liquid must in the first instance be heated a few degrees above what I have designated the "critical" point. The appearances exhibited by the ascending and descending sheets of matter of unequal density are most remarkable, but must be seen in order to be understood. They only occur in this striking form in fluids heated a little above the critical point, and are produced by the great changes of density which slight variations of pressure or temperature produce in this case. They are always a clear proof that the matter in the tube is homogeneous, and that we have not liquid and gas in presence of one another. These striæ are, in short, only an extraordinary development of the movements seen in ordinary liquids and gases when they are heated from below. The experiments to be immediately described will explain their great intensity above the critical point.

When the temperature falls below the critical point, the formation of a cloud indicates that we have now heterogeneous matter in the tube, fine drops of liquid in presence of a gas. We must take care, however, not to suppose that a cloud *necessarily* precedes the formation of true liquid. If the pressure be sufficiently great no cloud of any kind will form.

I now proceed to describe the general results of the experiments upon carbonic acid. If a certain volume of carbonic acid at the temperature of 13·1° and under a pressure of one atmosphere be exposed to a gradually-increasing pressure, its volume will steadily diminish, but at a faster rate than according to Boyle's law, till at the pressure of 48·9 atmospheres its volume is reduced to about $\frac{1}{81}$ of the original volume at one atmosphere. Liquefaction now begins and continues with very slight augmentation of pressure, the necessity for which I traced to the presence of a minute quantity of air (about $\frac{1}{500}$th part) in the carbonic acid. On augmenting the pressure after liquefaction, the volume slowly diminished, but at a much faster rate than in the case of ordinary liquids. Later experiments carried to much higher pressures have fully confirmed this result. At 21·5° similar results were obtained, but a pressure of nearly 60 atmospheres was required before liquefaction began.

At 30·9° C., or 87·7° F., the critical point of temperature is reached. It is the temperature at which liquid ceases to be formed under any pressure. At a temperature a little below this point the surface of separation between liquid and gas becomes very faint and loses its curvature, the density and other physical properties of the liquid and gas being now identical and the tube filled with homogeneous matter. If the temperature and pressure be kept steady, no evidence of heterogeneity will be obtained by optical tests under the most varied conditions of volume.

If we now follow the course of a given volume of carbonic acid gas at 31·1°, or 0·2° above the critical point, we shall find that its course resembles that of the gas at lower temperatures till the volume is reached at which liquefaction might be expected to begin. A rapid but not (as in the case of the formation of liquid) abrupt fall then supervenes, after which the carbonic acid undergoes a slow diminution of volume as the pressure augments. The curves, which are here exhibited as they were represented in the Bakerian lecture, illustrate very clearly these statements. We have thus carbonic acid at 0·2° above the critical point, and at a pressure of 73 atmospheres behaving very nearly as if it liquefied. At this pressure an augmentation of only $\frac{1}{37}$th of the entire pressure diminishes the volume of the carbonic acid to about one-half. Yet during the whole of this fall, no evidence of heterogeneity, or of two states of matter present together in the tube, could at any period be obtained. Carbonic acid at this temperature of 31·1°, and under a pressure of 75 atmospheres, behaves much more as a liquid than as a gas when the pressure is either augmented or diminished; yet it never exhibits under any conditions the characteristic properties of the liquid state; that is to say, no surface of separation is formed by change of pressure, nor will it collect into drops and form a cloud.

At 32·5° the fall, when liquefaction might be expected, is less abrupt than at 31·1°; and at 35·5°, although still manifest, it is further reduced. At 48·1° the fall shown at

lower temperatures can no longer be distinctly observed, and the curve representing the change of volume approximates to that of a perfect gas. There can be little, if any, doubt that at a higher temperature carbonic acid would behave under augmenting pressures nearly as nitrogen or hydrogen.*

I have frequently exposed carbonic acid, without making precise measurements, to much higher pressures than any of the foregoing, and have made it pass without break or interruption from what is regarded by every one as the gaseous state, to what is, in like manner, universally regarded as the liquid state. Take, for example, a given volume of carbonic acid gas at 50° C., or at a higher temperature, and expose it to increasing pressure till 150 atmospheres have been reached. In this process its volume will steadily diminish as the pressure augments, and no sudden diminution of volume, without the application of external pressure, will occur at any stage of it. When the full pressure has been applied, let the temperature be allowed to fall till the carbonic acid has reached the ordinary temperature of the atmosphere. During the whole of this operation no breach of continuity has occurred. It begins with a gas, and by a series of gradual changes, presenting nowhere any abrupt alteration of volume or sudden evolution of heat, it ends with a liquid. The closest observation fails to discover anywhere indications of a change of condition in the carbonic acid, or evidence, at any period of the process, of part of it being in one physical state and part in another. That the gas has actually changed into a liquid would, indeed, never have been suspected, had it not shown itself to be so changed by entering into ebullition on the removal of the pressure. For convenience, this process has been divided into two stages, the compression of the carbonic acid and its subsequent cooling; but these operations might have been performed simultaneously, if care were taken so to arrange the application of the pressure and the rate of cooling that the pressure should not be less than 76 atmospheres when the carbonic acid had cooled to 31°.

We are now prepared for the consideration of the following important question. What is the condition of carbonic acid when it passes, at temperatures above 31°, from the gaseous state down to the volume of the liquid, without giving evidence at any part of the process of liquefaction having occurred? Does it continue in the gaseous state, or does it liquefy, or have we to deal with a new condition of matter? If the experiment were made at 100°, or at a higher temperature, when all indications of a fall had disappeared, the probable answer which would be given to this question is that the gas preserves its gaseous condition during the compression; and few would hesitate to declare this statement to be true, if the pressure were applied to such gases as hydrogen or nitrogen. On the other hand, when the experiment is made with carbonic acid at temperatures a little above 31°, the great fall which occurs at one period of the process would lead to the conjecture that liquefaction had actually taken place, although optical tests carefully applied failed at any time to discover the presence of a liquid in contact with gas. But against this view it may be urged with great force, that the fact of additional pressure being always required for a further diminution of volume is opposed to the known laws which hold in the change of bodies from the gaseous to the liquid state. Besides, the higher the temperature at which the gas is compressed, the less the fall becomes, and at last it disappears.

The answer to the foregoing question, according to what appears to me to be the true interpretation of the experiments already described, is to be found in the close and intimate relations which subsist between the gaseous and liquid states of matter. The ordinary gaseous and ordinary liquid states are, in short, only widely separated forms of the same condition of matter, and may be made to pass into one another by a series of gradations so gentle that the passage shall nowhere present any interruption or breach of continuity. From carbonic acid as a perfect gas to carbonic acid as a perfect liquid, the transition we have seen may be accomplished by a continuous process, and the gas and liquid are only distant stages of a long series of continuous physical changes. Under certain conditions of temperature and pressure, carbonic acid finds itself, it is true, in what may be described as a state of instability, and suddenly passes, with evolution of heat and without application of additional pressure or change of temperature, to the volume, which by the continuous process can only be reached through a long and circuitous route. In the abrupt change which here occurs, a marked difference is exhibited, while the process is going on, in the optical and other physical properties of the carbonic acid which has collapsed into the smaller volume, and of the carbonic acid not yet altered. There is no difficulty here, therefore, in distinguishing between the liquid and the gas. But in other cases the distinction cannot be made; and under many of the conditions I have described it would be vain to attempt to assign carbonic acid to the liquid rather than the gaseous state. Carbonic acid, at the temperature of 35·5°, and under a pressure of 108 atmospheres, is reduced to $\frac{1}{430}$ of the volume it occupied under a pressure of one atmosphere; but if anyone ask whether it is now in the gaseous or liquid state, the question does not, I believe, admit of a positive reply. Carbonic acid at 35·5°, and under 108 atmospheres of pressure, stands nearly midway between the gas and liquid; and we have no valid grounds for assigning it to the one form of matter any more than to the other. The same observation would apply with even greater force to the state in which carbonic acid exists at higher temperatures and under greater pressures than those just mentioned. In short, the passage under great pressures from the liquid to the gaseous state may be effected by the application of heat without break or breach of continuity. That a marked change in the physical properties of the substance occurs during this process is no objection to its being continuous. If mercury as a liquid is opaque and as a gas is transparent, the red and translucent bromine, on the other hand, when heated above the critical point, becomes so opaque as almost to resemble a mass of resin. Frankland has shown that the flame of hydrogen becomes continuous when the

* These different modes of passing from the gaseous to the liquid state are admirably illustrated by a solid model constructed by Prof. J. Thomson, which was exhibited at the lecture. I have been favoured by Prof. Thomson with the following description of this model:—

"The model combines Dr. Andrews's experimental results in a manner tending to show clearly their mutual correlation. It consists of a curved surface referred to three axes of rectangular co-ordinates, and formed so that the three co-ordinates of each point in the curved surface represent, for any given mass of carbonic acid, a pressure, a temperature, and a volume, which can co-exist in that mass.

"In Dr. Andrews's diagram of curves, published in his paper in the "Transactions of the Royal Society for 1869," p. 583, the experimental results, for each of several temperatures experimented on, are combined in the form of a plane curved line referred to two axes of rectangular co-ordinates. The curved surface in the model is obtained by placing these curved lines with their planes parallel to one another, and separated by intervals proportional to the differences of the temperatures to which the curves severally belong, and with the origins of co-ordinates of the curves situated in a straight line perpendicular to their planes, and with the axes of co-ordinates of all of them parallel in pairs to one another, and by cutting the curved surface out so as to pass through those curved lines smoothly or evenly.

"The curved surface so obtained exhibits in a very obvious way the remarkable phenomena of the voluminal conditions at and near the critical point of temperature and pressure in comparison with the voluminal conditions throughout other parts of the indefinite range of gradually varying temperatares and pressures. This curved surface also helps to afford a clear view of the nature and meaning of the continuity of the liquid and gaseous states of matter. It does so by its own obvious continuity throughout the expanse to which it might be extended round the outside of the critical point in receding from the range of the points of pressure and temperature where an abrupt change of volume can occur by gasification or condensation. On the curved surface in the model, Dr. Andrews's curves for the temperatures 13·1°, 21·5°, 31·1°, 35·5°, and 48·1° centigrade, from which it was constructed, are shown drawn in their proper places. The model admits of easily exhibiting in due relation to one another a second set of curves in which each curve would be for a constant pressure, and in which the co-ordinates would represent temperatures and corresponding volumes. It serves generally as an aid towards bringing the whole subject clearly before the mind."

gas is burned under a pressure of 20 atmospheres, and these experiments have been since extended by the same able chemist and Lockyer. We must not, however, suppose that one intermediate state exists between liquid and gas; on the contrary, an infinite succession of intermediate states may truly be said to connect the liquid proper and the gas proper; in other words, the passage is continuous. When the critical point is attained, the density of the liquid and gas becomes the same, and the tube is filled with homogeneous matter.

As regards the question of the continuity of the solid and liquid states, it would be necessary, in order to establish this continuity, to obtain, by the combined action of heat and pressure, the solid and liquid of the same density and of like physical properties. To accomplish this result will probably require pressures far beyond any which can be reached in transparent tubes; but it may be possible to show by experiment that the solid and liquid can be made to approach to the required conditions.

ON A LAW IN CHEMICAL DYNAMICS.*

By JOHN HALL GLADSTONE, Ph.D., F.R.S., and ALFRED TRIBE, F.C.S.

It is well known that one metal has the power of decomposing the salts of certain other metals, and that the chemical change will proceed until the more powerful metal has entirely taken the place of the other. The authors have investigated what takes place during the process.

The experiments were generally performed as follows:—72 c.c. of an aqueous solution of the salt of known strength, and at 12° C., were placed in a tall glass; a perfectly clean plate of metal of 3230 square millimetres was weighed and placed vertically in this solution without reaching either to the top or bottom; the action was allowed to proceed quietly for ten minutes, when the plate was removed, and the deposited metal was washed off. The loss of weight gave the amount of metal dissolved, and represented the chemical action.

The most complete series of results was with copper and nitrate of silver.

Nitrate-of-silver solution.		Copper dissolved.			
Proportional number.	Percentage of salt.	Actual weights.	Average.	Theoretical.	Difference.
1.	0·3541	0·0045, 0·0050	0·00475	0·00455	+0·0002
2.	0·7083	0·0135, 0·0140	0·01375	0·01365	+0·0001
3.	1·0623	0·0240, 0·0250	0·02450	0·02590	−0·0014
4.	1·4166	0·0420	0·04200	0·04090	+0·0011
5.	1·7705	0·0600	0·06000	0·05830	+0·0017
6.	2·1246	0·0785	0·07850	0·07900	−0·0005
7.	2·4788	0·0975	0·09750	0·09940	−0·0019
8.	2·8332	0·1230, 0·1230	0·12300	0·12280	+0·0002
9.	3·1873	0·1510, 0·1480	0·14950	0·14810	+0·0014
10.	3·5415	0·1680, 0·1670	0·16750	0·17490	−0·0074
11.	3·8956	0·1955	0·19550	0·20350	−0·0080
12.	4·2497	0·2170, 0·2285, 0·2310, 0·2200	0·22410	0·23360	−0·0095
14.	4·9580	0·2740	0·27400	0·29820	−0·0242
16.	5·6664	0·3270	0·32700		
20.	7·0830	0·4540, 0·4100	0·43200		
24.	8·4994	0·5400	0·54000		
30.	10·6240	0·6850	0·68500		
32.	11·3330	0·7100	0·71000		
40.	14·1660	0·8440, 0·9090	0·87650		
48.	16·9990	1·0690	1·06900		
60.	21·2460	1·3590	1·35900		
70.	24·7880	1·5800	1·58000		

In the earlier terms of this series, *twice the percentage of silver-salt gives three times the chemical action.* The close agreement of the observed numbers with those calculated on this supposition as far as the 9th term, is shown in the fifth and sixth columns. The law then breaks down, and after about 7 per cent the increased action is almost in direct ratio with the increased strength.

The position of the plate in the solution was found to make no difference to this 2-3 law.

Similar series of experiments were made with zinc and chloride of copper, zinc and sulphate of copper, zinc and nitrate of lead, iron and sulphate of copper, and other combinations; and in every instance where the solution was weak and the action simple, the law of three times the chemical change for twice the strength was found to hold good.

It was proved that the breaking down of the law at about 3·5 per cent of salt in solution was irrespective of the quantity of the liquid, or of the time for which the plate was exposed. With 72 c.c. of a 1·41 per cent solution of nitrate of silver the rate of action remained sensibly the same for as long as twenty-five minutes, notwithstanding the constant deposition of silver. This apparently paradoxical result is due to fresh relays of the original solution being brought up to the plate by the currents produced, and that period of time elapsing before any of the products of decomposition are brought back again in their circuit.

When it was perceived that within easily ascertainable limits the chemical action is the same for similar consecutive periods of time, experiments were made in far weaker solutions. It was only necessary to lengthen the time of exposure. It was thus found that the law of three times the chemical action for twice the strength of solution holds good though at least eleven terms of the powers of two; in fact, from a solution that could dissolve 1 grm. of copper during the hour, to a solution that dissolved only 0·000001 grms., a million times less.

The manner in which the silver is deposited on a copper plate was examined, and the currents produced were studied. At first a light blue current is perceived flowing upwards from the surface of the plate, presently a deep blue current pours downwards, and these two currents in opposite directions continue to form simultaneously. A similar phenomenon was observed in every case where a metallic salt attacked a plate of another metal. The downward current was found to be a solution of almost pure nitrate of copper, containing about three times as much NO_3 as the original silver solution, while the upward current was a diluted solution of the mixed nitrates. Moreover, the heavy currrent took its rise in the entangled mass of crystals right against the plate, while the light current flowed from the tops of the crystalline branches. It was evident that when the fresh silver was deposited on these branches, and the fresh copper taken up from the plate, there was not merely a transference of the nitric element from one combination to another, but an actual molecular move of it towards the copper plate, producing an accumulation of nitrate of copper there, and a corresponding loss of salt in the liquid that is drawn within the influence of the branching crystals. Hence the opposite currents.

The amount of action in a circuit of two metals and a saline solution must have as one of its regulating conditions the conducting-power of that solution. It appeared by experiment that a strong solution of nitrate of silver offers less resistance than a weak one; and it was also found, on adding nitrate of potassium to the nitrate of silver, and its power of attacking the copper plate was increased; that the augmentation of the foreign salt increased the action still further; and the 2-3 law holds good between two solutions in which both the silver and potassium salt are doubled, though it does not hold good if the quantity of foreign salt be kept constant. Similar results were obtained with mixed nitrates of silver and copper.

While these later experiments offer an explanation of the fact that a solution of double the strength produces more than double the chemical action, they do not explain

* Abstract of a paper read before the Royal Society, June 15, 1871.

why it should produce exactly three times the effect, or why the ratio should be the same in all substitutions of this nature hitherto tried. The simplicity and wide range of the 2-3 law seem to indicate that it is a very primary one in chemical dynamics.

ON THE

DETERMINATION OF AVAILABLE CHLORINE IN BLEACHING POWDER.

By GEORGE LUNGE, Ph.D., F.C.S.

In the last issue of the Chemical News there is, reprinted from the *American Chemist*, a paper by Mr. Herreshoff, describing a new method for the determination of available chlorine in bleaching powder. This method is founded on the well-known reaction between potassium bichromate and stannous chloride. I have nothing to say against its principle, and it may very likely yield accurate results in practice. But it must suffer under the disadvantage common to all volumetric methods based upon the application of stannous chloride, viz., the change which the solution of the latter undergoes so rapidly that it requires to be re-standardised for every new series of tests. This alone would be a drawback to the general introduction of Mr. Herreshoff's plan, but apart from it, the *raison d'être* which its author gives for the new method, and without which it does not seem to be called for at all, is, in my opinion, contrary to facts. He finds "the methods now in general use inconvenient, and, unless executed with the utmost care, liable to much inaccuracy," and he alleges against Penot's arsenic method (the only one he quotes, and certainly the best) several disadvantages. Now this method, as modified by Mohr, is so extremely easy of execution, quick and accurate that I believe most chemists will require strong reasons for inducing them to give it up for Herreshoff's or any other method. The disadvantages, however, which Mr. Herreshoff enumerates do not at all exist in fact, as I shall prove *seriatim*.

He says: "arsenious acid is with difficulty purified, and there is no convenient method by which to test its purity." It is, perhaps, not very pleasant work to re-sublime arsenic, but not at all difficult; besides, it can be easily avoided; at least I have never experienced any difficulty whatever in obtaining perfectly pure arsenious acid from the dealers in pure chemicals. Nothing, again, is more convenient than to test for its purity; heat (of course under a protecting hood) a little of the arsenic in a porcelain capsule, covered with another, and remove the second capsule when a little sublimate has been formed. If this sublimate shows no reddish tint, but is of a pure white, there are no sulphides in the arsenic, as they are more volatile than the arsenious acid, and sublime first. Then continue to heat till all arsenic is volatilised, and convince yourself that no fixed residue is left.

He says, further: "The standard solution of sodic arsenite is tedious to prepare, from the fact that it requires a long time for complete solution of the required amount of arsenic in sodic carbonate solution." This I do not understand at all. If the arsenic is finely pulverised, and if the quantities of sodium carbonate and water as prescribed in the usual text-books (say Fresenius or Mohr) are employed, I have always found that a few minutes after the liquid was fully boiling the arsenic was completely dissolved. It need then only be left to cool, and filled up to the required volume, and the standard solution is ready.

Lastly: "This solution will not keep with certainty for any length of time, and is newly standardised only with difficulty." It is well-known that Mohr has found out the cause of the arsenite solution sometimes becoming oxidised, viz., the presence of oxidisable sulphur compounds in the arsenic or the sodium carbonate employed. If such are avoided, and nothing is easier, then the arsenite solution keeps good for years. Mohr mentions that he found it unchanged after four years. I, for my part, have never had an opportunity of trying it for such a long period, as my stock of solution never lasted more than a few months at a time, but for some time I made a regular practice of testing the very last portion of the standard solution, which was kept in a large sized bottle, standing with its mouth upwards, and exposed to the light, and I never found the standard in the least changed. Nor can I see any trouble in re-standardising. I do it by means of iodine solution which has been first standardised itself with a small quantity of pure arsenic. I prefer, in opposition to Mr. Herreshoff, to run the arsenite solution into the iodine solution, as this more nearly corresponds to the operation in actual bleaching powder testings. In these the end of the reaction is tried on a piece of filtering paper moistened with a solution of starch containing a little potassium iodide. I find that the brown spots produced by the testing vanish again in a day or so, and the same paper, spread on a large porcelain crucible cover and kept from dust, lasts scores of times over again.

These are all the objections Mr. Herreshoff makes against Penot-Mohr's method, and I think they all fall to the ground. So far this method must be considered not only one of the best, but also the easiest and simplest for bleaching powder estimations.

ON COLOURS FROM COAL-TAR.*

By HARRY N. DRAPER, F.G.S.

(Continued from vol. xxiii., p. 308).

Now the quantity of crimson dye which is given by coal is, if we consider the question of weight only, by no means large. Here is a block of coal, which weighs 100 lbs., and here in succession are the quantities of tar, naphtha, benzol, nitrobenzol, aniline, and magenta which the 100 lbs. of coal give. See how sudden is the transition; notice how absurdly insignificant seems the quantity of magenta given by this large mass of coal. This smallness of quantity is, however, compensated to a great extent by the marvellous intensity of the colour. I think I can give you some idea of this. You will see, in the first place, that the quantity of wool which the magenta in this bottle will dye is nearly as large as that of the coal itself. But there is a very simple way of illustrating this in a striking manner. Here are two sheets of paper. One of them has been dusted over with some magenta, in fine powder, and the other with mauve. The colour-giving substances are there, but, at least to those of you who are at a distance, they are scarcely visible. But if we direct a stream of alcohol against the paper, you will see the latent colour develope itself in a very beautiful manner.

This experiment may be varied in a charming manner. Here you have a bouquet of apparently white flowers, on which I, before the lecture, dusted some of these dyes. On projecting a stream of alcohol upon them you will see, however, that they assume tints which, though I cannot say of them that each is exactly appropriate to the flower on which it appears, are at least sufficiently pretty.

In making magenta on the large scale which I have mentioned, there are large quantities of residuary products; and as it is important that these should be made as profitable as possible, they have been, of course, examined by the manufacturer. One result of this has been the discovery of the very beautiful orange colour which we have here, and though it is known in commerce as *phosphine*, chemists will recognise it better as a salt of chrysaniline.

This dye cannot be made at will, but is invariably formed in making magenta, and is separated during its purification. It gives, as you see, a very beautiful yellow orange tint, and is much used to produce scarlets, by first dyeing the

* A lecture delivered before the Royal Dublin Society.

silk or wool in magenta, and then passing it through a bath of phosphine.

Here is also a brown, which is one of these residual colours.

I spoke just now of magenta as being a raw material from which other dyes were produced, and we will now proceed to examine some of the means by which it is made to give blues and violets, and even greens. The most important process for making blues is that in which the magenta is heated with a further quantity of aniline. The process takes some time, and the mixture, which first becomes purple, changes finally to a very beautiful blue. This is what is known as "*bleu de Lyon.*" It is, unfortunately, not soluble in water, and several methods have been adopted to make it so. The one most usually employed is exactly like that which is used with indigo for the same purpose, namely, treatment with sulphuric acid. A sulpho-acid is formed, and the result is a blue completely soluble in water. Here is a solution of this blue, the tint of which is very beautiful.

But, perhaps, the most interesting of the aniline blues is that called "Nicholson's blue." I cannot tell you how this is prepared, as the process has not been made the subject of a patent, but I can show you the blue itself. It is perfectly soluble in water, and what is most curious is, that, like salts of rosaniline, it is almost completely decolourised by alkalies. I have here an alkaline solution of this colouring matter which has been prepared before the lecture, and we will immerse this skein of silk in it, and then wash it well with water. If, now, we put the silk into water containing a little sulphuric acid, you will see the blue developed at once. This process of dyeing blue is now very extensively employed.

The fact that the combination of aniline with magenta gave rise to violets and blues, led Dr. Hofmann to suppose that other bodies might supply the place of the aniline. He found that this was actually the case, and that the bodies known to chemists as iodide of ethyl and iodide of methyl could be substituted for aniline with most successful results. This discovery has given rise to an entirely new series of colours, known in trade as "Hofmann's." The iodide of ethyl, or of methyl, is heated with the magenta, just as in the case of the aniline, and this beautiful violet is the first result. The tint obtained much depends upon the quantity of iodide used; becoming bluer, and even greener, as it is in excess. Perhaps the most interesting point in this process is, however, that if the quantity of iodide of ethyl is properly proportioned, a most beautiful green is the result. Here we have it in solution, and here is paper dyed in it. I think this is one of the most beautiful and most natural colours in the whole coal-tar series, though, where all are so beautiful, it is difficult to assign the place of honour to any one. The great advantage of this green is that it is at least as beautiful a colour by gaslight as by daylight. But it has the most remarkable property of being changed by exposure to heat. It differs, as I said, from the violent dyes only in containing more iodide of ethyl than they do. But this excess of iodide can be removed by heat; and if we pass this piece of paper, which has some of the green dye on it, over the flame of the lamp you will see an almost immediate change to violet. The degree of heat required is so near to that which chars the paper that I do not think this need be alarming to ladies who sit too near the fire. It might, however, be made the means of securing a charming variety in costume.

When I tell you that from the final residuum from these manufactures, when all the colour has been got out, especially from Dale's process for making violet, a very intense black is obtained, you will have formed some idea of the capability of aniline as a dye-producing material. This black is used largely in the manufacture of printing ink.

But we must now pass to the consideration of some of the other coal-tar constituents which produce colour, and I regret that our time is so short that we cannot speak of them, except in the briefest manner. The first of these which we shall notice is *phenol*. Here is a beautiful specimen of this body, which I owe to the kindness of Dr. Calvert of Manchester, who is the manufacturer of it in all the forms in which we find it in common. To you it is perhaps more familiar as *carbolic acid*, and its use as a disinfectant and as a remedy for toothache are sufficiently well known. We have only now to consider it as a producer of colour. At the beginning of this lecture I showed you the colour produced by phenol itself when a solution of chloride of iron is added to it. Had we time for the experiments we should find that this colour-giving property is shared by almost every compound of this body. One of the most interesting of these is *rosolic acid*. This body is procured by heating phenol with a mixture of sulphuric and oxalic acids. In commerce it is known as *aurine*. You see it here, in a fine specimen which Dr. Calvert has sent me, as a resinous mass having a greenish metallic lustre. When this substance is heated with ammonia it forms a very intensely coloured compound, which you will see produced when we add ammonia to the powdered acid in this dish. Aurine is used for dyeing this orange tint on silk, of which we have a specimen here. But if instead of merely adding the ammonia it is heated with rosolic acid in a closed vessel under pressure, there is found a new substance known as *peonine*, which was lately very extensively, and is still, I believe, to some extent, used as a dye for woollens. I ought here to mention that this dye has been said to have a specifically poisonous action, and to produce blistering where the fabrics dyed with it were worn next the skin. It is, however, easily recognised, Dr. Calvert tells me, by the bleaching action exercised on it by a solution of sulphurous acid. When peonine is heated with aniline, it is converted into the blue colour called "azuline," which at one time was manufactured on a very large scale, but has now been replaced by the blues I have already brought before you.

Then when phenol is heated with nitric acid a very violent action takes place, and the body called *carbazotic* or *picric* acid is produced. This body forms very beautiful crystals, and is much used in dyeing the beautiful yellow shade of which we have an example here, and also in giving green shades when combined with the blue colours. Picric acid, in its turn, gives with cyanide of potassium a crimson dye which, when converted into an ammonia salt, is identical with the beautiful colouring matter called *murexide*, a colour formerly obtained from animal sources.

Next we pass to *naphthaline*, a substance which is a positive trouble to gas manufacturers, and in choking up the mains becomes a fruitful source of that discontent which all of us express at one time or another in reference to our gas supply.

Naphthaline, too, has been made to give colours; and though I am passing over a subject which would afford material for at least an entire lecture, I can only call your attention to two colouring matters derived from it. One of these is called "Manchester yellow," and is much used in colouring soap; the other is a *naphthaline brown*. For specimens of both of these colours, I am indebted to the kindness of Messrs. Roberts, Dale, and Co., of Manchester, who are manufacturers of them.

One of the most cherished aims of those who have experimented on the products of the destructive distillation of coal has been the production from some of them of the colouring matter of *madder*. Some idea of the importance of this problem may be gathered from the fact that the total growth of this plant is estimated to amount to 47,500 tons, having a value of £2,150,000. England alone pays no less than £100,000 annually for the madder with which are produced the red, purple, and black printed calicoes for which she has become famous. All this money is paid to foreign countries, for England does not cultivate madder. But if we have not madder of our own, we possess coal, and every new use we can make of this becomes a new source of wealth. It is known that all the various tints, which, with different mordants, are given by madder,

are due to a substance called *alizarine*. Now it was discovered so recently as last year that this body, *anthracene*, which you see here as a coal product, and a specimen of which I hold in my hand, is capable, when treated in a suitable manner, of giving a colouring substance which is in every respect the same as the alizarine of madder. I regret exceedingly that we cannot now go into the details of this subject, but I introduce it to you notice because a lecture on the coloured derivatives of coal-tar would be wanting in the last and most interesting link which has been added to the subject were it to be altogether omitted.

I may, however, just say that this discovery is due to two German chemists, Messrs. Graebe and Liebermann, and that the manufacture of artificial alizarine is being carried on both by them in Germany, and by Mr. Perkin in England. Mr. Perkin has made a most important step on the industrial application of the discovery, for he has recently taken out a new patent in which is made a very important modification of the original process, which was too expensive to be of real commercial importance. It is interesting to find Mr. Perkin in 1856 the pioneer of the entire industry of the coal-tar colours, and now in 1870 intimately connected with that which will yet most probably prove to be the most important discovery which has yet been made in connection with it.

I may say, too, that at present there is a difficulty in the way of the application of this means of making alizarine, and this is the comparative scarcity of anthracene itself. Two thousand tons of coal give only 1 ton of anthracene; and until this quantity can be increased either by improved methods of operation, or until some other product of coal-tar—naphthaline, perhaps—can be converted into anthracene, the production of artificial alizarine will not attain to that commercial importance which is certainly in store for it.

I will now endeavour to show you how readily the dyes from coal-tar attach themselves to silk and wool, and thus illustrate experimentally the very simple process of dyeing with them. For silk and wools no mordants are used, as the affinity of these substances for the colours is very great.

Here are solutions of *magenta*, of *Hofmann's violet*, and of *picric acid*, and you see we have only to pass the skeins through them in order to dye them in a moment. But the colours do no possess this affinity for linen or cotton. I can show you this, I think. Here I have a pattern embroidered in silk on a cotton ground, and if we pass this through a solution of magenta you see it becomes uniformly coloured. But if we now leave it for a few minutes in dilute ammonia you will see that the dye is nearly removed from the linen, while the silk retains a beautifully deep tint.

You will naturally inquire how, then, the coal-tar dyes are applied to linen and cotton fabrics. Sometimes they are mordanted with tannin, which has the property of fixing the dye; but the usual plan is to print the colour in combination with white of egg—albumen—and then to coagulate the mixture by heat. Here is an egg which we have boiled hard, and if we put it into this warm solution of magenta, you will get a very good idea of the affinity of these colours for albumen. Now, you see it has become completely dyed. The consumption of albumen for this purpose is enormous, and is said to amount in one French province alone, where these dyeing and printing operations are carried on, to 300,000 pounds weight a year.

The coal-tar dyes have received many other applications besides those to dyeing and printing articles of wearing apparel. They have been employed to colour starch, and muslin stiffened with those starches looks very pretty indeed; they have been made the bases of printing and lithographic inks; are largely used in paper-staining; they are also employed in making coloured writing inks. Naphthaline yellow is used in giving a yellow tint to fancy soaps. Lastly, I may say that travellers have found rosaniline replacing rouge and henna on the cheeks and nails of Eastern ladies.

Before I leave a subject which has insensibly drawn me on much further than I intended, I must ask your attention to the beautiful bronze-like reflection which some of the aniline colours possess.

This appearance is common to all of them, to a greater or less extent; but I think the one which has it in the greatest intensity is the Hofmann violet.

Here is a large sheet of glass, over which we have spread some of this colour, which you see is of the most lovely purple by transmitted light, but reflects a tint like that of some varieties of tropical beetles, or the tail-feathers of the peacock. This fact has of course not escaped attention, and has been used in the decoration of several kinds of leather goods, of straw hats, and even of articles made of iron and steel. It is interesting to notice that the reflected colour is exactly the complementary of the colour transmitted.

It is not easy to obtain statistics of a manufacture like this of the coal-tar colours. I have already given you a few figures in reference to magenta, and to these I may now add, that the united gas works of Europe are capable of furnishing 53,000 cwts. of magenta, and that the estimated value of all the tar dyes made is about a million and a quarter pounds sterling annually.

You will see from the series of colours we have arranged here, that this black coal acts, so to speak, the part of a prism, and gives tints which extend from one end of the spectrum to the other; and, indeed, almost approach in brilliancy the natural spectrum.

It was once said of a celebrated divine, that he had not only exhausted his subject, but his hearers too; and as I do not wish you to say this of me, I will detain you no longer. There was an old story about a farthing's worth of iron, which, when made into chronometer springs, became worth a thousand pounds. In the industry we have been considering, we have a parallel to this. Dirt has been well-defined as "matter in the wrong place." This is just what coal-tar was before the discovery of these colours. When it could be made into mauve and magenta, it soon got into its right place, and has become a new means of employing labour, and a new source of wealth; for the almost useless tar gave a dye which, at the time of its discovery (it is cheaper now) sold, if not for its weight in gold, at the price of platinum.

I am painfully conscious of the imperfection of my attempt to lay before you this subject as I could have wished, but I cannot conclude without pointing out that these discoveries have arisen entirely from results obtained —not in trying to make dyes, but in studying chemistry for chemistry's sake. Hofmann, Perkin, Nicholson—all those whose names are intimately connected with the manufacture of colours from coal-tar—were students of pure chemistry. And tracing back from this large industry, which is slowly, but surely, changing the position of England from that of a colour-importing to that of a colour-exporting country, we come upon the name of him who, in discovering benzol, became the parent of it all. And it cannot be without encouragement to the student to note that the earnest study of Nature alone raised the book-binder's apprentice to the high position which Faraday occupied as a philosopher and teacher; that if Nature is in this respect like death,

> "Pulsat æquo pede pauperum tabernas regumque turres,"

and confers her favours alike on rich and poor, she yet is the truest type of perpetual life; that Faradays yet to come may, while sitting at her feet, and

> "Nourishing a youth sublime
> With the fairy-tales of science and the long results of time,"

look forward, like him whom we have lost, to the period when, to use the language of an elegant writer, "the sun of truth will arise in unclouded brilliancy, and place them in the enjoyment of that intellectual light which has ever been among the holiest aspirations of the human race."

EXAMPLES FOR PRACTICE IN QUANTITATIVE ANALYSIS.

By ALEXIS A. JULIEN.

(Continued from vol. xxiii., p. 290).

Example No. 6.—Analysis of Calcic Carbonate.

This is a pure precipitated *calcic carbonate.*

A. *Determination of* CaO.—Weigh out 1 to 1½ grms., throw into a beaker, moisten, add dilute HCl in excess, cover, heat to boiling until all CO_2 is expelled, add sufficient *ammonic oxalate* (Table II.), and then $(NH_4)_2O$ in slight excess, cover, and set aside over night. Decant carefully upon a filter, wash by decantation with boiling water, and transfer to the filter, taking care, before the addition of a fresh portion, to wait until the fluid has completely passed through the filter. If any particles of the precipitate cannot be rubbed from the sides of the beaker, dissolve them in a few drops of highly dilute HCl, add $(NH_4)_2O$, and transfer to the filter. The precipitate, when dried, is removed from the filter as thoroughly as possible, the filter burned on a platinum wire, and the whole treated in either of the following three ways:—

Conversion into CaO.—This method is especially applicable to small quantities of precipitate, under half a gramme, and consists in a strong ignition to bright redness over a blast-lamp, until the weight remains constant.

Conversion into $CaCO_3$.—The ashes of the filter are emptied into the hollow of the lid of the crucible, the lid is placed inverted on the crucible, and the latter heated, at first very gently, then more strongly, until the bottom reaches a very faint redness, and is so kept from ten to fifteen minutes, removing the lid from time to time. Cool, weigh, moisten with a little water, and test this after a time with a minute slip of *turmeric paper.* Should the paper turn brown, rinse off the slip of paper, throw in a small lump of $(NH_4)_2CO_3$, evaporate to dryness (best on the water-bath), heat to very faint redness, and weigh. If the weight has increased, repeat the same operation to constant weight.

Conversion into $CaSO_4$.—Moisten the precipitate with pure concentrated H_2SO_4, and ignite, or ignite it with pure $(NH_4)_2SO_4$, to a low redness, and repeat the operation to a constant weight, with the use of dilute H_2SO_4.

B. *Indirect Determination of* CO_2.—The apparatus required consists of a flask (50 c.c.), with a doubly perforated stopper, through which on the one side a tube passes down to the bottom of the flask, while its outer end is closed with a piece of rubber tubing and of glass rod. The tube which passes through the other perforation of the stopper is terminated just below the cork, while its outer end is connected, after a triple bend, with a tube filled with $CaCl_2$, which has not been over-ignited. The calcic carbonate is weighed in a small tube of just sufficient length to stand up at first in the flask. A sufficient quantity of dilute HCl is introduced into the flask, the tube inserted, the cork adjusted, and the whole carefully wiped and weighed. The tube is then upset, and the acid gradually allowed to decompose the carbonate. The liquid is then gently heated, the wax stopper is displaced by a tube filled with $CaCl_2$, air is drawn through the apparatus by means of an aspirator to the extent of six times the volume of the flask, the wax stopper is replaced, the whole cooled completely, wiped, and weighed. The loss in weight represents the CO_2.

Example No. 7.—Analysis of Limestone.

A. *Main Analysis.*—Dissolve 2 grms. in HCl and a little HNO_3, in a covered beaker, heat to boiling, transfer to a casserole, evaporate to dryness, moisten with HCl, dissolve in hot water, and filter.

(*a*). *Determination of* SiO_2.—Wash, dry, and ignite the residue, mix it with six parts of Na_2CO_3, fuse in a platinum crucible, soften the fused mass with water, acidify with HCl, evaporate to dryness, moisten with HCl, dissolve in hot water, filter, wash, dry, ignite, and weigh. Result, SiO_2.

(*b*). *Determination of* Al_2O_3 *and* Fe_2O_3.—Unite the filtrate from (*a*) to the main filtrate, add a little NH_4Cl and then $(NH_4)_2O$ in the slightest possible excess, boil a few minutes to expel the excess of $(NH_4)_2O$, filter rapidly, keeping the beaker and funnel carefully covered, wash thoroughly, dry, ignite, and weigh. But if the precipitate is bulky, re-dissolve in a little HCl, and divide the solution accurately; in one half, re-precipitate with a slight excess of $(NH_4)_2O$ as before, boil, filter, wash, dry, ignite, and weigh. Result, Al_2O_3 and Fe_2O_3 (and P_2O_5, if present in the limestone). In the other half, reduce the solution and determine the Fe volumetrically, as directed farther on, in Example No. 9.

(*c*). *Determination of* CaO.—Unite all the filtrates and washings from (*b*), heat to boiling, add sufficient ammonic oxalate (Table II.) and $(NH_4)_2O$ in slight excess, and then proceed exactly as in Example No. 6, A. Re-dissolve the calcic oxalate in HCl, re-precipitate with $(NH_4)_2O$ in excess, filter, wash, dry, and ignite. Result, CaO.

(*d*). *Determination of* MgO.—Unite the filtrates and washings from *c*, concentrate as much as possible, and precipitate the MgO exactly as in Example No. 2, A.

B. *Determination of* CO_2.—Employ one of the methods in Example No. 6, B.

C. *Determination of* S *and* P_2O_5.—Moisten 6 grms. of limestone with water, digest with HNO_3 until solution, evaporate to dryness, re-dissolve in HNO_3, dilute, filter, wash, and divide the solution.

(*a*). *Determination of* S.—In one half, dilute very largely, heat to boiling, add Ba_2NO_3 in slight excess, and proceed as in Example No. 2, B. Result, the entire amount of S in the limestone, occurring both as SO_3 and as S in the sulphides.

(*b*). *Determination of* P_2O_5.—To the other half of the solution add 100° c.c. of ammonic molybdate, stir, keep near the boiling-point several hours, and set aside over night in a warm place. Then decant on a ribbed filter, if the supernatant liquid is colourless, and transfer precipitate to filter by means of small portions of the filtrate. Rinse the beaker and wash the precipitate once with the diluted precipitant. Heat the filtrate and washings to boiling, add a little more of the precipitant, and set aside, to determine if any more P_2O_5 will be precipitated. Dissolve the precipitate back into the original beaker by pouring dilute $(NH_4)_2O$ through the filter. If a red residue of oxide of iron remains undissolved, pour dilute HNO_3, upon it, allow it to pass into the $(NH_4)_2O$ solution, acidulate that with HNO_3, boil, add more of the precipitant, and set aside as before, filter, and wash several times with the diluted precipitant, then dissolve the precipitate on the filter, and adhering to the beaker in as little as possible dilute $(NH_4)_2O$ into a small beaker. Add HCl almost to neutralisation, and from 1 to 10 c.c. of magnesia mixture, and continue as in Example No. 2, A.

D. *Determination of* SO_3.—Dissolve 5 grms. in a little HCl, evaporate nearly to dryness, dilute, filter, and wash. Heat to boiling, add sufficient $BaCl_2$ (Table II.), and continue as in Example No. 2, B. Result, the SO_3 actually occurring in the limestone. If the S in this amount be deducted from that found in C, *a*, the amount of S of the sulphides will be obtained.

E. *Determination of* H_2O.

(*a*). *Direct Determination.*—The apparatus required consists of a piece of hard glass tubing of large bore, connected at each end with a tube filled with $CaCl_2$. About 2 grms. of limestone are placed in a weighed platinum boat, the latter inserted in the long tube, a gentle current of air drawn through the whole apparatus by means of an aspirator, and the boat heated gradually up to an intense heat. The tube next the aspirator should be weighed before and after the operation, and its increase in weight denotes the amount of H_2O. The apparatus

may be improved by causing the air to pass through a bottle of concentrated H_2SO_4 before entering the apparatus; and by inserting another tube full of $CaCl_2$ as a guard, next the aspirator. If the two weighed soda-lime U-tubes (Example No. 6, B, *a*) are inserted after the weighed tube, and if the boat is heated with sufficient intensity, the amount of CO_2 may be determined in the same operation.

(*b*). *Indirect Determination.*—Heat 2 grms. in a weighed crucible, at 130° C., until the weight remains constant. The loss in weight denotes the amount of H_2O.

F. *Determination of Organic Matter.*—Fuse about 4 grms. of vitrified borax in a weighed platinum crucible, over a Bunsen burner, until the weight remains constant. Add about 1 grm. of limestone, weigh, and heat gradually to redness, until the contents of the crucible are in a state of calm fusion. Cool and weigh. The loss of weight denotes the CO_2+H_2O+ organic matter; and by deducting the amounts of the first two, already found, the amount of organic matter is obtained.

Example No. 8.—Determination of Copper in Ores.

Duplicate samples of the same ore, finely pulverised, should always be employed in the ensuing processes, in quantities from 1 to 3 grms., according to the richness or poorness of the ore.

A. *Roasting the Ores.*—This is especially necessary when the ore contains much sulphur or bituminous matter, but is always useful in insuring its subsequent decomposition. Put about 2 grms. of ore into a porcelain capsule and heat upon a tin plate, over the flame of a Bunsen burner, carefully stirring with a platinum wire, until no more fumes are evolved. This is usually ended in about ten minutes.

B. *Extraction of the Copper.*—Three methods are commonly employed.

(*a*). *Mohr's Method.*—Put about 2 grms. of ore into a casserole, add 10 c.c. concentrated H_2SO_4 and 10 c.c. concentrated HNO_3, cover with a convex cover, and heat carefully, almost to dryness, and until but slight fumes of H_2SO_4 are any longer evolved. Cool, add water, filter, and wash the siliceous residue.

(*b*). *Gibbs's Method for Sulphides.*—Mix the ore in a porcelain crucible with 3 to 4 times its weight of a mixture of 10 parts of KNO_3 and 14 parts of $KHSO_4$. Heat the whole slowly to low redness, add enough concentrated H_2SO_4 to convert all the K_2SO_4 into bisulphate, and heat again carefully until the contents of the crucible fuse to a liquid mass. Cool, add water, filter, and wash.

(*c*). *Storer and Pearson's Method for Sulphides.*—Mix 2 to 5 grms. with its bulk of powdered $KClO_3$ in a covered beaker, add HNO_3 of ordinary strength, rather more than sufficient to cover the powder. Heat to gentle ebullition, adding from time to time $KClO_3$, if needful, until the S is completely oxidised. Transfer to a casserole, add a quantity of strong HCl (rather larger than the quantity of HNO_3 first employed), evaporate to dryness, treat with water, boil, filter, and wash. It is always necessary to examine the siliceous residue on the filter for copper, before proceeding to the next process.

C. *Determination of* Cu.—Several methods may be employed, equally accurate in their results, although more skill and experience are usually necessary in the first three methods given below. Whatever method may be chosen, it is advisable for the student to render himself familiar with it, by the use of a copper solution of known strength, before applying it to the solution from the ore.

(*a*). *Precipitation with Zinc.*—Place the solution in a weighed platinum dish and throw in a piece of zinc, soluble in HCl without residue.* A porcelain dish, or casserole, may be substituted for the platinum, but it is best in that case to allow the zinc to rest upon a weighed slip of platinum foil. Add sufficient dilute HCl or H_2SO_4, if necessary, to produce a moderate evolution of H; or, if the latter is too brisk, add a little water. Cover the dish with a convex cover, keep up the evolution of H until the solution has become colourless, and rinse off the convex cover into the dish. Test a small portion for copper with HS water, and if no brown tint is produced, ascertain if any zinc remains undissolved, by feeling about with a glass rod and by adding HCl. Press the Cu together, decant the clear liquid, and wash rapidly by decantation with boiling water until the washings are quite free from acid. Decant the water as far as practicable, rinse with strong alcohol, dry at 100° C., and weigh. If a porcelain dish and platinum foil have been employed, transfer the foil and loose copper to a weighed porcelain crucible, dry, and weigh. Afterwards dissolve the Cu from the platinum dish, or foil, with HNO_3, wash, and again weigh the latter.

(*b*). *Precipitation with Iron.*—Place the cold, dilute, and nearly neutral solution in a porcelain casserole, and insert a clean sheet of iron or flat coil of pianoforte wire. The iron must be of such a material as dissolves uniformly (without ridges), and without the separation of black particles or flakes in weighable quantity. Control the evolution of gas as in the preceding process. As soon as the iron is coated with copper, add 20 c.c. of HCl, heat almost to the boiling-point, until the solution is free from copper, remove the iron, and wash the spongy coherent mass, by decantation (being careful to prevent it from falling to pieces, and rapidly, to prevent oxidation), first with boiling water, and afterwards with strong alcohol. Transfer to a weighed porcelain crucible, dry at 100° C., and weigh.

(*c*). *Precipitation with a Hypophosphite.*—The cold concentrated solution is treated with excess of a solution of an alkaline hypophosphite, and then gradually warmed on a water-bath to 80° or 90° C., care being taken to avoid loss by a sudden effervescence. The copper shortly separates in a coherent sponge. When the precipitation is complete, wash rapidly as in the preceding methods, dry, and weigh in a weighed porcelain crucible. Collect on a filter, wash thoroughly, dry, ignite, and weigh in a close crucible as oxide.

$$2CuSO_4+2NaPH_2O_2+4H_2O=$$
$$=2CuH+Na_2SO_4+SO_2+2H_3PO_4.$$
$$CuH \text{ boiled}=Cu+H.$$

—*American Chemist.*

* Lehigh and New Jersey zinc is generally free from lead.

ANALYSIS OF SUGARS.*

M. Peligot's Process.

This process is based on the essentially different action exercised by alkalies on the two sorts of sugars, *i.e.*, cane sugar and glucose (*sucre d'Amidon*, grape sugar, fruit sugar, &c.). Cane sugar combines with the alkalies; it forms with bases some compounds in definite proportions from which we may extract the sugar without the latter undergoing the slightest modification. Glucose will combine with alkalies just the same, but it gives birth to some compounds of such an emphemeral nature that it is impossible to keep them intact more then for a few moments. In fact, if a solution of glucose and potash is left to itself at an ordinary temperature, we may observe that the quantity of free potash contained in the liquor diminishes every day, and finally disappears altogether when the glucose is used in excess. The glucose is transformed, in fact, into one or more acids, which colour the liquid brown, and which form with the potash some neutral salts. The action which alkalies exercise slowly on the glucose at the ordinary temperature is developed instantaneously, if the solution of these bodies is boiled; in some minutes the transformation of glucose into these acids is complete.

* *Saccharimetrie Optique, Chimique, et Melassimetrique.* By L'Abbé Moigno.

The alkali which M. Peligot uses in his saccharimetrical analysis is lime. It is well known that pure water will only dissolve a thousandth part of its weight of lime, whilst sugar water will dissolve a considerable quantity, proportionate to the weight of sugar it contains. The compound which is formed when a solution of ordinary sugar is placed in contact with quicklime used in excess has been noted by M. Soubeiran. It is represented by the formula $2C_{24}H_{12}O_{12},3CaO$.

Thus, two equivalents of sugar, weighing 427 grammes, combine with 1050 grammes of lime, or three equivalents.

To analyse a raw sugar, weigh 10 grammes of it, and dissolve it in 75 cubic centimetres of water; add little by little to this solution, which is made in a glass or porcelain mortar, 10 grammes of sifted quicklime, rub it with the pestle 8 or 10 minutes, then throw the mixture on a filter to separate the undissolved lime (this base having been used in excess). In order to dissolve rapidly all the lime the sugar will take, it is better to pass the solution a second time through the filter. By means of a graduated pipette, take 10 cubic centimetres of the solution of saccharate of lime, add to it 2 or 3 decilitres of water—add to this liquid a few drops of the blue tincture of litmus, then neutralise it exactly with a standardised solution of sulphuric acid. This proof-liquor contains per litre 21 grammes of pure sulphuric acid, with one equivalent of water. A litre of this liquid saturates the quantity of lime dissolved by 50 grammes of sugar. The normal solution of sulphuric acid is first placed in a burette graduated into cubic centimetres, each of which is divided into ten parts.

The burette is filled up to zero; then the acid is dropped into the alkaline solution, which is kept agitated during the process, until the blue tint of the latter turns red under the influence of the last drops of the proof-liquor. Then by reading the divisions of the burette, the quantity of normal acid which has been required to attain this point of saturation, you obtain the quantity of lime, and thence the quantity of sugar contained in the solution of saccharate of lime; the total volume of this solution is known by means of a table prepared by M. Payen, for estimating the volume furnished by the given weights of sugar and of water.

For the analysis of ordinary raw sugar, the above is the process. M. Peligot states that he has proved that the proportion of glucose beet sugars contain is too small to be appreciated by the second operation about to be mentioned. But it happens sometimes that granulated glucose is introduced fraudulently into raw sugars intended for refining. To prove this adulteration, as well as to analyse molasses and the inferior raw sugars, which contain variable proportions of glucose, resulting from the modification of ordinary sugar, in consequence of the processes of extraction, &c., to analyse a product containing cane sugar and glucose, the process is as follows:—

After the first alkalimetrical valuation, place in a medicine phial one part of alkaline liquid, which heat in a water-bath to 212° F. for some minutes. If this liquid contains only the saccharate of lime produced by *pure* sugar, it becomes turbid by the action of heat, in virtue of the curious property which the calcareous compound possesses of coagulating, like the albumen of the egg, when heated to the boiling point. But this muddiness disappears on the liquid being allowed to cool, when it does not take a darker tint than it possessed before it was heated; and on submitting it to a second alkalimetrical trial after it has become cool, we get the same result as before. But if the sugar contains glucose, the solution, when heated in a water-bath, takes a brown tint; a brown deposit forms, which does not disappear on cooling, if there is a large proportion of glucose, and a strong odour is developed as of burnt sugar. Lastly, the second alkalimetrical determination shows a smaller quantity of lime than the first, which quantity will almost all belong to the pure sugar; the lime dissolved by the cold glucose having given birth to some neutral salts, on which the normal sulphuric acid liquor has no action.

In cases where pure glucose is to be analysed, after the cold liquor has been mixed with the lime, the first determination will show very nearly the same extent of alkalinity as with ordinary sugar; the second, made on a portion of the liquid heated to 212° F., will indicate the same quantity of lime as that which would have been dissolved in an equal volume of pure water; this quantity is very small—one decilitre saturates four cubic centimetres of the normal solution of sulphuric acid. Although the liquor may then be brown-coloured, the point of saturation may easily be seized, by taking care to add a little more of the tincture of litmus, and to stop at the moment when the solution, which becomes green, takes a clearer tint by the addition of the sulphuric acid. The trial of saccharine solutions is made by operating as above; the only precaution necessary is to work on liquids marking 6° to 8° on Baumé's areometer.

The juices of the cane and the beet are found naturally in these conditions; if more attenuated solutions are employed, it is at the risk of not being able to dissolve rapidly all the lime which they will take up; if they are more concentrated, they become too viscid for rapid filtration. The quantity of quicklime employed for these liquids should be such that it may be very nearly equal in weight to that of the sugar which is supposed to exist in the product to be analysed. This quantity is indicated approximately by the areometrical degree of the liquor.—*The Sugar Cane.*

REDUCTION OF NITRATE OF SILVER BY CHARCOAL.

By C. F. CHANDLER, Ph.D.

When solid nitrate of silver, either in crystals or sticks, is placed upon glowing charcoal, deflagration takes place, the silver being left in the metallic state, while binoxide of nitrogen and carbonic acid are evolved. The nitrate is fused by the heat of the reaction and sinks into the pores of the charcoal, and as each particle of charcoal is replaced by metallic silver, the structure of the original wood is preserved. With proper management, pieces of silver of any desired size can be prepared, showing the exact structure of the wood. A crystal of nitrate is placed on the end of a piece of charcoal, and the blowpipe flame is directed upon the coal near the crystal to start the reaction. When deflagration begins, crystal after crystal may be added. The nitrate fuses, passes down through the porous metal already reduced until it reaches the glowing coal, where it is reduced. I have prepared in this manner lumps of silver weighing an ounce or more, which exhibit most beautifully the rings of the wood.—*American Chemist.*

CORRESPONDENCE.

HISTORY OF THE AMMONIA PROCESS.

To the Editor of the Chemical News.

Sir—Dr. Angus Smith's last report, under the "Alkali Act," affords another proof that the ammonia process, originated by Chapman, Smith, and myself in 1867, has taken its place among the recognised resources of the laboratory. The time has now arrived for reviewing its history, partly with the object of getting justice done to its inventors, and partly with the object of preparing younger chemists for the sort of reception which awaits them at the hands of their chemical brethren in this country, should they be so unfortunate as to make any notable advance in chemical methods—especially in methods admitting of immediate

and practical application to such chemical questions as engage the attention of Government.

The ammonia process was published by me at the meeting of the Chemical Society held on the 20th of June, 1867; on which day I also gave evidence about it in the House of Lords, before the Royal Commission on Water Supply, and received a promise that our new method should be employed in the investigations undertaken for the Commission. The pledge was kept; the Commission received and made use of analyses done by the new process. Some of these analyses were made by my colleagues and myself at our own expense, but the greater number of them by Dr. Frankland and Dr. Odling, at the expense of the nation.

Chemists now in the habit of working the ammonia process will be amused (should they chance to turn to the blue-book containing the evidence of Drs. Frankland and Odling) to learn that these gentlemen did not get concordant results, which they attributed to some defect in the process. In 1868, many other chemists, high in official position, gave evidence before the Commissioners, and, being interrogated touching the working of our process, agreed mainly in this—That it was not a quantitative method. An honourable exception which I ought not to pass over was formed by Mr. Way, who, being in the year 1867, chemist on the Rivers' Commission, gave us his support at that early period in the history of our troubles. The last reports prepared by Mr. Way at that time contained very many water analyses done by the new process.

Very curious was the opposition we encountered at this stage of our career. One chemist could, as he informed the Chemical Section of the British Association in 1867, decompose a very dilute solution of albumen so completely, by boiling it with weak solution of carbonate of soda, as to obtain the whole of its nitrogen in the form of ammonia. Another chemist made some combustions of water residues (using a complicated apparatus for the purpose, but, as his test-analyses showed, not attaining any very unusual degree of accuracy), and wanted the Chemical Society to believe, because his combustions and our process assigned different characters to the same water, that, therefore, our process was fallacious—with combustions, confessedly tenths of a milligramme, and even a whole milligramme off the truth, he would correct, and control results claiming to be within one or two hundredths of a milligramme of the truth! One of our brethren could not work the Nessler test; another could not comprehend how we could divide organic substances so minutely as we claimed to do; another did not see how we could measure albumen quantitatively by the ammonia yielded by it, if only a definite fraction and not the entire nitrogen of the albumen were evolved as ammonia; and to this day some of our brethren have probably not been made to understand that in our first paper we described two distinct modifications of the ammonia process. But the ammonia process maintained its ground, and it is doubtful whether any new chemical method was so often and so widely practised within so short a period of its birth. I have related how from the very first the ammonia process was taken up by the two Government commissions which were sitting at the time of its invention. By-and-bye, it was adopted by the chemist to the Privy Council, the late Dr. Miller, whose latest water analyses for the Privy Council were done by our process. Almost as soon as intelligence of the method could reach the sanitary officers of our Indian Government they adopted it too. Even the Sewage Committee of the British Association used it.

J. Alfred Wanklyn.

ELECTRICAL POWER.

To the Editor of the Chemical News.

Sir,—In the thunderstorm which about a week ago utterly shattered a tree in these gardens, there is a remarkable illustration of the small *quantity* of electricity contained in a flash of lightning. The greater part of the electricity passed through an iron chair which stood under the tree. It had been newly painted green. The electricity on entering the iron reduced the metals in the paint (copper and lead) to a metallic state, at the same time fusing them. The nature of the action can scarcely be discerned by the naked eye, and probably there is not altogether half a grain of the reduced metal in the little metallic globules, which are visible by a microscope, deposited on the surface.

As the equivalent of lead is more than three times that of zinc, this is an illustration of Faraday's statement that a grain of zinc will produce more electricity in quantity than there is in a flash of lightning.—I am, &c.,

H. Highton.

2, The Cedars, Putney,
June 29, 1871.

MISCELLANEOUS.

Government Prosecution of a Chemical Works.—Mr. A. E. Fletcher, Government inspector of chemical works, has entered a suit against a St. Helen's firm for an infringement of the "Alkali Act," by allowing the escape of too much muriatic acid. As the firm immediately paid the prescribed fine of £50 the case will not be proceeded with. This is the fourth prosecution instituted since the passing of the act, and they have all been directed against the proprietors of works situated in St. Helen's and Widnes.—*Liverpool Mercury*.

Patent Law Reform.—At a meeting of London Patent Agents, held on the fourth instant, to consider the proposed changes in the patent laws, George Haseltine, M.A., in the chair, the following resolutions were adopted:—(1). That the chief defects of the patent laws have arisen from a want of appreciation of the *natural* rights of inventors to the sole use of their inventions, an unreserved recognition of which rights must pervade every equitable patent system, and the true aim of patent legislation is to harmonise these individual rights with the material interests of the state. (2). That the grant of patents to mere "*first importers*" is an injustice to inventors, an injury to society, as it induces the "pirating" of inventions, and the reason for these grants no longer existing, legislation should confine the issue of patents to actual inventors and their representatives. (3). That, in view of the benefits inventors confer on the public, and the expenses incident to the completion and introduction of new inventions, a patent for fourteen years is an inadequate compensation, and we deem it expedient to grant patents for a term of twenty-one years without the privilege of extension. (4). That the patent laws impose *penalties* upon inventors in the form of excessive fees, which justice and public policy demand should be reduced to the amount requisite to defray the expenses of an efficient administration of a simple patent system, and fees of ten pounds for the entire term—now one hundred and seventy-five pounds—would yield more than sufficient for the purpose. (5). That the defects of the present practice should be remedied by the adoption of equitable "regulations," and the introduction of the system of granting patents, at the risk of the applicants, without any official supervision of the specification or preliminary investigation of the merits of the invention. (6). That the rights of patentees should be determined by a competent tribunal, excluding all technical objections to the validity of the patent, and we deem it expedient to dispense with jurors and "scientific experts" in patent suits. (7). That these resolutions, signed by the Chairman, be forwarded to the Parliamentary "Select Committee on Letters Patent," and such other publicity be given them as he may deem conducive to the success of a liberal measure of patent legislation.

THE MANUFACTURE OF CHLORINE.

The process for the Manufacture of Chlorine which bears my name is now in operation at the works of the following manufacturers, who are now making by it a very large proportion of the total chlorine produced in this country:—

Messrs. C. ALLHUSEN & SONS, Newcastle-on-Tyne.
„ BLACK & CO., South Shields.
„ J. C. GAMBLE & SONS, St. Helens.
„ GASKELL, DEACON, & CO., Widnes.
„ HALL BROTHERS & SHAW, Widnes.
The HARDSHAW BROOK CHEMICAL COMPANY, St. Helens.
Mr. WILLIAM HUNT, Castleford.
Mr. A. G. KURTZ, St. Helens.
Messrs. W. J. KANE & SON, Dublin.
„ JAMES MUSPRATT & SONS, Widnes.
Mr. MORGAN MOONEY, Dublin.
Messrs. H. L. PATTINSON & CO., Newcastle-on-Tyne.
„ W. PILKINGTON & SONS, Widnes.
„ SULLIVAN & CO., Widnes.
The WALKER ALKALI COMPANY, Newcastle-on-Tyne.

The following, though not yet actually working the process, have very nearly completed apparatus for it:—

Messrs. CHARLES TENNANT & CO., Glasgow.
„ MUSPRATT BROTHERS & HUNTLEY, Flint.
The RUNCORN SOAP & ALKALI COMPANY, Weston.
The NETHAM CHEMICAL COMPANY, Bristol.

The cost of the regeneration by my process of manganese enough for the production of a ton of bleaching-powder does not average more than about fifteen shillings; and in comparing the cost of my process with that of the old process, only a part of even this fifteen shillings has to be counted, seeing that the solution of my mud requires so much less labour and fuel than are required for the solution of native manganese. The only labour involved in the working of Weldon stills consists in opening and shutting a few cocks. One still can produce chlorine enough for from 15 to 30 tons of bleaching-powder per week, and one workman can attend to as many stills as are required for the production of the largest quantity of chlorine made by any one firm in the world.

The consumption of acid, in my process, per ton of bleaching-powder, is shown by the following figures, for which I am indebted to the courtesy of a Widnes firm. They are for the ten weeks from April 4th to June 20th, 1871, omitting Whitsun week:—

April 4th to May 30th.

Average bleaching-powder made per week ..	44 tons 1 cwt.
Average strength of the bleaching-powder (chamber-test)	37·34 per cent.
Acid at 24° T. used per ton	172 cubic feet.

Week ending June 13th.

Bleaching-powder made	43 tons 11 cwts. 2 qrs.
Average chamber-test of ditto	37·23 per cent.
Acid at 24° T. per ton	166 cubic feet.

Week ending June 20th.

Bleaching-powder made..	43 tons 5 cwts. 1 qr.
Average chamber-test of ditto	36·18 per cent.
Acid at 24° T. per ton	140 cubic feet.

The average consumption of acid, by the firm in question, for the ten weeks, was thus 166 cubic feet at 24° T., per ton of bleaching-powder.

The firm who have given me the above figures use Buxton lime. When an inferior kind of lime is used the consumption of acid is greater, but I believe that the average consumption, per ton of bleaching powder, by all the firms employing my process, does not exceed 170 cubic feet at 24° Twaddell, or the quantity containing 2832 lbs. real HCl.

Although, at present, for every 2832 lbs. HCl going into their stills, few British manufacturers decompose less than 60, while many decompose 80, or even more than 80, cwts. of salt, that quantity of acid *might* go into the stills for every 47 or 47½ cwts. of salt decomposed. In a paper presented to the Chemical Section of the British Association in 1863, by Lieut.-Colonel Allhusen and Mr. R. Calvert Clapham, it was shewn that the quantity of HCl actually condensed at the works of Messrs. Allhusen and those of the Walker Alkali Company was 55·8 parts per 100 parts of salt decomposed: which would give 2832 lbs. HCl per 45 cwts. and 37 lbs. of salt. There can be little doubt that that quantity of acid is nearly always condensed per 46 cwts. of salt decomposed; and I hold that, within 2 or 3 per cent, *all* the acid condensed *might* go into the stills. There are manufacturers working on the Lancashire system nearly a third of whose acid goes down their wash-towers; but there are others who do not send down their wash-towers, per ton of salt decomposed, more than the equivalent of 1½ cubic feet of acid at 24° T., and what is done by these latter is of course possible for all who use close roasters. Nor need those who use open roasters have less acid for their stills, per quantity of salt decomposed, than manufacturers working on the other plan, seeing that the acid from open roasters can easily be got strong enough for a mixture of it with the pot-acid to be of quite sufficient strength for the solution of my mud.

It is perfectly possible, then, for 2832 lbs. HCl to be got into the chlorine-stills for every 47½ cwts. of salt decomposed. But this quantity of acid is more than *need* be used per ton of bleaching-powder made by my process, as at present practised. It includes about 500 lbs. going out of the stills as free acid, and afterwards neutralized by limestone. A slight increase of still-power, permitting the stills to be worked with an excess of mud, would enable these 500 lbs. of lost acid to be reduced to 200 lbs. This would reduce the 2832 lbs. HCl to 2532 lbs., and so enable any manufacturer obtaining, in a state in which it could go into his stills, that proportion of his acid which might easily be obtained in that state by proper arrangements, to make, by the form of my process at present in use, a ton of bleaching-powder, at 37 per cent, for every 42 cwts. of salt which he decomposed.

But there is another form of my process, which is capable of yielding a ton of bleaching-powder from as little as *fourteen hundredweights* of salt. In this form of the process the chloride of manganese is decomposed by magnesia, instead of by lime, and the resulting chloride of magnesium is then decomposed by heat into magnesia and hydrochloric acid. The same magnesia serves over and over again continually; the loss of manganese which is inseparable from the lime form of the process is avoided; nothing is consumed but coal and air; and all the chlorine contained in the acid employed is yielded, if desired, in the free state. Bleaching-powder was successfully made by this form of the process, at the works of Messrs. J. C. GAMBLE & SONS, as far back as 1868, and at the Works of the HARDSHAW BROOK CHEMICAL COMPANY improved apparatus for it is now being prepared, and will be in operation very shortly.

Several processes for the manufacture of chlorine in which manganese is not used, the chlorine being obtained by the decomposition either of hydrochloric acid or of metallic chlorides by means of atmospheric air directly applied, are now being experimented with. Theoretically, these processes also should yield as much chlorine as the magnesia form of the manganese process, but I believe that it will be found that the reactions on which they are based can be carried to *completeness* only by the use of such an excess of air as to render the chlorine obtained so dilute as to require impracticably large apparatus for its absorption, and hence that in practice they can be carried only so far as to make the actual yield of chlorine fall very much below that which I have every confidence that I shall soon be realizing at Hardshaw Brook; while the chlorine yielded by these processes, even when obtained by only partial decompositions, is so mixed with other gases that its absorption has as yet been effected only by causing it to travel, in apparatus of special construction, for a very long distance over exceedingly thin layers of lime. The magnesia form of my process, however, yields the chlorine in a state in which it can be employed in the ordinary chambers, and I believe that that form of my process will be found to possess so many other practical advantages as to maintain, unimpaired, the supremacy of manganese as the agent by whose means chlorine can be most conveniently and economically manufactured.

WALTER WELDON.

Offices of WELDON'S CHLORINE PROCESSES COMPANY, (Limited),
59, Lincoln's Inn Fields, London, W.C.

June 29th, 1871.

THE CHEMICAL NEWS.

Vol. XXIV. No. 607.

ON PROTOPLASMIC LIFE.

By F. CRACE CALVERT, F.R.S., &c.

A year since, the publication of Dr. Tyndall's interesting paper on the abundance of germ-life in the atmosphere, and the difficulty of destroying this life, as well as other papers published by eminent men of science, suggested the inquiry if the germs existing or produced in a liquid in a state of fermentation or of putrefaction could be conveyed to a liquid susceptible of entering into these states; and although at the present time the results of this inquiry are not sufficiently complete for publication, still I have observed some facts arising out of the subject of protoplasmic life which I wish now to lay before the Royal Society.

Although prepared, by the perusal of the papers of many workers in this field, to experience difficulties in prosecuting the study, I must confess I did not calculate on encountering so many as I met, and especially those arising from the rapid development of germ-life, and of which I have hitherto seen no notice in any papers which have come under my observation. Thus, if the white of a new-laid egg be mixed with water (free from life), and exposed to the atmosphere for only fifteen minutes, in the months of August or September, it will show life in abundance. From this cause I was misled in many of my earlier experiments, not having been sufficiently careful to avoid even momentary exposure of the fluids to the atmosphere. To the want of the knowledge of this fact may be traced the erroneous conclusions arrived at by several gentlemen who had devoted their attention to the subject of spontaneous generation.

I believe that I have overcome the difficulty of the fluids under examination becoming polluted by impregnation by the protoplasmic life existing in the atmosphere, by adopting the following simple method of working.

As a pure fluid free from life, and having no chemical reaction, was essential to carrying out the investigation, I directed my attention to the preparation of pure distilled water. Having always found life in distilled water prepared by the ordinary methods, by keeping it a few days, after many trials I employed the following apparatus, which gave very satisfactory results, as it enabled me to obtain water which remained free from life for several months.

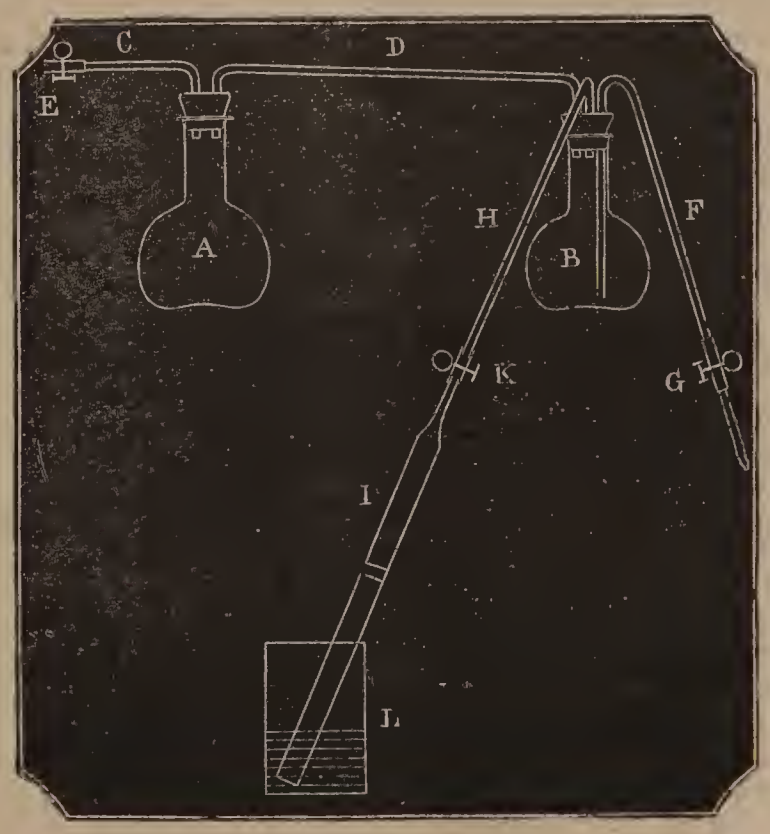
It consists of two flasks, A and B (A rather larger than B), fitted with perforated caoutchouc stoppers.* These flasks are connected by the tube D. Into the stopper of A is fitted a tube C, to which is joined a piece of caoutchouc tubing, which may be closed by the clip E. Through the stopper of B is a syphon, F, the long limb of which is cut and joined with caoutchouc tubing, which can be closed by the clip G. Through this stopper is a third tube, H, connected by caoutchouc with the tube I; this can be closed by the clip K. The tube, I, is about 3 feet long, and goes into the vessel L, which is partly filled with water.

The water to be distilled is mixed with solution of potash and permanganate of potash, and placed in the flask A.† Before distillation is commenced, a rapid current of pure hydrogen or some other gas must be passed through the apparatus by the tube C to displace the air and carry off all the germs the air may have contained. The clip G is first left open, then this closed and the clip K opened, which allows the gas to pass through the water in the vessel L.

The gas should be passed through for about fifteen minutes. The clip E is then closed, and the distillation carried on. When the operation is complete, the gas must be again passed through the apparatus, and the connection with the tube I broken by closing the clip K. The water is drawn off through the syphon F. The long tube acts as a ssfety-tube, and is made so long that the absorption is noticed in ample time to close the clip before any air can enter through that tube.

The water has to be re-distilled three or four times before it is obtained free from germs, and must be kept in the apparatus in which it is distilled until wanted, to prevent any contact with air.

Some water which had been distilled on the 20th of November, 1870, being still free from life on the 7th of December, was introduced by the syphon H into twelve small tubes, and left exposed to the atmosphere for fifteen hours, when the tubes were closed. Every eight days some of the tubes were opened, and their contents examined. On the fifteenth, therefore, the first examination was made, when no life was observed; on the twenty-third two or three other tubes were examined, and again no life was detected; whilst in the series opened on the



2nd of January, 1871 (that is to say, twenty-four days from the time the tubes were closed), two or three black vibrios were found in each field.

Being impressed with the idea that this slow and limited development of protoplasmic life might be attributed to the small amount of life existing in the atmosphere at this period of the year,* a second series of experiments was commenced on the 4th of January. The distilled water in the flask being still free from life, a certain quantity of it was put into twelve small tubes, which were placed near putrid meat at a temperature of 21° to 26° C. for two hours, and then sealed. On the 10th of the same month the contents of some of the tubes were examined, when two or three small black vibrios were observed under each field. This result shows that the fluid having been placed near a source of protoplasmic life, germs had introduced themselves in two hours in sufficient quantity for life to become visible in six days instead of twenty-four. Other tubes of

* The stoppers and caoutchouc tubing used for the various joints must be new, and must be well boiled in water before use.

† The reasons why I employed permanganate of potash (in large excess) were that, under the influence of heat, its oxidising powers were much increased, and that it gave off no gas that could interfere with the purity of the water, this salt in solution not even yielding oxygen under any circumstances.

* During the intense cold of December and January last I found it took an exposure to the atmosphere of two days at a temperature of 12° C. before life appeared in solution of white of egg in the pure distilled water, whilst as the weather got warmer the time required became less.

this series were opened on the 17th of January, when a slight increase of life was noticed; but no further development appeared to take place after this date, as some examined on the 10th of March did not contain more life than those of the 17th of January.

This very limited amount of life suggested the idea that it might be due to the employment of perfectly pure water, and that the vibrios did not increase from want of the elements necessary for sustaining their life. I therefore commenced a third series of experiments. Before proceeding to describe this series, I would call attention to the fact that the water in the flask had remained perfectly free from life up to this time, a period of close on sixteen weeks.

On the 9th of February 100 fluid grains of albumen from a new-laid egg were introduced, as quickly as possible and with the greatest care, into 10 ounces of pure distilled water contained in the flask in which it had been condensed, and an atmosphere of hydrogen kept over it. On the 16th some of the fluid was taken out by means of the syphon H, and examined, and no life being present, twelve tubes were filled with the fluid, exposed to the air for eight hours, and closed. On the 21st the contents of some of the tubes were examined, when a few vibrios and microzyma were distinctly seen in each field. On the 27th other tubes were examined, and showed a marked increase in the amount of life. In this series life appeared in five days, and an increase in ten, instead of requiring twenty-four days, as was the case when pure water only was employed.

Albumen therefore facilitated the development of life. Of course the contents of the flask were examined at the same time, but in no instance was life detected. I believe that these three series of experiments tend to prove the fallacy of the theory of spontaneous generation; for if it were possible, why should not life have appeared in the pure distilled water, or in the albuminous solution, which were kept successively in the flask B, as well as in the fluids which were contained in the tubes, and had been exposed to the atmosphere or near animal matter in a state of decay, and had thus become impregnated with the germs of protoplasmic life? What gives still further interest to these experiments is, that, having operated during the severe weather of last winter, when little or no life existed in the atmosphere, I was able to impregnate the fluids with germs without introducing developed life.

The quantity of life produced in the above-recited experiments being comparatively small, I was led to infer that this might be due to the influence of the atmosphere of hydrogen employed to displace the air in the apparatus used for obtaining the water. I, therefore, on the 2nd of March, prepared a solution of albumen similar to that before employed, but expelled the air out of the apparatus by pure oxygen; and as the contents of the flask B were free from life on the 8th of March, a series of small tubes were filled and exposed for twenty-six hours to the atmosphere near putrid matter, and then sealed. Several of these tubes were opened on the 11th, and immediately examined, when only a few cells were observed in each field. A second lot was opened on the 14th, and they showed considerable increase of life, there being two or three vibrios under each field. A third quantity was opened on the 25th, when no increase had taken place. This latter result tends to show that although oxygen appears to favour the development of germs, still it does not appear to favour their reproduction.

As the weather had become much warmer, and a marked increase of life in the atmosphere had taken place, some of the same albumen solution as had been employed in the above experiments was left exposed in similar tubes to its influence, when a large quantity of life was rapidly developed and continued to increase. This result appears to show that the increase of life is not due to reproduction merely, but to the introduction of fresh germs; for, excepting this fresh supply, there appears to be no reason why life should increase more rapidly in the open than in the closed tubes.

In concluding this paper I have great pleasure in recognising the able and persevering attention with which my assistant, Mr. William Thompson, has carried out these experiments.

ASSAY OF GOLD AND SILVER,

AS PRACTISED AT THE LABORATORY OF THE SCHOOL OF MINES, COLUMBIA COLLEGE.

By T. M. BLOSSOM, E.M.

All substances containing gold and silver may, for the purpose of the assayer, be divided into two classes, as follows:—

Class I.—Minerals or ores, including incidental industrial products.

Class II.—Metallic gold and silver, and alloys, native or artificial.

Gold.

Class I.—Minerals.

Sylvanite—Graphic Tellurium....$(AuAg)Te_3$—Au 30—Ag 10.
Nagyagite—Foliated Tellurium..$(Pb,Au,Ag)_2,(Te,Sb,S)_3$—Au9—Ag0·5

Class II.—Alloys.

Native Gold		AuAg—Au65—99.
Palladium Gold	Porpezite ..	AuPd—Au85·98Ag4·17.
Rhodium Gold..		AuRd—Au59—66.
Gold Amalgam		$(AuAg)_2Hg_5$—Au38·39Ag5.
Artificial Alloys	Gold Coin, Jewelry, &c.	

Of the foregoing list, native gold alone occurs in nature in sufficient abundance to acquire any great commercial value. It is commonly found in a quartzose gangue, and nearly always associated with one, or more, of the following minerals: Iron and copper pyrites, mispickel or arsenical pyrites, blende, and galena.

Silver.

Class I.—Ores and Minerals.

	Mineral.	Formula.	Per cent of Silver.
1.	Naumannite ..	AgSe	.. 73·20
2.	Eucairite	CuSe+AgSe ..	.. 43·10
3.	Hessite	AgTe	.. 62·80
4.	Sylvanite	$(AuAg)Te_3$	.. 10·00—15·00
5.	Silver Glance ..	AgS	.. 87·04
6.	Stromeyerite ..	$(Ag,2Cu)S$	.. 2·96—53·10
7.	Sternbergite ..	$AgS+3FeS+FeS_2$	.. 34·20
8.	Miargyrite ..	AgS,Sb_2S_3	.. 36·70
9.	Pyrargyrite ..	$3AgS,Sb_2S_3$	.. 59·80
10.	Proustite	$3AgS,As_2S_3$ ..	.. 65·40
11.	Stephanite ..	$5AgS,Sb_2S_3$	.. 68·50
12.	Brogniardite ..	PbS,AgS,Sb_2S_3 ..	.. 26·10
13.	Polybasite ..	$9(Ag,2Cu)S,(Sb,As)_2S_3$	68·00
14.	Tetrahedrite	$4(2Cu,Fe,Zn,Ag,Hg)S,(Sb,As,Bi)_2S_3$	3·09—31·29
15.	Xanthoconite	$(3AgS,As_2S_3)+2(3AgS,As_2S_3)$	64·00
16.	Fireblende ..	Ag—Sb—S	.. 62·30
17.	Freieslebenite..	$5(Pb,Ag)S,2Sb_2S_3$	.. 22—24
18.	Kerargyrite ..	AgCl	.. 75·33
19.	Bromyrite ..	AgBr	.. 57·40
20.	Embolite	Ag(Cl,Br)	.. 61·71
21.	Iodorite	AgI	.. 46·00

Minerals often containing silver in small quantities:—

1.	Galena	PbS.
2.	Blende	ZnS.
3.	Pyrites	FeS_2.
4.	Chalcopyrite	Cu_2S,Fe_2S_3.
5.	Erubescite	$3Cu_2S,Fe_2S_3$.
6.	Mispickel	FeS_2+FeAs_2.
7.	Altaite	PbTe.
8.	Nagyagite	$(Pb,Au,Ag)_2,(Te,Sb,S)_2$.
9.	Chiviatite	$(Cu_2Pb)S.\frac{3}{2}Bi_2S_3$.
10.	Dufrenoysite	$2PbS,As_2S_3$.
11.	Enargite	$3Cu_2S,As_2S_5$.
12.	Slags, &c.	
13.	Cupel Bottoms, Dross, Litharge, &c.	

Class II.—Alloys.

Alloy.	Formula.	Per cent.
1. Native Silver..	AgAu (generally),	..
2. Native Gold	AuAg	Ag1—35
3. Native Copper	Cu	sometimes 10
4. Chilenite	Ag_6Bi	Ag86·2
5. Bismuth Silver	Ag—Cu—As—Bi	Ag60·0
6. Discrasite { Antimonial Silver }	Ag_2Sb	Ag78·0
7. Amalgam	$AgHg_2$	Ag35·0
,, ...	$AgHg_3$	Ag26·0
8. Arquerite	Ag_6Hg	Ag86·5
9. Artificial Alloys	..Silver Coin, Jewelry, &c.	

The principal sources of silver are, silver glance, stephanite, pyrargyrite, and kerargyrite, native silver, galena, and argentiferous copper ores.

The assay of gold and silver, therefore, comprises—

I. Assay of Ores, II. Assay of Alloys, according as we have presented to us material of Class I. or of Class II.

I. Assay of Ores.

Assays of gold and of silver ores are made in a manner almost precisely the same, so that a general description will answer for both, the peculiar requirements of each being pointed out in place. The assay of ores embraces the following steps:—

1. Preparation of the sample. 2. Collection of the gold and silver in a button of metallic lead. 3. Cupellation of the lead button, by which the lead is oxidised and absorbed by the cupel, leaving behind a bead of the gold and silver. 4. Weighing the bead. 5. Inquartation, parting, and cupellation of the gold residue. 6. Weighing the gold bead.

1. *Preparation of the Sample.*—It is essential, in the first place, to obtain a fair average sample of the ore, otherwise the results of the assay may be commercially worthless. Selection must be left to the judgment of the assayer. The sample must be dried, if necessary, care being taken not to roast it. It must then be pounded in an iron mortar and passed through a sieve of eighty meshes to the linear inch. If any native metal, in the form of scales or filaments, remain upon the sieve, take the weights, separately, of what has passed through and of what is left upon the sieve. The latter must be assayed according to "Assay of Alloys," and the result referred to the whole amount of ore. (See Calculation of Results.) It is essential that the whole of the sample except the malleable portion, be passed through the sieve. Mix thoroughly the sifted ore.

2. *The Collection of the Gold and Silver* in a button of metallic lead is effected in a crucible, or in a scorifier, whence two methods of assay:—

(*a.*) Crucible assay. (*b.*) Scorification assay.

The former is applicable to all ores; the latter is limited, practically, by the small size of scorifiers to the richer ores.

(*a.*) Crucible assay.—An ore of gold and silver is composed of precious metal, gangue, and oxides, sulphides, &c., of foreign metals. To collect the precious metals in a button of lead, the ore is mixed with litharge, suitable fluxes, an oxidising or a reducing agent, and fused in the crucible. Litharge is reduced to metallic lead; the latter seizes upon the precious metals and collects in a button at the bottom of the crucible, while the foreign materials form, with the fluxes, a fusible slag above the lead button. The crucible is broken when cold, and the malleable button detached from the slag by hammering on an anvil.

The following are the necessary reagents for crucible assays:—

Reagents.

Litharge.—To supply lead; to oxidise sulphur, arsenic, antimony, &c., to flux siliceous material and impurities in general.

Carbonate of Soda or of Potash.—A substitute in part for litharge, to flux siliceous and other impurities. The alkaline carbonates have the power, also, of oxidising many metals, as iron, zinc, tin, by means of the carbonic acid they contain.

Nitre.—To oxidise sulphur, arsenic, &c.

Argol (crude bitartrate of potash).—To reduce litharge to metallic lead.

Charcoal.—A substitute for argol; also used in roasting ores, to decompose arseniates and antimoniates.

Borax Glass.—To flux oxidised basic impurities, such as alumina, lime, magnesia, and oxide of iron. Borax is neither oxidising nor desulphurising.

Silica, or Powdered Glass.—Used sometimes as a substitute for borax.

Common Salt.—To cover the charge in the crucible. It also serves to wash down the sides of the crucible, if the charge boil up.

Carbonate of Ammonia.—Used in roasting ores, to decompose sulphates.

The reagents must all be finely pulverised and dried, and kept in closed vessels.

Carbonate of soda is better than carbonate of potash, because it does not deliquesce. Borax should be fused to a glass and pulverised. This prevents the loss which its boiling up might occasion, if used in the ordinary state. Litharge is an almost universal flux, and might be employed alone; but, as in this case a large amount would be required, there would be danger of losing the charge, through piercing of the crucible. Carbonate of soda is, therefore, substituted for a part of the litharge. There is an extra advantage in the use of carbonate of soda, arising from the fact that alkaline carbonates, on account of their great fusibility, can hold in suspension, without losing their fluidity, a large proportion of pulverised infusible substances.

Preliminary Assays of Reagents.

Ordinary commercial litharge always contains silver, so it becomes necessary to determine in each new lot the amount of silver contained, for deduction from the silver found in the regular assay of an ore. We must also determine, beforehand, the reducing powers of argol and charcoal, and the oxidising power of nitre. This necessity arises from the impurities of the reagents. By reducing power, we mean the amount of metallic lead that one gramme of the reagent will reduce from litharge, and by oxidising power the amount of metallic lead that one gramme of nitre will oxidise. The following are the charges for the preliminary assays:—

1.—*Reducing Power.*

Argol.		Charcoal.	
Argol..	2 grms.	Charcoal	1 grm.
Litharge	2 A. T.*	Litharge	2 A. T.
Carb. Soda ..	⅓ A. T.	Carb. Soda.. ..	⅓ A. T.
Salt	Cover.	Salt	Cover.

2.—*Oxidising Power.*		3.—Ag. *in Litharge.*	
Nitre..	3 grms.	Litharge	4 A. T
Charcoal	1 grm.	Carb. Soda.. ..	2 A. T.
Litharge	2 A. T.	Charcoal	1 grm.
Carb. Soda ..	⅓ A. T.	Salt	Cover.
Salt	Cover.		

In these, as in all other cases, except when the contrary is specified, duplicate charges must be made, to afford

* Prof. Chandler has devised and adopted, in addition to the French system, a set of weights similar to that employed by the German assayers. This set includes weights designated "Assay Tons," and fractions thereof, as follows: 4 A. T., 2 A. T., 1 A. T., ⅓ A. T., 1-6 A. T., 1-10 A. T. The assay ton weighs 29·1666 grms., and bears the same relation to a milligramme as the ton of 2000 lbs. av. bears to the troy ounce, *i.e.*,

$$1 \text{ milligramme} = \frac{1 \text{ (A. T.)}}{29{,}166} \text{ and } 1 \text{ oz. troy} = \frac{2000 \text{ (lbs. av.)}}{29{,}166}$$

A milligramme, then, is the assay ounce. The advantage of these weights is apparent. The ore for an assay is weighed in assay tons. Suppose that we obtain from 1 A. T. of ore 85 milligrammes, or assay ounces, of silver, we know, without calculation, that a ton of 2000 lbs. avoirdupois will yield 85 ounces troy. An article on this "New System of Assay Weights" may be found in the American supplement of the *Chemical News* for August, 1869.

some check upon the results obtained. If they differ greatly, another assay must be made; if only slightly, the mean may be taken. In the case of (1) and (2) the same precautions are necessary as in the preliminary assay of an ore. (See farther on).

All the charges require a hot fire, should be withdrawn from the furnace as soon as completely fused, and the crucibles should be tapped gently while held in the tongs, to detach any particles of lead adhering to the sides. When cold they are broken and the lead buttons are hammered into a cubical form, both because this is a convenient shape and because the buttons are thus freed from all slag. Weigh the buttons of (1) and (2) and note, in each case, the mean weight. The buttons of (1) tell us how much lead is reduced by 2 grammes of argol and by 1 gramme of charcoal. The reducing power follows. In the case of (2) we should, in the absence of nitre, have obtained a button of a certain weight, say 28 grammes, due to the charcoal present. We have obtained a button of less weight, say 13 grammes, that is, 3 grammes nitre have oxidised part of the lead, 15 grammes, whence 1 gramme nitre will oxidise 5 grammes lead. The lead button from (3) on being cupelled, will yield a bead of silver representing the amount in 4 assay tons of litharge.

In the regular assay, nitre does not act by oxidising metallic lead, but it attacks its equivalent reducing agent in the ore, be it sulphur, arsenic, or other constituent.

(To be continued).

ON THE ORIGIN OF THE DIAMOND.*

By the Rev. W. B. CLARKE, M.A., F.G.S.

Connected with coal plants in transmuted deposits there has arisen another enquiry amongst ourselves as to the probable origin of the diamond. How has the diamond been produced, and to what geological formation does it belong, are questions which have had various replies. Although we may not be able to solve the mystery, it may, perchance, be not uninteresting to review the statements that have been put forth by different authorities, now the public mind in Australia is excited by accounts of increasing discoveries of the precious gem in New South Wales.

It appears that I did not miscalculate when, in 1860, I headed a notice of five diamonds that had come into my hands, "New South Wales a Diamond Country ("Southern Gold Fields," p. 272); for, up to the present time, several thousands have been brought to light. In some valuable papers by Mr. Norman Taylor, and in a report of similar character by Professor Thomson of our University, may be found a clear exposition of the phenomena presented in the diamond field at Two-mile Flat on the Cudgegong River, which these gentlemen have recently explored and described.

The opinions expressed by them are to the effect that the diamond district is limited to the presence of an ancient drift deposit covered generally by basaltic rocks, and that when found in the river bed, or in alluvial soil, the diamonds are frequently scratched and broken, whilst in the drift alluded to they are found intact. And at the points where they are thus found in the river bed, they are so found in consequence of the tailings of the miners having been washed thereto.

The river having changed its course, the area referred to is merely an alluvial space at one of those points.

The general formations of more ancient date in the vicinity are considered to be Upper Silurian traversed by greenstone, with overlying carboniferous beds as outliers of more extended strata. Mr. Norman Taylor has suggested that the diamonds have been in some way derived from the carbon in the coal measures. Opinions as to the derivation of diamond from vegetable matter by a process of distillation, somewhat like that to which coal is due, and even from animal matter capable of supplying carbon, have been long held by certain philosophers.

Considering the facts glanced at before,* relating to the transmutation of rocks by heat and other agencies, the formation of diamond in the humid way does not appear to me an extravagant supposition. But, on examining the sand or deposit in which the Cudgegong Diamonds are found, I was struck with the amount of minute gems, such as zircon, topaz, sapphire, corundum, spinel, pleonaste, &c., which composed the finest sifted material in which gold is also found; and Mr. Norman Taylor dwells on the circumstance, that the diamond is not only associated with the gold (as in most other foreign localities), but with those gems which are held to have had an igneous origin, occurring as they do in rocks which are so denominated; and in some cases (I may add) in true lava of modern volcanos.

But before I go further into this question, I must digress, in order to explain, that though diamond is thus associated, on the Cudgegong and on the Macquarie, as at Suttor's Bar, yet there are in my knowledge hundreds of spots throughout the length and breadth of Australia where the same gems are found in as great abundance, often of much larger proportions, with or without gold and without a trace of the existence of diamond. I have found them myself in this way in a variety of places in this and the neighbouring colonies, in an area which I do not exaggerate when I call it a hundred thousand square miles; and within the last year I have received thousands of such gems from correspondents and visitors who have consulted me, without finding among them more than a few diamonds and but ten independent of the present produce from Two Mile Flat and Suttor's Bar.

Those ten were found not far from Bingera, and are the first fruits of a new locality. They were accompanied by zircon, larger than any found with diamonds on the Cudgegong, but also with very small crystallisations of the same mineral and quartz. The friend to whom I am indebted for the examination of these diamonds is encouraging a search for more. I may add that I have seen no diamond from Cudgegong exactly resembling those from Bingera.

I have received also two diamonds said to be found near Kangaloon, on the Mittagong Range; but, as many other minerals which are probably not indigenous there, have also been forwarded from the same neighbourhood, I have much hesitation in accepting the statements made.

A further announcement was made to me in 1870, of diamonds on the Darling, a few miles from Fort Bourke, but on examining a large collection of the pebbles consigned to the Commercial Banking Company as "diamonds" and "precious stones," I found that they were all varieties of silica [quartz, jasper, agate, chalcedony], with small highly polished fragments of fossil wood and other drift.

On the Cudgegong there are five principal places where the mineral is found. They occur at various depths from the surface, greenstone in some instances having caused the formation of unequal hollows for the collection of drift. The intrusive rock follows the strike of the older rocks, which is about N. 25° W.

The older drift has been since covered by a basaltic flow, which in turn has suffered from the denudation that has spread the drift, so producing a younger drift, to which Mr. Norman Taylor assigns the term Newer Pliocene, in contrast with the older. This designation is, no doubt, due to his Victorian practice. The basalt he compares with that of the Coliban River in Victoria, which from my own personal knowledge of that locality I can confirm.

The carboniferous rocks have not furnished much detritus to the older drifts; but such occurs abundantly

* From the Anniversary Address delivered to the Royal Society of New South Wales.

* "On the Transmutation of Rocks in Australasia," by the Rev. W. B. Clarke, M.A.; read before the Philosophical Society of N.S.W., May 10, 1865 (T. P, S., p. 266).

in the river bed. A still more recent wash of drift occurs on the present surface.

Mr. Taylor very properly presents to notice a difficulty which has been hinted at already.

If the diamonds were derived from the carboniferous rocks, why are they not found in the river bed, except where the tailings of the miners have been washed in? From all the evidence arrived at, the newer drift is derived from the older, and with them is associated a cement of quartz and altered rock held by a yellowish green silicate of iron and hydroxide of iron, from hand specimens of which I have myself taken gold. Mr. Taylor says it contains diamonds also.

Many of the pebbles, which are of quartz and very hard flinty altered rock, have long attracted my attention, on account of the glaze or polish which they wear. They have exactly the outward coating which distinguishes so many of the surface pebbles found in the very heart of the interior of Australia, traversed by Sturt, M'Kinlay, and Burke and Wills. What may have been the way in which these pebbles have been polished is not easy to be discovered. Iron sand, or, better still, perhaps, gem sand, in violent motion, may have been the agent, since we know granite rocks in sandy desserts are polished by sand-flows far from water. It has been suggested, that the polish arises from the action of silicated water, as the hollows in the pebbles are as smooth as the general surface. But they are only in the condition of the greatest part of the surface drift all over the interior of New Holland. Unless, therefore, we assume, that a flood of silicated water has covered the greater part of New Holland, we cannot so explain the phenomenon. If, on the other hand, the gems and the iron belong to the basaltic rocks, and if these are younger than the cement, such an explanation can only be accepted in connection with a much more distant origin for the pebbles than any local strata. The older drift, therefore, cannot have a local origin.

It is certain, moreover, that if the other gems have been derived from basaltic rocks, and not from the greenstone, of which there is no evidence, the basalt was of an older period than that which now covers the drift, and such older basalt is not traceable. All, therefore, favours the belief that the term drift, implying a driving of material from a distance, is a correct term to apply to the diamond-bearing deposits; but a question of another kind immediately suggests itself,—Was the motive power of this drift, and of necessity of the gold drifts, *fluviatile* or *glacial?* A marine accumulation is not suggested; and no fossil remains, favouring such a solution of the question, have been found. Silicified wood of the carboniferous age occurs abundantly in the drift; but it must have been silicified long before any diamond could have been formed from the carbon which the original wood contained, unless diamonds claim an antiquity as high as that of the coal measures themselves, or even one higher than theirs. In that case, they must also be drifted, as well as the minerals and rocks that are associated with them.

This may be the final result of our enquiries, but there are many who (as Mr. Taylor does) think the diamond is a product of chemical forces now in operation, and therefore, it is a strictly local and limited product, not necessarily connected with any carboniferous beds of comparatively high antiquity, As magnesite exists in the vicinity, and that is certainly a recent product, arising from the decomposition of the exposed igneous rocks, so infiltration, decomposition, and reconstruction of carbonaceous materials, of whatever age, under the influence of chemical transformation, may be producing diamonds at this moment, wherever the needful conditions exist.

An author of some distinction, M. Favre, Professor of Geology at Geneva, has turned his attention to this very subject, and as his paper "On Artificial Minerals" may not be generally known, I will refer to it. [It is to be found in the *Bulletin* of the *Société Geologique de France*, vol. xii., 2nd series.] He therein reviews the experiments which, up to 1855, had been made in the production of artificial diamonds, and refers to the experiments of M. Jaquelain who had procured from the diamond a carbonaceous matter having the aspect of coke, and those of M. Despretz who had proved that melted carbon and melted diamond are nothing but graphite. This is akin to the idea of Glocker of Breslau, and of others before him, that diamond is an altered coal. Petzholdt also found in different diamonds—especially the brown—traces of similar organisation to that of silicified vegetable matter; but Dufrenoy rejects the opinion of Liebig, that they can have a vegetable origin.

M. Favre shows, that of thirty-four minerals found with diamond (according to the catalogue of M. Denis), consisting of sulphurets, carbonates, oxides, silicates, and native metals, thirty have been artificially produced; and of the thirty, twenty-nine were produced by the aid of volatile chlorides.

If this be the case, though one of the conditions is heat, the argument as to an igneous origin for diamond, because it is found in association with minerals of igneous origin, must be abandoned or modified.

Ten years later, Professor Goppert, in his work "On the Organic Nature of the Diamond," pointed out, as Jaquelain had done, that it may be turned into coke. He says, that some must have been soft, as they are superficially impressed by sand and crystals; that others contain crystals of other minerals, germs of plants, and fragments of vegetation. Hence, it would certainly appear, that the origin of such diamonds cannot have been igneous, and, I may add, assuredly not more so than those granitic rocks I have already mentioned, that contain coal measure plants. He states further, in 1868, that he had a diamond which contained *dendrites*, such as occurs on minerals of aqueous origin; that there are at Berlin, one which contains bodies resembling *Protococcus pluvialis*, and another green corpuscles linked together, closely resembling *Palmoglæa macrococca*. To these supposed Algæ the names have been given of *P. adamantinus* and *Palmogleites adamantinus*. As illustrating the views he takes of these diamonds he says, the metamorphic rocks in which they occur also contain evidences of vegetable fossils, such as *Eozoon canadense*; and that even in some topazes there are traces of organic substances.

A very interesting lecture was delivered by Dr. Percy, "On Chemical Geology," on December 12, 1863, before the School of Mines, in which he treats of the formation of silica; of "that glorous mineral corundum;" of spinel, and of other gem stones; showing the influence of water, moderate heat, and salts of chromium, and he then adds: "the diamond will come ultimately, no doubt." There is nothing to show that an igneous origin is attributed to them.

As an item in this enquiry, we may refer to a notice in *Silliman's American Journal* (vol. vi., p. 110), 1848, by Professors E. and W. B. Rogers, referring to a previous paper, on "A New Method of Determining the Carbon in Graphite" (vol. v., p. 392), in which the authors show that "the diamond may be converted into carbonic acid in the liquid way, and at a moderate heat, by the reaction of a mixture of bi-chromate of potassa and sulphuric acid, in other words, by the oxidating power of chromic acid." The method is much the same, as in the process of oxidating graphite. By this method, they obtained from half a grain of diamond an evolution of as much carbon as was nearly equal to what was due to the entire weight of the diamond.

On the other hand, Sir J. Herschel (Physical Geography) quotes the case of a Bahia diamond mentioned by Harting, which contained well-formed filaments of iron pyrites, and he infers from the combination of iron and carbon at high temperatures the possibility of an igneous origin for diamond.

A paper by Messrs. Sorby and Baker was read in 1869 before the Royal Society of London, on the structure of certain minerals, among them ruby, sapphire, and diamond, showing that these gems contain cavities entirely

or partially filled with a liquid, probably condensed carbonic acid, as well as with crystals—that some emeralds contain a strong saline solution with cubic crystals, probably of chloride of potassium, and that the black specks in diamonds (such *e. g.*, as those seen in our Cudgegong mineral) are really crystals, which are sometimes surrounded by contraction cracks, a black cross appearing under polarised light. The authors conclude that the diamond does not afford positive evidence of a high temperature, though not opposed to it.

That its structure has great peculiarities has been shown by the changes produced in a yellow diamond by heat. This stone was exhibited by M. Frémy to the Académie des Sciences at Paris in 1866, when it was seen to become rose-coloured by the application of heat, returning to its proper tint on cooling. It is said to be the first instance of such a phenomenon. But, on turning to the 7th Report of the British Association, it will be seen, that in 1837, Sir David Brewster pointed out that the diamond possesses strata of different refractive powers; and he uses this as a strong argument for its vegetable origin—the changes of refraction, and, consequently, the density in parts and hardness in the same crystal being due to the action of the gases imprisoned in an expansive mass.

If we now consider the relations of the diamond to the rocks in which it is found, we shall see how great or how little is the dependence upon *them* for its origin.

A statement was made in *Nature*, February, 1870, p. 363, respecting the finding of a diamond in *granite* in the neighbourhood of Prague. It is described as exceeding in hardness the Brazilian diamonds. It was suggested to be zircon, but this Dlaschkowitz stone appears to be a veritable diamond. Its occurence in *granite* was also mentioned in the *Chemical Journal*. The statement came from Professor Schafarik, who sent it to the Bohemian paper *Politik*. On such authority it was received but not believed as authentic.

It was not till I found mention of it in an Italian publication that I discovered the mistake that had been committed. In a notice, under the head "Scoperta di Diamanti in Boemia," in No. 6 of the *Bollettino* of the *Reale Comitato Geologico d' Italia*, published in June, 1870, p. 175, we read "Fecesi questa scoperta sul finire dello scorso anno nelle vicinanze di Dlazkovic, villaggio posto tra Bilin e Lobositz, in Boemia, dove existe un giacimento di sabbie *Granatifere* lavorate per l'estrazione dei *piropi*, varietà di *granato* di un bel color rosso. Commista al prodotto della lavatura di queste sabbie, rimarcossi dai lavaratori una piccola pietra sconosciuta, durissima, e di color giallo-verdastro, che sottoposta ad esame si riconobbe essere un piccolissimo *diamante* del peso di 57 milligrammi ed in forma di esaedro a spigoli rotundati. *Dopo* di quest' epoca *altri diamanti* di simil fatta si ritrovarono, benchè assai di rado in *quelle sabbie granatifere* Quantunque sia questa scoperta di ben poca importanza, pure crediamo bene di segnalarla, essendo indubbiamente questo il *primo giacimento diamantifero che in Europa siasi trovato.*"

From this we learn that these diamonds were *not found in granite*, but in a *garnetiferous sand*, which is a new fact for *Europe*, but not for the supposed origin of diamond in a plutonic rock. I have quoted the original words to prevent mistakes as to the meaning.

(To be continued.)

ON THE

ESTIMATION OF PHOSPHORIC ACID.

By CHARLES E. MUNROE.

I. Though the methods commonly in use for the quantitative determination of phosphoric acid are capable in most cases of giving accurate results, yet it will, I think, hardly be claimed for them that they render new methods unnecessary, and I have therefore undertaken the following investigation in the hope of adding something of value to our analytical resources.

My attention was first called to the employment of ferric chloride with the addition of sufficient mercuric oxide to neutralise the excess of acid. Free mercuric oxide was first added directly, but, as a complete separation could not be effected in this manner, it was found more advantageous to produce the oxide in the solution itself. This was accomplished by first adding mercuric chloride and then potassic or sodic hydrate. As sodic hydrate* can be obtained in commerce absolutely pure this was employed. The precipitate, consisting of ferric phosphate and ferric and mercuric oxides, was then evaporated to dryness in the manner recommended by Chatard,† filtered and washed on the Bunsen pump.‡ Unhappily the phosphoric acid re-dissolved after evaporation to dryness, and the process was therefore abandoned. Bunsen's delicate test with magnesium wire was used throughout the work, sometimes in connection with ammonic molybdate, for the detection of phosphoric acid.

I next studied the behaviour of aluminic oxide toward phosphoric acid, and this time met with better sucess.

The following course was pursued. To the boiling phosphate solution a weighed quantity of pure aluminic sulphate, previously dissolved, was added. A solution of mercuric chloride was then added, and finally sodic hydrate until a precipitate of mercuric oxide was obtained which remained undissolved. In order to hasten the operation the precipitate was allowed to settle and the supernatant liquid poured upon the filter. The gelatinous precipitate was then evaporated to complete dryness as before mentioned, filtered, ignited, and weighed. The increase of weight over that of the aluminic oxide used was phosphoric oxide. It was found extremely difficult to burn the filter. Care must be taken that for every grm. of phosphoric oxide at least 2 grms. of aluminic oxide are added.

The percentage of aluminic oxide, in the sulphate used, was determined by ignition, ammonic carbonate being used to drive off the last traces of sulphuric oxide. The following results were obtained:—

	Grms.		Grms.	
(1).	0·7320 $Al_2(SO_4)_3.18H_2O$	gave	0·1310 Al_2O_3	= 17·89 p. c.
(2).	0·7100 ,,	,,	0·1270 ,,	= 1787 ,,

Mean 17·88.

Anhydrous disodic phosphate was the first salt treated. In order to work with greater rapidity a solution of known strength was prepared of which 50 c.m.$_3$ corresponded to 0·6195 grms. of phosphate. This gave the following results:—

(1).	0·6195 grms.	gave	0·3099 grms.	P_2O_5	= 50·02 p. ct.
(2).	0·6195 ,,	,,	0·3100 ,,	,,	= 50·03 ,,
(3).	0·6195 ,,	,,	0·3097 ,,	,,	= 50·01 ,,
(4).	0·6195 ,,	,,	0·3097 ,,	,,	= 50·01 ,,

Mean 50·02. Theory 50·00.

Ammonio-sodic phosphate ($Na(NH_4)HPo_4,4H_2O$) was next analysed. The amount of phosphoric oxide in the salt was found by igniting it and weighing the sodic metaphosphate,

	Grms.		Grms.		
(1).	1·4650	gave	0·6172 $NaPO_3$	= 29·32	per cent P_2O_5
(2).	1·5017 ,,		0·6344 ,,	= 29·40	,, ,,

Mean 29·36.

By the alumina process the following results were then obtained:—

---

* The article used was manufactured in England by the direct oxidation of metallic sodium.

† *American Journal of Science*, vol. iv., p. 247.

‡ A simple modification of the Bunsen pump may be obtained by connecting a piece of glass tubing, by means of rubber, with a Bunsen funnel. A funnel holding 50 c.m.^{3} connected with a piece of glass tubing 1 metre in length emptied itself five times, while another funnel of the same capacity, arranged as usual, did so but once. The pressure was so great that the filter had to be protected with a platinum point to prevent it from giving way.

(1). 1·5405 grms. gave 0·4514 grms. P_2O_5 = 29·30 per cent
(2). 1·2610 ,, ,, 0·3707 ,, ,, = 29·39 ,,
(3). 1·1355 ,, ,, 0·3321 ,, ,, = 29·29 ,,
Mean 29·33.

Calcic phosphate did not give good results by this process on account of the difficulty of washing out the calcic sulphate formed. I succeeded no better with ammonio-magnesic phosphate; doubtless because some of the magnesia went down with the alumina. These experiments are sufficient to show that phosphoric acid may be determined with extreme precision in the alkaline phosphates by the method above given, but the method applies with advantage only to these salts. On the other hand, it must be remembered that many phosphates may be decomposed by fusion with the alkaline carbonates and the phosphoric acid then determined as above, so that in fact the method applies in perhaps the greater number of cases which occur in practice.

II. Rose's* method for the separation of phosphoric acid by means of mercurous nitrate and subsequent estimation in the form of pyrophosphate of magnesia has been much used. It will, however, be acknowledged that it has some serious defects. It is tedious, the many operations required increase the chances of error, and the fusion of mercurous phosphate with the mixed carbonates exerts, according to Rose, a sensible action upon the platinum crucible. Nevertheless the perfect separation which it gives is a strong recommendation of the method.

It appeared possible that a valuable modification of this process might result from the addition of mercuric oxide in the manner already employed in the alumina process above described.

The experiments were executed in the following manner. To a boiling solution of the phosphate mercurous nitrate was added in slight excess. This threw down a lemon-yellow coloured, crystalline precipitate of nitro-mercurous phosphate, which adhered to the sides of the beaker when touched by the stirring rod. Mercuric nitrate was then added and finally sodic hydrate until a slight precipitate of mercuric oxide was obtained which remained undissolved. The mixture of the two salts was found to be insoluble in both hot and cold water, and to wash like sand.

The next step was to find a readier means of treating the nitro-mercurous phosphate.

It was first proposed to dissolve the washed and dried precipitate in chlorhydric acid and titrate with potassic permanganate so as to oxidise the mercurous to the mercuric salt. This process failed. The salt was then treated with sulphuric acid. The final reaction was perfectly sharp, but the results were not satisfactory.

These results having proved that nothing was to be gained in that direction, I tried to remove the mercury by decomposing the nitro-mercurous phosphate with nitric acid and precipitating the mercury with sulphydric acid or ammonic sulphide. The phosphoric acid was then to be determined in the filtrate by the ammonio-magnesian solution. On examining the mercurous sulphide it was found that some of the phosphoric acid was always precipitated with it. Its presence was proved by Bunsen's test with the magnesium wire. The salt was then dissolved in a solution of potassic cyanide and a current of sulphydric acid passed through, but with the same result as before. Again it was thought that the phosphoric acid might be precipitated directly from the cyanide solution by ammonio-magnesic chloride, but experiment showed that the cyanide contained so much cyanate and carbonate that, although the solution was boiled and chlorhydric acid was added to it, accurate results could not be obtained.

As the ignition of the nitro-mercurous phosphate with the non-volatile metallic oxides, in order to drive off the mercury, promised well, this process was then tried in the following manner.

* "Traité de Chimie Analytique," vol. ii., p. 708.

The dried salt was thoroughly mixed with a weighed quantity of cupric oxide in a platinum crucible and the filter placed on top. The whole was ignited, at first gently, then to low redness, at the mouth of a muffle,* then cooled, a few drops of nitric acid added to oxidise the cupric oxide reduced by the filter, and then re-ignited. The ignition was continued until the weight became constant. The increased weight was the phosphoric oxide (P_2O_5). After ignition the cupric oxide and phosphate came out of the crucible in a beautiful coherent mass, leaving it perfectly clean and unharmed.

(To be continued).

CORRESPONDENCE.

ANALYSES OF MANURES.

To the Editor of the Chemical News.

Sir,—Mr. A. H. Church in his letter on "Agriculture and Chemistry" in the Chemical News for June 9, 1871, publishes an analysis of a substance sold in England as manure, and adds that the manufacturer had evidently scraped the floor a trifle too hard. I may say to Mr. Church that there are manufacturers here who do not trouble themselves to scrape the floor, but simply have recourse to the pump, when they make their "fertilisers."

I analysed a commercial manure last year which sold for 30 dollars per ton—say £5 10s. sterling—with the following result, viz:—

Water	53·5
Organic matter	21·6
Silica	1·6
Phosphate and carbonate of lime	23·3
	100·0

It will be apparent that as 2000 lbs. of the above "dirt" contained 1070 lbs. of water the purchaser paid for the solid matters about £11 sterling, or three quarters of the price of genuine Peruvian guano.

I may add that tricks like the above have caused a widespread distrust of artificial manures.

Peruvian guano, obtained of the importers, and this is the only manure, except flour of bone, that I use in my own horticultural experiments on a small scale, maintains its old reputation pretty well, but there are rumours afloat that even this is damped more than is needful to lay the dust.—I am, &c.,

J. M. Merrick.

Laboratory, 59, Broad Street,
Boston, Mass., U.S.

HISTORY OF THE AMMONIA PROCESS.

To the Editor of the Chemical News.

Sir,—In your last impression is a letter with the above heading from Mr. Wanklyn, in which, in the beginning of the last paragraph, speaking of the opposition which the process for estimating the nitrogenous organic matter in water, put forth by himself and Messrs. Chapman and Smith,† met with, he says, "One chemist could, as he informed the Chemical Section of the British Association in 1867, decompose a very dilute solution of albumen so completely, by boiling it with weak solution of carbonate of soda, as to obtain the whole of its nitrogen in the

* Justice is not done the muffle furnace. It gives an even, mellow heat which can be easily regulated, and for igniting precipitates it is unequalled. I have before spoken of the difficulty found in burning the filter with the aluminic phosphate. By placing it at the mouth of the muffle I was able to ignite it in the most perfect manner, without tipping the crucible, in less than ten minutes. Discretion must be used in placing the crucible in the muffle.

† *Journ. Chem. Soc.*, vol. v., second series, p. 445 *et seq.*

form of ammonia," and as I am the chemist referred to, I trust you will allow me to say a few words upon the matter, as I clearly think that, in the way in which Mr. Wanklyn has put it, your readers would be led to suppose that my experiments had been proved wrong by similar experiments made and published by Mr. Wanklyn or his colleagues, which has not been the case.

The paper above referred to as read by me is published in your valuable journal in full,* and, since its publication, I have repeatedly made similar experiments, and I have no reason to doubt the accuracy of the conclusions I then arrived at, both as regards the actions upon the solutions containing urea and upon the solutions of albumen described in it.

The term "*weak* solution of carbonate of soda" is not mine, but Mr. Wanklyn's; my experiments were begun with 2 grms. of dry carbonate of soda to a litre of water, as in Messrs. Wanklyn, Chapman, and Smith's experiments, but as the distillation proceeds the solution gets gradually stronger and stronger, and at the end of the experiment it may, perhaps, be considered a somewhat strong solution. The experiments are so easily made, I have just now concluded one: it was made as follows:—In 1 litre of water was dissolved equal to 0·0014 grains of dry white of egg containing 0·000217 grains of ammonia, and 2 grms. of dry carbonate of soda, and this solution was put into a retort capable of holding not less than 2 litres of water, and was rapidly distilled until the distillate did not show a trace of ammonia on standing for a quarter of an hour after adding Nessler's test. The residue in the retort, distilled with hydrate and permanganate of potash, gave a distillate which yielded only the most minute trace of colour with the Nessler test, showing that the nitrogen in the albumen was practically removed from it by the previous action of the carbonate of soda upon it.—I am, &c.,

Dugald Campbell.

7, Quality Court, Chancery Lane, London,
July 12, 1871.

MISCELLANEOUS.

Publication of Abridgments of Letters Patent.—The following letter has been received by Mr. P. Spence, of the Pendleton Alum Works, Manchester, from Her Majesty's Commissioners of Patents, in reply to an influentially signed memorial of patentees, manufacturers, and others, asking an earlier publication of the abridgments, and of the "Persons" and "Subjects" indexes, hitherto always from six to eighteen months behind. By the aid of the weekly issues referred to (and which the Commissioners kindly promise to commence on the 15th inst.), it will be perceived that any inventor, manufacturer, or other interested party, will be enabled henceforth to refer with ease and certainty to the latest patented improvements in any given field:—

"Patent Office, July 5th, 1871.

"Sir,—Your letter of May 12th and accompanying memorial were considered by the Commissioners of Patents at their meeting on the 29th ult., and I have now the pleasure to acquaint you that they decided to comply with the wishes of the memorialists. The abridgements furnished by the applicants for letters patent will therefore be published weekly with indexes of Persons and Subjects, commencing on Friday, July 15th, with the abridgements delivered between 1st and 7th of January, and of which the six months' term would expire between the 1st and 7th of July. Will you be so good as to communicate this information to the gentlemen who signed the memorial. —I am, sir, your obedient servant, B. Woodcroft, Clerk to the Commissioners of Patents."

* Chemical News, vol. xvi., p. 139 *et seq.*

Meat Preserving.—Many methods have been introduced to meet the ever-growing want of England—cheap animal food. Some of these methods have been successful, and others the reverse. We could ill spare the little that is already placed at our disposal by Australian and other meat companies; and the highly remunerative character of investments in the preserved-meat trade affords a sure guarantee for greater efforts in the future than any that have hitherto been made. Liebig's process has been carried on very profitably at home as well as abroad; but the preparation of extract of meat has been declared wasteful from the small amount of stimulating material preserved, and the carting away of all albumenoid matters to the manure-heap. A new plan has been introduced by an engineer, whose experience in sugar refineries and other extensive works in hot latitudes has ensured a practical and economical solution of one of the most important problems of the day. Mr. T. F. Henley does away with steeping meat in water, and with boiling and otherwise treating it in the most costly way. He simply squeezes a definite amount of juice out of the fibre, and by mechanical desiccation preserves the latter intact. The pressed meat thus obtained contains 10 per cent of alcoholic extract and salt, and over 50 per cent of fibrin and other albumenoid constituents. It is exceedingly rich, and so is the meat-juice which Mr. Henley evaporates in vacuum pans. The juice contains about 15 per cent of alcoholic extract, and over 50 per cent of albumen. The ancient method of abstracting water only from the animal matter is relied on as the preservative, and the low temperature at which the evaporation is carried on prevents any loss of flavour or other deterioration. It is perhaps strange that so cheap and simple a process should not have been suggested before. Mr. Henley has worked at it for some time, and perfected it so as to ensure its immediate adoption. The first works, on an extensive scale, are to be opened in the River Plate, on the Estancia Nueva Alemania, where cattle have been reared and fattened for the European markets. It is proposed to slaughter three hundred bullocks daily; and since it is stated that the hides and feet pay the first cost of the bullock and of its slaughtering, the financial prospects of the undertaking wear a promising aspect.—*British Medical Journal.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, June 5, 1871.

This number contains the following original papers relating to chemistry and collateral sciences:—

New Method for Measuring Magnetism in Mechanical Units.—A. Cazin.—An algebraico-physical paper.

New Facts concerning Selenium.—P. Guyot.—The author draws the following conclusions from his experiments:—(1) Selenium, dissolved in sulphide of carbon, does not precipitate any other acid salts than nitrate of silver; (2) among the neutral salts, also, none but the silver salt just alluded to are precipitated by the aforesaid solution; (3) the solution alluded to precipitates some metals in alkaline solution, since there is seleniuretted hydrogen formed, which acts upon these solutions; (4) all these precipitates are seleniurets; (5) with iodine, proto-iodide of selenium in a crystalline form is obtained.

New Liquid Fire.—P. Guyot.—When to flowers of sulphur in excess bromine is added, and this mixture, after having been left

standing for a while in a glass-stoppered bottle, filtered through asbestos, there is obtained a liquid which, on analysis, was found to consist, in 100 parts, of 83·33 of bromine and 16·77 of sulphur, being, therefore, proto-bromide of sulphur. This liquid, when brought into contact with liquid ammonia, appears at first inert, but after a few minutes the mixture boils violently and bursts into flame. The author describes at length his experiments which led to the following results:—Bromide of sulphur behaves in the presence of ammonia like chloride of sulphur, but the reaction with the bromide is not instantaneous; the bromide of sulphur may be employed for the purpose of producing liquid fire, to which the author gives the name of *nouveau feu lorrain*. The reader is reminded that, in 1869, the late J. Nicklès, at Nancy, discovered a composition for a liquid fire which obtained the name of *feu lorrain*. The use of the bromide of sulphur is more safe, but all attempts made by the author to bring this mixture, by various means, into a more manageable pasty mass have failed.

Dynamite.—P. Guyot.—The main gist of this paper is the communication of an observation which is not by any means unimportant. The substance known as dynamite (consisting essentially of nitroglycerine absorbed by any suitable inert powder) is met with in the trade made up in cartridges weighing, on an average, 71 grms., and packed in boxes weighing, with contents, about from 25 to 30 kilos. The author, happening to have in his possession a number of cartridges containing dynamite (the body of the cartridge is made of stout grey paper), found that these objects, after some lapse of time, became moist and oily looking, and a cardboard box in which the cartridges were kept was also found impregnated with a liquid, which, on investigation, turned out to be nitroglycerine. A small piece of the paper so impregnated exploded violently when brought into contact with glowing coals, and the like effect was observed when a piece of the paper was laid upon an anvil and smartly struck with a hammer. The author also found that the wood of the boxes in which dynamite cartridges are kept becomes, by slow degrees, impregnated with nitroglycerine, and thereby a most dangerously explosive material, which may give rise to serious accidents in warehouses where dynamite is kept.

June 12, 1871.

This number contains the following original papers and memoirs bearing upon chemistry and allied sciences:—

Memoir on the Celestial Origin of Atmospheric Electricity. M. Becquerel.—This very lengthy essay is, notwithstanding its high intrinsic value, not well suited for any useful abstraction, an observation which also applies to the two following papers.

Note on Simple Relations Existing between the Pressure of Aqueous Vapour and the Temperature.—J. G. Duperray.

Physical Constitution of the Sun.—A. Boillot.

Establishment of a Meteorological Observatory on the Azores.—Dr. Buys-Ballot.—After briefly pointing out the great importance, not simply in a scientific, but also in a mercantile and industrial point of view, of having, on one of the islands just named (they belong to Portugal, and are situated at about 40° N. lat., and 30° W. of Greenwich), a meteorological station, connected by submarine telegraphs with Europe and America. The author states that probably by September, 1872, this desirable object will be accomplished by the activity of M. Fradesso da Silveira, the Director of the Observatory at Lisbon.

June 19, 1871.

This number contains the following original papers and memoirs relating to physico-chemical sciences:—

Low Temperature of the 18th of May last and of the first days of June.—Ch. Sainte-Claire Deville.—From the contents of this lengthy paper, containing a series of communications received by the author from different localities in France, it appears that, even in the very south of that country, the temperature fell during this period to so low a degree as has not been witnessed within man's memory at this time of the season; moreover, heavy storms, accompanied by deluging rains and seriously destructive hail, have occurred in many parts of France; while near Paris, at St. Germain en Laye, the author found the temperature was −3·5° on the 18th of May, in the morning, at a height of 33 centimetres above the soil (a meadow).

Alteration which the Yellow Metal employed for Coppering (as it is technically termed) Wooden Ships undergoes, and on the means of ascertaining the nature thereof beforehand.—A. Bobierre.—After referring to his former labours on this subject (see *Ann. de Chim. et de Phys.*, 4th series, vol. xv.), the author in this memoir states chiefly that the effects of wear and tear (slow dissolving of the metal by the aid of an electric current) are only applicable under the following restrictions:—The alloy to be tested should be previously acted upon by an acid (*décapé*); a chemical analysis of the alloy is also necessary in order to ascertain its precise composition, and for the purpose of ascertaining the impurities it may contain. Lastly, it is necssary to know whether or not the metal was rolled out while red-hot.

Dissociation as Viewed Thermodynamically.—J. Moutier.

Heat Produced by the Combustion of Magnesium and Zinc.—A. Ditte.—Are both algebraico-physical memoirs.

Researches on the Formation of Gallic Acid.—M. Sacc.—The author points out that, if the theory usually accepted for the mode of formation of gallic acid (which, according to Pelouze's experiments, has the formula $C_7H_3O_5$, and is derived from tannic acid simply by its splitting up into sugar and gallic acid in the presence of water) be correct, there ought to be obtained a smaller quantity, by weight, of gallic acid from a given quantity of tannic acid used. That this does not so happen has been proved already by Dr. Stenhouse, who found that tannic acid, while being converted into gallic acid, yields its own weight of the latter. The author of this paper, having made a series of experiments on this subject, found that tannic acid, while being converted into gallic acid, increases considerably in weight, and concludes that hydratation there takes place, and that accordingly tannic acid is only the anhydride of gallic acid.

Use of Gaize for the Preparation of Alkaline Silicates.—A. Scheurer-Kestner.—After referring to the memoir on gaize (a peculiar mineral found in some parts of France), by Sainte-Claire Deville and Desnoyer (see *Comptes Rendus*, vol. lxx., p. 581), the author communicates, at length, a series of experiments instituted by him with a gaize, composed, in 100 parts, of—Hygroscopic water, 3·4; water of combination, 3·2; silica soluble in alkaline solutions, 43·7; insoluble silica, 40·8; alumina, 3·8; ferric oxide, 3·8; lime, 0·9. The results of the author's experiments are that gaize, boiled for a length of time with caustic soda, yields a silicate, $Si_5Na_4H_8O_{16}$; that boiling under pressure at 150° does not yield a better result, and that therefore it is not likely that gaize may be industrially employed for the preparation of alkaline silicates by being simply boiled with caustic soda.

Use of Dynamite for the Purpose of Breaking Up Heavy Masses of Cast-Iron.—P. Champion.—This paper records, at considerable length, the results of some experiments made upon an anvil belonging to a steam hammer, and weighing over 5 tons, which was broken up into lumps of suitable size for the purpose of being smelted down by the aid of two small charges of dynamite.

Experimental Researches on the Constitution of Blood and on the Nutrition of Muscular Tissue.—W. Marcet.

This number contains, also, a series of papers bearing upon meteorology.

Revue des Cours Scientifiques de la France et de l'Etranger, (2nd series), No. 1, July 1, 1871.

This number does not contain any original papers relating to chemistry and allied sciences.

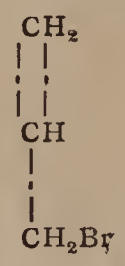
Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 10, 1871.

This number contains the following original papers and memoirs:—

Density (Sp. Gr.) of the Elements Compared with the Density of their Oxides.—H. Ludwig.—In order to give some idea of the main contents of this lengthy paper, we quote the following examples from its contents:—Light elements—viz., those the oxides of which are heavier than the elements themselves—Hydrogenium, solid, sp. gr. 0·733 (T. Graham), water, sp. gr. 1·000; silicium, sp. gr. at 10°, 2·49 (F. Wœhler), silica, sp. gr. at 4°, 2·652 (Dumas and Lecoyer); the oxides of these elements exhibit neither an acid nor alkaline reaction, and consequently correspond in that respect with those of the earthy metals. Potassium, sp. gr. 0·865 (Gay Lussac and Thénard); potassa, sp. gr. 2·656 (Karsten). In this manner twenty elements are named and proved to belong to the class of light elements. The opposite class, heavy elements, contains, according to the author, oxygen, the haloids, selenium, sulphur, nitrogen, &c., forty-one in number.

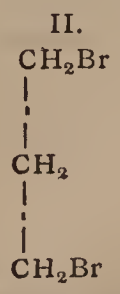
Observations on the Constitution of Rosaniline.—H. Baumhauer.—The value of the contents of this paper depends upon the diagrams representing the constitutional formula of rosaniline, first as represented by Dr. Kekulé in his work "Chemie der Benzol Derivate," vol. i., p. 180, and next as modified by this author.

Contribution to our Knowledge on the Constitution of the Allyl Compounds.—F. Geromont.—The author states that, starting from the proposition that the constitutional formula of allyl-bromide (*allyl-bromür*) should be—



he succeeded in preparing from allyl-bromide, by the addition thereto of bromhydric acid, two other compounds, of the following constitution:—

Propylen-bromide (methyl-ethylen-bromide).



Trimethylen-bromide.

This reaction takes place readily when concentrated hydrobromic acid is used, and the operation performed in sealed tubes. At 100°, the two bodies the formula of which has just been quoted are separated from each other by fractioned distillation. The trimethylen-bromide forms about two-thirds of the entire crude fluid first obtained; after

having been purified, the sp. gr. of this body was found to be, at 0°, 2·0177; its boiling-point, 160°—163°. By the action of acetate of silver, aided by glacial acetic acid, the trimethylen-bromide is converted into acetic acid-trimethylenester (*essigsäure-trimethylenester*), a colourless heavy liquid, boiling at from 203° to 205°, and yielding, on being saponified with hydrate of baryta, trimethylen-glycol.

On Umbelliferon.—H. Hlasiwetz.—The substance was just named was first discovered by Zwenger and Sommer (*Ann. Chem. Pharm.*, vol. cxxxix., p. 99) in the bark of *Daphne mezereum*, and was next found by them in the products of the dry distillation of several resins derived from plants belonging to the natural order of the *Umbelliferæ*, umbelliferon being best obtained from the galbanum resin. The main portion of this essay is devoted, however, to a discussion bearing upon the constitutional formula of umbelliferon in reference to the recent researches on æsculetin (Chemical News, vol. xxiii., p. 275) by H. Schiff. Taking into consideration the behaviour of umbelliferon to acetyl-chloride, the author of this paper gives, for the body just alluded to, and æsculetin and para-æsculetin, the following formulæ:—

$$\underbrace{C_2H_2\left\{\begin{matrix}CH.O\\CH.O\\C.OH\\H\end{matrix}\right.}_{\text{Umbelliferon.}} \qquad \underbrace{C_6H_2\left\{\begin{matrix}CH.O\\C.OH\\C.OH\\OH\end{matrix}\right.}_{\text{Æsculetin.}} \qquad \underbrace{C_6H_2\left\{\begin{matrix}CH{\cdot}O\\CH{\cdot}O\\CH{\cdot}O\\O\end{matrix}\right.}_{\text{Para-æsculetin.}}$$

When an alkaline solution of umbelliferon is treated with sodium-amalgam, there is obtained umbellic acid, $C_9H_{10}O_4$, which is readily converted into resorcine, which is also directly formed from umbelliferon by the action of strong caustic potassa solution upon that body at a higher temperature.

Researches on the Constitution of the Benzol Derivatives.—V. von Richter.—This is the second instalment of an essay on this subject. According to this author, the three isomeric series of the benzol derivatives may be represented as follows:—

$C_6H_4\left\{\begin{matrix}Br\\NO_2\end{matrix}\right.$	$C_6H_4\left\{\begin{matrix}Br\\NO_2\end{matrix}\right.$	$C_6H_4\left\{\begin{matrix}Br\\NO_2\end{matrix}\right.$
(Boils at 125°.)	(Boils at 56°.)	(Boils at 37°.)
Orthonitrophenol.	Dinitrobenzol.	Volatile nitrophenol.
Chinon.	Resorcin.	Pyrocatechin.
Ortho-oxybenzoic acid.	Salicylic acid.	Para-oxybenzoic acid.

New Class of Dyes.—A. Baeyer.—The author first refers to his former paper on gallein (Chemical News, vol. xxiii., p. 275). The composition of this substance was, on analysis, found to be $C_{18}H_{14}O_7$. When treated with zinc and dilute sulphuric acid, gallein is converted into gallin, a solid, colourless, crystalline substance, soluble in ether, and, better yet, in an aqueous solution of pyrogallic acid. Gallin, dried in vacuum, was found, on analysis, to lead to the formula $C_{18}H_{16}O_6$; it is difficultly soluble in cold, but readily soluble in boiling water, and very readily in alcohol. Gallin exhibits great similarity to hæmatoxylin, with which it also shares the property of becoming readily pink-coloured, both in solid state and in solution; it (gallin) dyes tissues in the same manner as gallein. When this last-named body is treated with concentrated sulphuric acid at 200°, cöruleine is obtained, the formula of which is $C_{18}H_{10}O_6$, its mode of derivation from gallein being expressed by—

$$\underbrace{C_{18}H_{14}O_7}_{\text{Gallein.}} - H_2O - H = C_{18}H_{10}O_6.$$

Cöruleine is difficultly soluble (almost insoluble) in water, alcohol, and ether; it dissolves more readily in acetic acid, yielding a dirty green-coloured solution. In hot aniline it is readily soluble, the solution exhibiting a magnificent indigo-blue colour; this solution, slightly acidified with acetic acid, dyes wool indigo-blue. Cöruleine dissolves in alkaline solutions, exhibiting a beautiful green colour; tissues mordanted with alumina are dyed green by this solution, while, if mordanted with iron compounds, a brown colour is the result. These dyes are fast, and resist soapsuds. The author points out that there is a great similarity between cöruleine and the lo-kao, Chinese green. By the aid of reducing agents, cöruleine is converted into cörulin, soluble in ether, and yielding a yellow-coloured solution. By the action of phthalic acid anhydride upon resorcine, fluoresceine is formed, a yellowish-red coloured body, soluble in alcohol; this substance dyes silk and wool yellow without the aid of any mordant. When fluoresceine is heated with reducing agents, it is converted into fluorescine, which, on being treated with chromic acid, becomes again fluoresceine.

Action of Hydriodic Acid upon Hydrophthalic Acid.—K. Mizerski.—When hydrophthalic acid is submitted, along with hydriodic acid, in a sealed tube, to a temperature of from 240° to 250° for about six hours, the main product of this reaction (about 60—65 per cent) is found to be hexa-hydrophthalic acid, $C_8H_{12}O_4$, exactly identical with the substance obtained by Dr. A. Baeyer from tetra-hydrophthalic acid, agreeing therewith also as regards its melting-point (207°).

Les Mondes, June 29, 1871.

This number does not contain any original papers relating to chemistry and collateral sciences; but we meet herein with a short scientifico-biographical notice on—

The Late Professor Payen.—P. Thomas.—The author, the nephew of the deceased, states that the eminent *savant* died lately of apoplexy. As regards the very varied and immense mass of researches and discoveries made by the deceased, the following brief instances are quoted:—In 1824, he was the first who pointed out the rational method of applying manures in agriculture, and about the same time brought forward the theory of the decolouration of liquids by animal charcoal, also suggesting the use of the residues of the sugar refining (scums which contain more or less animal charcoal along with other substances) in agriculture. In 1830, he laid the foundation of the proper valuation of manures according to their richness in nitrogen. The late author's exhaustive researches on amylaceous matter settled the exact structure, mode of formation, and the derivation of dextrine and glucose from starch; the existence of diastase, also, was first pointed out by the deceased. Prof. Payen, very well known, also, among a great many others, by his excellent work on industrial chemistry, "Précis de Chimie Industrielle" (Paris: Hachette and Co., 1867), was, since 1842, a member of the French Academy of Sciences, and held the Professorships of Industrial Chemistry at the Ecole Centrale des Arts et des Manufactures since 1830, and at the Conservatoire des Arts et Métiers since 1839. The deceased was not only a very eminent scientific man, but was thoroughly and practically acquainted with almost every branch of industrial pursuits. Anselme Payen was born at Paris on January 17th, 1795, and was in early life first the technical manager of a beet-root sugar work at Vaugirard, and afterwards of a very large chemical work near Paris.

July 6, 1871.

Among the great variety of matter contained in this number, including political subjects, the only original communication which belongs to chemico-physical science is—

University of Cordova, Argentine Republic, South America.—The Government of the country alluded to has just added to its University (hitherto only consisting of two faculties—viz., law and divinity) a faculty of sciences, of which Dr. Burmeister, the celebrated author of the work bearing title "Geschichte der Schöpfung," and hitherto Director of the Museum at Buenos Ayres, has been appointed the Dean, while the following gentlemen have been appointed to the chairs placed after their names:—Dr. Stelzner, mineralogy and geology; Siewert (from Halle), chemistry; Lorenz (from Munich), botany; Holzmuller (from Merseburg), mathematics; Gould (from the United States), astronomy. For the chairs of natural philosophy and zoology, it is also expected to find amongst the scientific men of Germany gentlemen who will be willing to take these positions. The Argentine Republic has a superficial area of 515,700 English square miles, with barely 2,000,0000 inhabitants. Cordova is a city with 25,000 inhabitants, and is rather centrally situated.

Bulletin de l'Academie Royale des Sciences, des Lettres et des Beaux Arts de Belgique, No. 5, 1871.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences;—

Adulteration of Roasted Chicory with Pulverised Peat.—Dr. Th. Swartz.—After referring to the circumstances which caused this investigation, the author states that his process for the detection of this gross fraud, though not injurious to health, is based upon the following points:—Since peat is a fossil combustible, due to the spontaneous decomposition of woody matter, and since among these products are found hydrocarbons belonging to the germs petroleum, ozokerite, paraffin, fossil wax, &c., these substances have been searched for by the author among peat. This, having been treated with chloroform, yields from 4 to 5 per cent of a bituminous matter, which, after having been purified, presents unmistakable characters. Chicory, not adulterated with peat, does not, of course, yield any similar substance. Peat, being in a great measure produced by partly-decayed plants, remnants of *Sphagnum*, *Hypnum*, and *Decranum* may be discovered among chicory adulterated with peat by the aid of the microscope. Peat yields, on average, from 8 to 10 per cent of ash, and if of very old formation, even as much as 20 per cent; while chicory does not, in its natural, pure, unadulterated state, yield more than from 4 to 6 per cent of ash, provided, previous to roasting, the roots have been well cleaned and freed from adhering sand and soil. To this paper is added an excellently executed number of engravings representing the microscopic structure of the plants above alluded to, and also that exhibited by pure chicory.

Preservation of Meat.—Dr. Melsens.—Samples of meat preserved in contact with air for a period of more than two years, were exhibited at the meeting of this Academy by the author, who, however, did not explain anything concerning the process whereby this result was obtained; but to the samples were added affidavits from competent judges—among whom were veterinary surgeons and the sanitary veterinary inspector of the abattoirs at Bruxelles—confirming the facts and certifying to the good quality of the meat after having been kept for so long a period of time.

The other papers in this number relate to botany and paleontology.

Journal für Gasbeleuchtung und Wasserversorgung, No. 10, 1871.

In addition to a series of very important papers directly bearing upon gas and waterworks' engineering and management, this number contains the following matter relating to chemistry:—

Influence the Water Supplied to Dantzig has on Leaden Pipes.—Dr. Lissauer.—After referring to some subjects only of local interest, the author states that it may be taken as a general rule that,

with soft water, leaden pipes, during the first four or five weeks after having been laid on, contaminate such water with lead, but afterwards, a strongly adhering coating of oxide of lead having been formed inside the pipes, no further danger is to be apprehended. As soon as water contains 58 milligrms. of carbonate of lime per litre, kept in solution by carbonic acid, leaden pipes are not acted upon.

Method of Improving Spring Water.—Dr. Schilling.—The sides and bottom of the well should be made perfectly watertight by means of masonry. Into the bottom wall is to be inserted a glazed earthenware tube or pipe, some feet in length, care being taken to cement it watertight into the bottom masonry; this tube should be filled, first with a layer of clean pebbles, next a layer of coarsely granulated charcoal, and next a layer of fine, white, clean sand, or other suitable filtering materials, through which the water of the well is forced to pass upwards, being thereby purified. The author states that the cleansing, renewing, of the filtering materials will have to be occasionally attended to; but it is clear that this operation, supposing the well to give, as desired, a constant and large supply of water, cannot be easily brought into actual practice.

Zeitschrift für Chemie von Beilstein, No. 7, 1871.

This number contains the following original papers and memoirs:—

Action of Chlorine upon Ethyl-Chloride.—W. Staedel.—This paper contains the abstract of an account of a series of experiments on the chlorine substitution products of ethyl-chloride made and published by the author some years ago, care having been taken to arrange the conditions of the experiments in such a manner as to obtain only the lower chlorinated products. The main contents of this paper bear upon the differences of results obtained by the author and by other experimenters on this same subject, and relate chiefly to the boiling-points of some of the substances obtained.

On Para-Sulpho Benzoic Acid.—I. Remsen.—After briefly referring to his researches on para-oxybenzoic acid (Chemical News, vol. xxii., p. 228), the author, in this paper, gives an account of some researches made in order to verify the correctness of his view that crude sulpho-benzoate of potassium contains two isomeric salts. For this purpose, the acid of that salt was set free, and next combined with baryta. This compound was repeatedly purified and re-crystallised; it lost its water of crystallisation at from 250° to 260°. The analysis of the salt led to the formula $(C_{14}H_{10}S_2O_{10})Ba+3H_2O$. The mother-liquor of the crystals of the salt just alluded to yielded another baryta salt of a different crystalline structure. Both of the salts here spoken of, having been converted again into potassium salts, the author found that the first-mentioned baryta salt yielded, on being fused with caustic potassa, pure para-oxybenzoic acid, accordingly proving that the baryta salt, the formula of which is above mentioned, is a salt of para-sulpho benzoic acid. Acid para-sulpho benzoate of barium is very difficultly soluble in hot water; it crystallises immediately on cooling. The neutral potassa salt of this acid is readily soluble in hot as well as in cold water; the chief product of the action of sulphuric acid upon benzoic acid is, therefore, meta sulphobenzoic acid, while some para-sulphobenzoic acid is also formed.

On Olibanum.—A. Kurbatow.—The author first refers to the researches on this subject made by Dr. Stenhouse (*Ann. Chem. Pharm.*, 35, 306 (1870). According to these experiments, olibanum consists of resin, gum, and an ethereal oil having the formula $C_{35}H_{28}O$. The author of this paper, having repeated Dr. S.'s researches, found that the ethereal oil of encens, boiling at 162°, yields, when submitted to fractioned distillation, an oil not containing oxygen (the crude oil contains that element) boiling at 160°, and another oil which boils at 175°, and contains oxygen. The first-named body—the main bulk of the oil—is termed by the author oliben, $C_{10}H_{16}$, (sp. gr. at 12°, 0·863); it is soluble in alcohol and ether, and is resinified by nitric acid: the other portion, which boils at 175°, contains, percentically—C, 83·55; H, 5·57; rest upon 100 being O; does not yield, when treated with sodium, any hydrocarbon. Oliben absorbs, while becoming brown-coloured, hydrochloric acid gas, and yields a camphor-like solid substance which fuses at 127°. Formula, $C_{10}H_{16}.HCl$. The resinous matter contained in the encens, previously deprived of its essential oil, is soluble in alcohol, brown-coloured, brittle, very readily fusible; it contains, in addition to oxygen, upon 100 parts, C, 76·96; H, 10·97. The resin submitted to distillation yields chiefly a compound, $C_{10}H_{16}$.

Dinitro-Aniline.—W. Rudnew.—The author describes, in catalogical order, and briefly:—Dinitro-acetanilid, $C_6H_3(NO_2)_2.NH(C_2H_3O)$, soluble in boiling water and cold alcohol, fuses at 120°, crystalline; dinitro-aniline, $C_6H_3(NO)_2.NH_2$, a greenish-yellow coloured powder, insoluble in cold and boiling hot water, tolerably well soluble in boiling alcohol, fuses at 175°; dinitro-citraconanil, $C_6H_3(NO_2)_2.N(C_5H_4O_2)$, not at all soluble in water and not in cold alcohol, readily so in that liquid when boiling, crystalline, fusing at 120°.

Action of Water upon Chloride of Antimony.—A. Sabanijen.—This paper treats mainly on the composition of the so-called algaroth powder, oxychloride of antimony, and on the mode of its formation, and the influence of time and temperature thereupon. The oxychloride here alluded to, $Sb_4Cl_2O_5$, is a crystalline material obtained, as is well known, by adding water to chloride of antimony, if cold be taken 30 times the bulk of the chloride, if hot 3 times, care being taken to keep the liquid at about 65° for several hours after the addition of the water to the chloride.

Volumetrical Estimation of Copper in Brass.—M. Kirpitschow.—The main results of the researches recorded in this paper may be summarised as follows:—The titration of an ammoniacal solution of brass with Na_2S is equally correct as if copper alone were present. A little more Na_2S (0·3 c.c.) is required than with pure copper, but this quantity is a constant one, amounting to about 1·5 per cent, and does not depend on the quantity of zinc which is present, since that metal is not acted upon by the Na_2S until after the precipition of all the copper.

Isomeric Dibromtoluols.—E. Wroblevsky.

Some of the Conversions of Isomeric Bromtoluidines.—E. Wroblevsky.—This and the preceding paper are, as regards their contents, papers recording, in catalogical order, a series of names and formulæ of bodies not well suited for any useful abstraction.

Mono- and Dinitro-Naphthaline.—Drs. F. Beilstein and A. Kuhlberg.—Mono-nitro-naphthaline, prepared by the action of strong crude nitric acid upon naphthaline, is readily soluble in sulphide of carbon, difficultly in alcohol, crystalline, and fuses at 58·5. Nitro-amido-naphthaline, $C_{10}H_6(NO_2)(NH_2)$; the sulphate of this base, $[C_{10}H_6(NO_2)(NH_2)]_2H_2SO_4+2H_2O$, is difficultly soluble in cold water, and loses its water of crystallisation by standing over sulphuric acid under a bell-jar; the free base, $C_{10}H_6(NO_2)(NH_2)$, is a red-coloured crystalline body, fusing at 118°. The authors conclude, from their experiments, that—(1) Naphthaline behaves in a manner analogous to benzol; and (2) that in the α dinitro-naphthaline the two nitro-groups are symmetrically placed. α dinitro-naphthaline is not acted upon by a concentrated and hot mixture of sulphuric acid and bichromate of potassa.

TO CORRESPONDENTS.

*** Vol. XXIII. of The Chemical News, containing a copious index is now ready, price 11s. 4d., by post, 12s., 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. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxiv. commenced on July 7th, and will be complete in twenty-six numbers. Reading Cases, price 1s. 6d. each, post free, may also be obtained at the Office.

Alkali.—A table for the percentage estimation of the carbonate of calcium contained in animal charcoal, calculated from the volume of the carbonic acid, will be found in "Select Methods in Chemical Analysis," by W. Crookes, F.R.S. (Longmans). We know of no other published tables connected with Dr. Schiebler's calcimeter.

S. E. Phillips.—We do not remember the dates. Consult the Index from vol. xx.

NOTICE TO AMERICAN SUBSCRIBERS.

In answer to numerous inquiries, the Publisher begs to state that Subscribers in the United States can be supplied with the CHEMICAL NEWS from this Office, post free, for the sum of £1 2s. 4d. per annum, payable in advance.

Royal Institution of Great Britain, Albemarle Street, W.

The next ACTONIAN PRIZE, or PRIZES, will be awarded in the year 1872 to an Essay, or Essays, illustrative of the Wisdom and Beneficence of the Almighty.

The subject is "The Theory of the Evolution of Living Things." The Prize Fund is Two Hundred Guineas, and it will be awarded as a single Prize, or in sums of not less than One Hundred Guineas each, or withheld altogether, as the Managers in their judgment shall think proper.

Competitors for the Prize are requested to send their Essays to the Royal Institution on or before June 30th, 1872, addressed to the Secretary; and the adjudication will be made by the Managers in December, 1872.

H. BENCE JONES, Hon. Sec. R.I.

July, 1871.

St. George's Hospital Medical School.—A Gentleman is required as TEACHER of PHYSIOLOGICAL CHEMISTRY. He will have to give, during the Winter Session, a Course of Fifteen Practical Demonstrations upon the Chemical Composition and Analysis of the Tissues and Secretions.

This course will have to be repeated more than once to different Classes of Students, so that it may probably occupy one hour of his time three days a week during the whole of the Winter Session.

Laboratory accommodation will be found, and the remuneration will be about £40 a session.

Applications to be addressed to

WILLIAM WADHAM, M.D., Dean of the School.

St. George's Hospital,
July 11, 1871.

NEW EDITION OF CULLEY'S TELEGRAPHY.

In One Volume, 8vo., with over 120 Woodcuts and 4 Plates of Machinery and Apparatus, price 14s. cloth,

A Handbook of Practical Telegraphy. By R. S. Culley, Member Inst. C.E., Engineer-in-Chief of Telegraphs to the Post Office. The Fifth Edition, revised and enlarged.

London: Longmans, Green, and Co., Paternoster Row.

Royal 8vo., pp. 388, price 7s. 6d. Third Edition.

The Patentee's Manual; being a Treatise on the Law and Practice of Letters Patent, especially intended for the use of Patentees and Inventors. By James Johnson, Barrister-at-Law; and J Henry Johnson, Assoc. Inst. C.E., Solicitor and Patent Agent.

The call for a Third Edition of this work is conclusive proof that it satisfies a want on the part of Patentees and Inventors, to whom a plain statement of the law bearing upon the subject of Letters Patent for Inventions is obviously a matter of great importance. Whilst the exposition of statutes and judicial decisions is expressed in plain and popular language, no sacrifice has been made of legal accuracy, and it will be found that the work contains a concise but ample and strictly correct enunciation of the law, with an examination of the decided cases to the latest date.

London: Longmans, Green, and Co.

Just published, price One shilling,

A Concise View of the Law connected with Letters Patent for Inventions. By James Johnson, of the Middle Temple, Barrister-at-Law, and J. Henry Johnson, Assoc. Inst. C.E., Solicitor and Patent Agent, Lincoln's Inn Fields and Glasgow. Authors of the "Patentees' Manual."

London: Longmans, Green and Co., Paternoster Row.

Chemical Technology, or Chemistry in its Applications to the Arts and Manufactures. By Thomas Richardson and Henry Watts. Second Edition, illustrated with numerous Wood Engravings.

Vol. I., Parts 1 and 2, price 36s., with more than 400 Illustrations.

Nature and Properties of Fuel: Secondary Products obtained from Fuel: Production of Light: Secondary Products of the Gas Manufacture.

Vol. I., Part 3, price 33s., with more than 300 Illustrations.

Sulphur and its Compounds: Acidimetry: Chlorine and its Bleaching Compounds: Soda, Potash: Alkalimetry: Grease.

Vol. I., Part 4, price 21s., 300 Illustrations.

Aluminium and Sodium: Stannates, Fungates, Chromates, and Silicates of Potash and Soda: Phosphorus, Borax: Nitre: Gun-Powder: Gun Cotton.

Vol. I., Part 5, price 36s.

Prussiate of Potash: Oxalic, Tartaric, and Citric Acids, and Appendices containing the latest information and specifications relating to the materials described in Parts 3 and 4.

Bailliere and Co., 20, King William Street, Strand.

PRACTICAL CHEMISTRY.

Laboratory, 60, Gower Street, Bedford Square, W.C.

Mr. Henry Matthews, F.C.S., is prepared to give Instruction in all branches of PRACTICAL CHEMISTRY, particularly in its application to MEDICINE AGRICULTURE, and COMMERCE.

The Laboratory is open daily, except Saturday, from ten to five o'clock; on Saturday, from ten till one o'clock.

Mr. Matthews is also prepared to undertake ANALYSES of every description.

For Particulars and Prospectuses, apply to Mr. Henry Matthews, the Laboratory, 60, Gower Street, Bedford Square, W.C.

BERNERS COLLEGE of CHEMISTRY.—EXPERIMENTAL MILITARY and NAVAL SCIENCES, under the direction of Professor E. V. GARDNER, F.E.S., &c.: of the late Royal Polytechnic Institution and the Royal Naval College.

The Laboratory and Class Rooms are open daily.

Especial facilities for persons preparing for Government and other examinations.

Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

For particulars, &c., apply to Prof. E. V. G., 44, Berners-street, W.

Chloride of Calcium (Purified Muriate of Lime), total insoluble impurities under ¼ per cent.

CHLORIDE OF BARIUM (Muriate of Baryta), free from Iron and Lead, total impurities, water excepted, under ¼ per cent.

GASKELL, DEACON, & CO.,
Alkali Manufacturers, Widnes, Lancashire.

Methylated Spirits.—David Smith Kidd, Licensed Maker, Commercial Street, Shoreditch, N.E. Also FINISH, FUSEL OIL, and RECT. NAPHTHA.

Water-glass, or Soluble Silicates of Soda and Potash, in large or small quantities, and either solid or in solution, at ROBERT RUMNEY'S, Ardwick Chemical Works, Manchester.

W. NEILL & SON'S

PATENT BLOWING ENGINES, ACID PUMPS, AND DONKEY PUMPS,

ESPECIALLY ADAPTED FOR

WELDON'S PATENT CHLORINE PROCESS.

W. NEILL and SON have just Patented most important improvements in the Air-Valves of Blowing-Engines, which enable them to secure the most perfect "Cut-off" at the termination of each stroke, together with a perfectly free inlet and outlet for the Air at the proper time, thus securing a much better result from each stroke of the Air-Piston, with greater freedom of action, also a very great saving in the wear and tear of valves.

These improvements are of especial advantage to Engines working under the comparatively high pressure of blast required in the Weldon Process.

W. Neill and Son have supplied Blowing Engines and Pumps to all the principal Alkali Makers who have adopted the Weldon Process, and are ready to furnish Plans and Estimates for the erection (with the latest improvements) of the whole of the Plant required.

Efficiency and Simplicity of Construction, with the best workmanship, guaranteed. References on application.

W. NEILL and SON, Engineers, &c.,
Bold, St. Helen's Junction, Lancashire.

BISULPHIDE OF CARBON,
PROTOSULPHATE,
RED OXIDE,
OXYCHLORIDE,
Sulphocyanide,

And every other Mercurial Preparation.

BISULPHITE OF LIME, TETRACHLORIDE OF CARBON,

Oxysulphuret of Antimony, Glacial Acetic Acid,

Liquor Ammoniæ,
Sulphide of Iron,
Pure Acids,
Chloride of Sulphur,
Acetone,
Chloroform,
Aldehyde,
Chlorate Baryta,
Arsenic Acids,
Fruit Essences for Confectionery & Liqueurs,
Perchloride of Iron,
Sulphite and Hyposulphite of Soda,
Phosphates of Soda and Ammonia,
Ethers,
Bromides,
Iodides,
Scale and Granular Preparations.

ALSO,

Pure Photographic Chemicals of every kind.

MANUFACTURED BY

WILLIAM BAILEY & SON,
HORSELEY FIELDS CHEMICAL WORKS,
WOLVERHAMPTON.

AMSTERDAM EXHIBITION, 1869.

The GRAND DIPLOMA of HONOUR, being the First Prize, and superior to the Gold Medal.

Liebig Company's Extract of Meat.—Paris EXHIBITION, 1867, TWO GOLD MEDALS; HAVRE EXHIBITION, 1868, THE GOLD MEDAL.—Only sort warranted perfect and genuine by Baron Liebig, the Inventor. "A success and a boon."—Medical Press and Circular. One pint of delicious beef-tea for 2½d., which costs 1s. if made fresh from meat. Cheapest and finest-flavoured "stock" for soups, &c.

CAUTION.—Require Baron Liebig's signature upon every jar. Sold by all Italian Warehousemen, Grocers, Chemists, and Ships. Store Dealers; all Wholesale Houses; and of LIEBIG'S EXTRACT of MEAT COMPANY (LIMITED), 43, Mark Lane, E.C.

NOTICE.—Various chemical analyses have been published purporting to show a fraction more of moisture to exist in the Company's Extract than in some imitation sorts. It is extremely easy to evaporate the water almost to any extent, but it is quite as certain that the fine meaty flavour which distinguishes the Company's Extract from all others would be destroyed if the concentration of the Extract were carried beyond a certain degree. Beef-tea made from Liebig Company's Extract with *boiling-hot water* will be found to be greatly superior in flavour, strength, and clearness, to any other sort. This explains the universal preference it obtains in the market.

This Extract is supplied to the British, French, Prussian, Russian, and other Governments.

THE CHEMICAL NEWS.

Vol. XXIV. No. 608.

ON DUST AND SMOKE.*

By JOHN TYNDALL, LL.D., F.R.S.,
Professor of Natural Philosophy, Royal Institution.

After a few preliminary experiments illustrative of the polarisation of light, Professor Tyndall adverted to the polarisation of light by fine dust, by the sky, and by the coarser particles of smoke. In the former the direction of maximum polarisation, as in the case of the sky, is at right angles to the illuminating beam. In the latter, according to the observations of Govi, the maximum quantity of polarised light was discharged obliquely to the beam. Govi's observation of a neutral point in such beam, on one side of which the polarisation was positive and on the other side negative, was also referred to. The additional fact was then adduced that the position of the neutral point varied with the density of the smoke. Beginning, for example, with an atmosphere thickened by the dense fumes of incense, resin, or gunpowder, and observing the neutral point, its direction was first observed to be inclined to the beam *towards* the source of illumination. Opening the windows so as to allow the smoke to escape gradually, the neutral point moved down the beam, passed the end of a normal drawn to the beam from the eye, and gradually moved forward several feet down the beam. The speaker did not halt at these observations; they were introduced as the starting-point of inquiries of a different nature, and after their introduction the discourse proceeded thus:—

But what, you may ask, is the practical good of these curiosities? And if you so ask, my object is in some senses gained, for I intended to provoke this question. I confess that if we exclude the interest attached to the observation of new facts, and the enhancement of that interest through the knowledge that bye-and-bye the facts will become the exponents of laws, these curiosities are in themselves worth nothing. They will not enable us to add to our stock of food, or drink, or clothes, or jewellery. But though thus shorn of all usefulness in themselves, they may, by leading the mind into places which it would not otherwise have entered, become the antecedents of practical consequences. In looking, for example, at this illuminated dust, we may ask ourselves what it is. How does it act, not upon a beam of light, but upon our own lungs and stomachs? The question at once assumes a practical character. We find on examination that this dust is organic matter—in part living, in part dead. There are among it particles of ground straw, torn rags, smoke, the pollen of flowers, the spores of fungi, and the germs of other things. But what have they to do with the animal economy? Let me give you an illustration to which my attention has been lately drawn by Mr. George Henry Lewes, who writes to me thus:—

"I wish to direct your attention to the experiments of Von Recklingshausen should you happen not to know them. They are striking confirmations of what you say of dust and disease. Last spring, when I was at his laboratory in Würzburg, I examined with him blood that had been three weeks, a month, and five weeks, out of the body, preserved in little porcelain cups under glass shades. This blood was living and growing. Not only were the Amœba-like movements of the white corpuscles present, but there were abundant evidences of the growth and development of the corpuscles. I also saw a frog's heart still pulsating which had been removed from the body (I forget how many days, but certainly more than a week). There were other examples of the same persistent vitality or absence of putrefaction. Von Recklingshausen did not attribute this to the absence of germs—germs were not mentioned by him; but when I asked him how he represented the thing to himself, he said the whole mystery of his operation consisted in keeping the blood *free from dirt*. The instruments employed were raised to a red heat just before use, the thread was silver thread and was similarly treated, and the porcelain cups, though not kept free from air, were kept free from currents. He said he often had failures, and these he attributed to particles of dust having escaped his precautions."

Professor Lister, who has founded upon the removal or destruction of this "dirt" great and numerous improvements in surgery, tells us the effect of its introduction into the blood of wounds. He informs us what would happen with the extracted blood should the dust get at it. The blood would putrefy and become fetid; and when you examine more closely what putrefaction means, you find the putrefying substance swarming with organic life, the germs of which have been derived from the air.

Another note which I received a day or two ago has a bearing particular significant at the present time upon this question of dust and dirt, and the wisdom of avoiding them. The note is from Mr. Ellis, of Sloane Street, to whom I owe a debt of gratitude for advice given to me when sorely wounded in the Alps. "I do not know," writes Mr. Ellis, "whether you happened to see the letters of which I enclose you a reprint, when they appeared in the *Times*. But I want to tell you this in reference to my method of vaccination as here described; because it has, as I think, a relation to the subject of the intake of organic particles from without into the body. Vaccination in the common way is done by scraping off the epidermis, and thrusting into the punctures made by the lancet the vaccine virus. By the method I use (and have used for more than twenty years) the epidermis is lifted by the effusion of serum from below, a result of the irritant cantharadine applied to the skin. The little bleb thus formed is pricked, a drop of fluid let out, and then a fine vaccine point is put into this spot, and after a minute of delay it is withdrawn. The epidermis falls back on the skin, and quite excludes the air—and not the air only, but what the air contains.

"Now mark the result—out of hundreds of cases of re-vaccination which I have performed, I have never had a single case of blood-poisoning or of abscess. By the ordinary way the occurrence of secondary abscess is by no means uncommon, and that of pyæmia is occasionally observed. I attribute the comparative safety of my method entirely, first, to the exclusion of the air and what it contains; and, secondly, to the greater size of the apertures for the inlet of mischief made by the lancet."

I bring these facts forward that they may be sifted and challenged if they be not correct. If they are correct it is needless to dwell upon their importance, nor is it necessary to say that if Mr. Ellis had resigned himself wholly to the guidance of the germ theory he could not have acted more in accordance with the requirements of that theory than he has actually done. It is what the air contains that does the mischief in vaccination. Mr. Ellis's results fall in with the general theory of putrefaction propounded by Schwann, and developed in this country with such striking success by Professor Lister. They point, if true, to a cause distinct from bad lymph for the failures and occasional mischief incidental to vaccination; and if followed up they may be the means of leaving the irrational opposition to vaccination no ground to stand upon, by removing even the isolated cases of injury on which the opponents of the practice rely.

We are now assuredly in the midst of practical matters. With your permission I will recur once more to a question which has recently occupied a good deal of public attention. You know that as regards the lowest forms of

* A Lecture delivered at the Royal Institution of Great Britain, June 9, 1871.

life, the world is divided, and has for a long time been divided, into two parties, the one affirming that you have only to submit absolutely dead matter to certain physical conditions to evolve from it living things; the other, without wishing to set bounds to the power of matter, affirming that in our day no life has ever been found to arise independently of pre-existing life. Many of you are aware that I belong to the party which claims life as a derivative of life. The question has two factors:—the evidence, and the mind that judges of the evidence; and you will not forget that it may be purely a mental set or bias on my part that causes me throughout this discussion from beginning to end, to see on the one side dubious facts and defective logic, and on the other side firm reasoning and a knowledge of what rigid experimental inquiry demands. But judged of practically, what, again, has the question of Spontaneous Generation to do with us? Let us see. There are numerous diseases of men and animals that are demonstrably the products of parasitic life, and such diseases may take the most terrible epidemic forms, as in the case of the silkworms of France in our day. Now it is in the highest degree important to know whether the parasites in question are spontaneously developed, or are wafted from without to those afflicted with the disease. The means of prevention, if not of cure, would be widely different in the two cases.

But this is by no means all. Besides these universally admitted cases, there is the broad theory now broached and daily growing in strength and clearness—daily, indeed, gaining more and more of assent from the most successful workers and profound thinkers of the medical profession itself—the theory, namely, that contagious disease generally is of this parasitic character. If I had heard or read anything since to cause me to regret having introduced this theory to your notice more than a year ago, I should here frankly express that regret. I would renounce in your presence whatever leaning towards the germ theory my words might then have betrayed. Let me state in two sentences the grounds on which the supporters of the theory rely. From their respective viruses you may plant typhoid fever, scarlatina, or small-pox. What is the crop that arises from this husbandry? As surely as a thistle rises from a thistle-seed, as surely as the fig comes from the fig, the grape from the grape, the thorn from the thorn, so surely does the typhoid virus increase and multiply into typhoid fever, the scarlatina virus into scarlatina, the small-pox virus into small-pox. What is the conclusion that suggests itself here? It is this:—That the thing which we vaguely call a virus is to all intents and purposes a *seed;* that, excluding the notion of vitality, in the whole range of chemical science, you cannot point to an action which illustrates this perfect parallelism with the phenomena of life—this demonstrated power of self-multiplication and reproduction. The germ theory alone accounts for the phenomena.

And here you see the bearing of the doctrine of Spontaneous Generation upon this question. For if the doctrine continues to be discredited as it has hitherto been, it will follow that the epidemics which spread havoc amongst us from time to time are not spontaneously generated, but that they arise from an ancestral stock whose habitat is the human body itself. It is not on bad air or foul drains that the attention of the physician will primarily be fixed, but upon disease germs which no bad air or foul drains can create, but which may be pushed by foul air into virulent energy of reproduction. You may think I am treading on dangerous ground, that I am putting forth views that may interfere with salutary practice. No such thing. If you wish to learn the impotence of medical science and practice in dealing with contagious diseases, you have only to refer to a recent Harveian oration by Dr. Gull. Such diseases defy the physician. They must burn themselves out. And indeed this, though I do not specially insist upon it, would favour the idea of their vital origin. For if the seeds of contagious disease be themselves living things, it will be difficult to destroy either them or their progeny without involving their living habitat in the same destruction.

And I would also ask you to be cautious in accepting the statement which has been so often made, and which is sure to be repeated, that I am quitting my own *métier* when I speak of these things. I am not dealing with professional questions. I am writing no prescription, nor should I venture to draw any conclusion from the condition of your pulse and tongue. I am dealing with a question on which minds accustomed to weigh the value of experimental evidence are alone competent to decide, and regarding which, in its present condition, minds so trained are as capable of forming an opinion as on the phenomena of magnetism and radiant heat. I cannot better conclude this portion of my story than by reading to you an extract from a letter addressed to me some time ago by Dr. William Budd, of Clifton, to whose insight and energy the town of Bristol owes so much in the way of sanitary improvement.

"As to the germ theory itself," writes Dr. Budd, "that is a matter on which I have long since made up my mind. From the day when I first began to think of these subjects, I have never had a doubt that the specific cause of contagious fevers must be living organisms.

"It is impossible, in fact, to make any statement bearing upon the essence or distinctive characters of these fevers, without using terms which are of all others *the most distinctive of life.* Take up the writings of the most violent opponent of the germ theory, and, ten to one, you will find them full of such terms as 'propagation,' 'self-propagation,' 'reproduction,' self-multiplication,' and so on. Try as he may—if he has anything to say of those diseases which is characteristic of them—he cannot evade the use of these terms, or the exact equivalents to them. While perfectly applicable to living things, these terms express qualities which are not only inapplicable to common chemical agents, but, as far as I can see, actually inconceivable of them."

Once, then, established within the body, this evil form of life, if you will allow me to call it so, must run its course. Medicine as yet is powerless to arrest its progress, and the great point to be aimed at is to prevent its access to the body. It was with this thought in my mind that I ventured to recommend, more than a year ago, the use of cotton-wool respirators in infectious places. I would here repeat my belief in their efficacy if properly constructed. But I do not wish to prejudice the use of these respirators in the minds of its opponents by connecting them indissolubly with the germ theory. There are too many trades in England where life is shortened and rendered miserable by the introduction of matters into the lungs which might be kept out of them. Dr. Greenhow has shown the stony grit deposited in the lungs of stonecutters. The black lungs of colliers is another case in point. In fact, a hundred obvious cases might be cited, and others that are not obvious might be added to them. We should not, for example, think that printing implied labours where the use of cotton-wool respirators might come into play; but I am told that the dust arising from the sorting of the type is very destructive of health. I went some time ago into a manufactory in one of our large towns, where iron vessels are enamelled by coating them with a mineral powder, and subjecting them to a heat sufficient to fuse the powder. The organisation of the establishment was excellent, and one thing only was needed to make it faultless. In a large room a number of women were engaged covering the vessels. The air was laden with the fine dust, and their faces appeared as white and bloodless as the powder with which they worked. By the use of cotton-wool respirators these women might be caused to breathe air more free from suspended matters than that of the open street. Over a year ago, I was written to by a Lancashire seedsman, who stated that during the seed season of each year his men suffered horribly from irritation and fever, so that many of

them left his service. He asked me could I help him, and I gave him my advice. At the conclusion of the season this year he wrote to me that he had simply folded a little cotton-wool in muslin, and tied it in front of the mouth; that he had passed through the season in comfort and without a single complaint from one of his men.

The substance has also been turned to other uses. An invalid tells me that at night he places a little of the wool before his mouth, slightly moistening it to make it adhere; that he has thereby prolonged his sleep, abated the irritation of his throat, and greatly mitigated a hacking cough from which he had long suffered. In fact, there is no doubt that this substance is capable of manifold useful applications. An objection was urged against the use of it: that it became wet and heated by the breath. While I was casting about for a remedy for this, a friend forwarded to me from Newcastle a form of respirator invented by Mr. Carrick, an hotel-keeper at Glasgow, which meets the case effectually, and by a slight modification may be caused to meet it perfectly.

We have thus been led by our first unpractical experiments into a thicket of practical considerations. In taking the next step, a personal peculiarity had some influence upon me. The only kind of fighting in which I take the least delight is the conflict of man with nature. I like to see a man conquer a peak or quench a conflagration. I remember clearly the interest I took twenty years ago in seeing the firemen of Berlin contending for mastery with a fire which had burst somewhere near the Brandenburger Thor; and I have often experienced the same interest in the streets of London. Admiring as I do the energy and bravery of our firemen, and having heard that smoke was a greater enemy to them than flame itself, the desire arose of devising a fireman's respirator. But before I describe what has been done in this direction, let me draw your attention to the means hitherto employed to enable a man to live in dense smoke. Thanks to the courtesy of Capt. Shaw, I am enabled to show you the action of the "smoke-jacket," known abroad as the "Appareil Paulin," from its supposed inventor. The jacket is of pliable cowhide. It has arms and a hood, with eye-glasses. With straps and buckles the jacket is tied round the wrists and waist, and a strap which passes between the legs prevents it from rising. On the left side of the jacket is fixed a screw, to which the ordinary hose of the fire-engine is attached, and through the hose air instead of water is urged into the space between the fireman's body and the jacket. It becomes partially inflated, but no pressure of any amount is attainable, because the air, though somewhat retarded, escapes with tolerable freedom from the wrists and waist. Hence the fireman, when his hose is long enough, can deliberately walk in the densest smoke or foulest air. But you see the use of the smoke-jacket necessitates the presence of several men; it also implies the presence of an engine. A single man could make no use of it, nor indeed, any number of men without a pumping engine. Its uses are thus summed up in a communication addressed to me by Captain Shaw:—

"This smoke-jacket is very useful for extinguishing fires in vaults, stopping conflagrations in the holds of ships, and penetrating wells, quarries, mines, cesspools, &c.—any places, in short, where the air has become unfit for respiration.

"The special advantages of this jacket are its great simplicity, its facility for use, and the rapidity with which it can be carried about and put on; but its drawback is that it requires the use of an engine or air-pump, and consequently is of no service to one man alone. For this latter reason smoke-jackets, although very effective for enabling us to get into convenient places for extinguishing fires, have very rarely proved of any avail for *saving life*."

Now, it is that very want that I thought ought to be supplied by a suitable respirator. Our fire-escapes are each in charge of a single man, and I wished to be able to place it in the power of each of those men to penetrate through the densest smoke into the recesses of a house, and there to rescue those who would otherwise be suffocated or burnt. I thought that cotton-wool, which so effectually arrested dust, might also be influential in arresting smoke. It was tried; but, though found soothing in certain gentle kinds of smoke, it was no match for the pungent fumes of a resinous fire, which we employ in our experiments in the laboratory, and which, I am gratified to learn from Captain Shaw, evolves the most abominable smoke with which he is acquainted. I cast about for an improvement, and in conversing on the subject with my friend Dr. Debus, he suggested the use of glycerine to moisten the wool, and render it more adhesive. In fact, this very substance had been employed by the most distinguished advocate of the doctrine of spontaneous generation, M. Pouchet, for the purpose of catching the atmospheric germs. He spread a film of glycerine on a plate of glass, urged air against the film, and examined the dust which stuck to it. The moistening of the cotton-wool with this substance was a decided improvement; still the respirator only enabled us to remain in dense smoke for three or four minutes, after which the irritation became unendurable. Reflection suggested that in combustion so imperfect as the production of dense smoke implies, there must be numerous hydrocarbons produced, which, being in a state of vapour, would be very imperfectly arrested by the cotton-wool. These in all probability were the cause of the residual irritation; and if these could be removed, a practically perfect respirator might possibly be obtained.

I state the reasoning exactly as it occurred to my mind. Its result will be anticipated by many present. All bodies possess the power of condensing in a greater or less degree gases and vapours upon their surfaces, and when the condensing body is very porous, or in a fine state of division, the force of condensation may produce very remarkable effects. Thus, a clean piece of platinum-foil placed in a mixture of oxygen and hydrogen so squeezes the gases together as to cause them to combine; and if the experiment be made with care, the heat of combination may raise the platinum to bright redness, so as to cause the remainder of the mixture to explode. The promptness of this action is greatly augmented by reducing the platinum to a state of fine division. A pellet of "spongy platinum," for instance, plunged into a mixture of oxygen and hydrogen, causes the gases to explode instantly. In virtue of its extreme porosity, a similar power is possessed by charcoal. It is not strong enough to cause the oxygen and hydrogen to combine like the spongy platinum, but it so squeezes the more condensable vapours, and also acts with such condensing power upon the oxygen of the air, as to bring both within the combining distance, thus enabling the oxygen to attack and destroy the vapours in the pores of the charcoal. In this way effluvia of all kinds may be virtually burnt up; and this is the principle of the excellent charcoal respirators invented by Dr. Stenhouse. Armed with one of these, you may go into the foulest-smelling places without having your nose offended. Some of you will remember Dr. Stenhouse lecturing in this room with a suspicious-looking vessel in front of the table. That vessel contained a decomposing cat. It was covered with a layer of charcoal, and nobody knew until told of it what the vessel contained.

I may be permitted in passing to give my testimony as to the efficacy of these charcoal respirators in providing warm air for the lungs. Not only is the sensible heat of the breath in part absorbed by the charcoal, but the considerable amount of latent heat which accompanies the aqueous vapour from the lungs is rendered free by the condensation of the vapour in the pores of the charcoal. Each particle of charcoal is thus converted into an incipient ember, and warms the air as it passes inwards. This is in entire accordance with the thermometric observations of Dr. Marcet.

But while powerful to arrest vapours, the charcoal res-

pirator is ineffectual as regards smoke. The particles get freely through the respirator. In a series of them tested downstairs, from half a minute to a minute was the limit of endurance. This might be exceeded by Faraday's method of emptying the lungs completely, and then filling them before going into a smoky atmosphere. In fact, each solid smoke particle is itself a bit of charcoal, and carries on it, and in it, its little load of irritating vapour. It is this, far more than the particles of carbon themselves, that produces the irritation. Hence two causes of offence are to be removed: the carbon particles which convey the irritant by adhesion and condensation, and the free vapour which accompanies the particles. The moistened cotton-wool I knew would arrest the first, fragments of charcoal I hoped would stop the second. In the first fireman's respirator, Mr. Carrick's arrangement of two valves, the one for inhalation, the other for exhalation, are preserved. But the portion of it which holds the filtering and absorbent substances is prolonged to a depth of four or five inches. On the partition of wire gauze at the bottom of the space which fronts the mouth is placed a layer of cotton-wool, moistened with glycerine; then a thin layer of dry wool; then a layer of charcoal fragments; a second thin layer of dry cotton-wool, succeeded by a layer of fragments of caustic lime. The succession of the layers may be changed without prejudice to the action. A wire-gauze cover keeps the substances from falling out of the respirator. In the densest smoke that we have hitherto employed, the layer of lime has not been found necessary; in a flaming building, indeed, the mixture of air with the smoke never permits the carbonic acid to become so dense as to be irrespirable; but in a place where the gas is present in undue quantity, the fragments of lime would materially mitigate its action.

In a small cellar-like chamber downstairs, with a stone flooring and stone walls, the first experiments were made. We placed there furnaces containing resinous pine-wood, lighted the wood, and placing over it a lid which prevented too brisk a circulation of the air, generated dense volumes of smoke. With our eyes protected by suitable glasses, my assistant and I have remained in this room for half-an-hour and more, when the smoke was so dense and pungent that a single inhalation through the undefended mouth would be perfectly unendurable: and we might have prolonged our stay for hours. Having thus far perfected the instrument, I wrote to Captain Shaw, the chief officer of the Metropolitan Fire Brigade, asking him whether such a respirator would be of use to him. His reply was prompt; it would be most valuable. He had, however, made himself acquainted with every contrivance of the kind in this and other countries, and had found none of them of any practical use. He offered to come and test it here, or to place a room at my disposal in the City. At my request he came here, accompanied by three of his men. Our small room was filled with smoke to their entire satisfaction. The three men went successively into it, and remained there as long as Captain Shaw wished them. On coming out they said that they had not suffered the slightest inconvenience; that they could have remained all day in the smoke. Captain Shaw then tested the instrument with the same result. From that hour the greatest interest has been taken in the perfecting of the instrment by Captain Shaw himself. He has attached to the respirator suitable hoods. The real problem is practically solved, and I can only say that if a tithe of the zeal, intelligence, and practical skill were bestowed on the cotton-wool respirator that Captain Shaw has devoted to the fireman's respirator the sufferings of many a precious life might be spared and its length augmented.*

The discourse was concluded as follows:—"Thus have we been led from the actinic decomposition of vapours through the tails of comets and the blue of the sky to the dust of London, from the germ theory of disease down to this fireman's respirator. Instead of this trivial example, I could, if time permitted, point to others of a more considerable kind in illustration of the tendency of pure science to lead to practical applications. Indeed, those very wanderings of the scientific intellect which at first sight appear utterly unpractical, become in the end the well-springs of practice. Yet I believe there is a philosophy embraced by some of our more ardent thinkers (who I fear on many points commit the well-intentioned, but fatal mistake of putting their own hopeful fancies in the place of fact) that would abolish these wanderings of the intellect and fix it from the outset on practical ends alone. I do not think that that philosophy will ever make itself good in the world, or that any freedom-loving student of nature could or would tolerate its chains."

A short time before the discourse I had an opportunity of inspecting the apparatus of Mr. Sinclair, which has been tested and highly spoken of by the Superintendent of of the Manchester Fire Brigade. The original idea is due to Von Humboldt, who proposed it for the Hartz mines. Galibert constructed the apparatus in an improved form, and it has been still further improved by Mr. Sinclair, who has purchased Galibert's patent. It consists of an air-tight bag, from which issue two tubes that unite on a single one with a respirator mouth-piece. The bag is filled with air, and the wearer inspires through one valve and expires through another. The expired breath is carried to the bottom of the bag, and is stated to remain there in consequence of the chilling experienced in its passage downwards. A bag of not inordinate size is said to be sufficient to supply a man with air for twenty minutes. Mr. Sinclair's apparatus was exhibited during the discourse.

* Mr. Ladd has also proposed a form of mouth-piece which promises well, and Mr. Cottrell has attached to it an ordinary fencing-mask. This will probably be the form of apparatus finally adopted.

ON THE

SPECIFIC GRAVITIES INDICATED BY BAUME'S HYDROMETERS.*

By Dr. WILSON H. PILE, Philadelphia.

In endeavouring to frame a simple rule or formula by which the degrees of Baumé's hydrometer could be reduced to their corresponding specific gravities, I was led to select the following illustration in determining the relation existing between the two scales, as being thus more readily comprehended than in any other way. Having never met with similar observations by others, I have endeavoured in the following paper to explain, as briefly as possible, the method by which the rules alluded to have been formed.

Without further preamble, and without going into any detail respecting the nature and principles of the hydrometer, which would be foreign to the subject, let a cylindrical tube of thin glass, closed at its lower extremity, be floated in water of the temperature of 60° F., dropping shot or mercury into the tube until it sinks within a short distance of the top; make a line at this point, which call the water-point; now divide the cylinder between this point and the bottom into 145 parts, and number these divisions from the water-line downwards; you will have thus formed a true Baumé's hydrometer for all liquids heavier than water, and, although very unlike the ordinary instrument, yet its indications will be perfectly reliable, provided the tube be of equal diameter throughout.

A question may here arise, why divide the scale into 145 parts? This division was selected as giving a scale corresponding with the average of a number of Baumé's

* From the *Proceedings of the American Pharmaceutical Association*, 1870.

hydrometers from different makers. Baumé himself left no practical or specific directions for this purpose. In fact, an examination of these instruments will, unfortunately, exhibit very wide discrepancies, thus rendering the indications unreliable.

No. I.—For Liquids Heavier than Water.

		Baumé.	Ratio.	Specific gravity.
	210	80°		
	205	75°		
	200	70°		
	195	65°	$\frac{140}{200}=0.7000$	
	190	60°	$\frac{140}{195}=0.7179$	
	185	55°	$\frac{140}{190}=0.7368$	
	180	50°	$\frac{140}{185}=0.7567$	
	175	45°	$\frac{140}{180}=0.7777$	
	170	40°	$\frac{140}{175}=0.8000$	
	165	35°	$\frac{140}{170}=0.8235$	
	160	30°	$\frac{140}{165}=0.8484$	
	155	25°	$\frac{140}{160}=0.8750$	
	150	20°	$\frac{140}{155}=0.9032$	
	145	15°	$\frac{140}{150}=0.9333$	
Water,	140	10°	$\frac{140}{145}=0.9655$	
			$\frac{140}{140}=1.0000$	

No. II.—For Liquids Lighter than Water.

		Baumé.	Ratio.	Specific gravity.
Water,	145	0°		
	140	5°	$\frac{145}{140}=1.0357$	
	135	10°	$\frac{145}{135}=1.0740$	
	130	15°	$\frac{145}{130}=1.1153$	
	125	20°	$\frac{145}{125}=1.1600$	
	120	25°	$\frac{145}{120}=1.2083$	
	115	30°	$\frac{145}{115}=1.2608$	
	110	35°	$\frac{145}{110}=3.3181$	
	105	40°	$\frac{145}{105}=1.3809$	
	100	45°	$\frac{145}{100}=1.4500$	
	95	50°	$\frac{145}{95}=1.5263$	
	90	55°	$\frac{145}{90}=1.6111$	

No. I.—For Liquids Heavier than Water.

	Baumé.	Ratio.	Specific gravity.
85	60°		
80	65°	$\frac{145}{85}=1.7058$	
75	70°	$\frac{145}{80}=1.8125$	
70	75°	$\frac{145}{75}=1.9333$	
65			
60			
55			
50			
45			
40			
35			
30			
25			
20			
15			
10			
5			

Rule.

$$\frac{145}{145-B.^{\circ}}=\text{sp. gr.}$$

$$145-\frac{145}{\text{sp. gr.}}=B.$$

No. II.—For Liquids Lighter than Water.

	Baumé.	Ratio.	Specific gravity.
80			
70			
60			
50			
40			
30			
20			
10			

Rule.

$$\frac{140}{B.^{\circ}+130}=\text{sp. gr.}$$

$$\frac{140}{\text{sp. gr.}}-130=B.$$

To remedy this as far as possible, Mr. Henry Pemberton, of Philadelphia, in 1851, proposed the scale as above described. This was adopted as the standard by the Philadelphia College of Pharmacy the same year, and thus was secured a uniform scale for this instrument.

You will bear in mind that the scale we have just been considering is for liquids that are heavier than water. Now, for liquids lighter than water, it would appear but natural that similar divisions should be continued upwards above the water-line. But it happens, unfortunately, that, from erroneous views taken by Baumé, which need not here be discussed, the degrees for light liquids are larger than those for heavy liquids, and it was found by Mr. Pemberton that an average of several hydrometers showed each degree to be about the $\frac{1}{140}$th part of the scale instead of the $\frac{1}{145}$th. To recur to our cylinder, the space below the water-line must be divided into 140 parts, and then similar divisions carried upwards as far as necessary.

All that part of the scale above the water-line will then indicate the degrees of Baumé for liquids lighter than water.

Another unfortunate idea of Baumé, and one which often leads to error, may here be alluded to. I refer to the numbering of the degrees for light liquids, calling the water-point in this scale 10° instead of 0°, and from thence increasing upwards.

I will remark here, that in the French Codex, published

in 1850, a modified Baumé's scale was ordered to be used, selecting one which would be equivalent to dividing our cylinder into 144 degrees, and retaining the same divisions for liquids lighter than water, but yet continuing the original idea of calling the water-point 10° for liquids lighter than water. Although the instrument, as thus modified, is undoubtedly an improvement over Baumé's scale, yet it does not appear to have been introduced into this country. The scale of this French hydrometer will be found in the appendix to Wood and Bache's "Dispensatory," together with that adopted by the College of Pharmacy of Philadelphia. To proceed with our subject, you will please remember the law of hydrostatics, "that a floating body always displaces a quantity of the liquid in which it floats, equalling in weight the total weight of the floating body itself." If, therefore, our cylinder, while immersed in water, displaces 145 parts, the number of parts which it displaces in any other liquid will necessarily equal the same weight; or, in other words, that number of parts of the liquid will weigh precisely as much as 145 parts of water. The density or specific gravity of the liquid will, of course, be in an inverse ratio to the number of parts displaced, and this relation holds good in whatever number of parts the cylinder is divided, and we have merely to divide the number of parts beneath the surface of the liquid into the number of parts to which it sinks in water to obtain the specific gravity of the liquid.

The diagram which I have here drawn will make this evident. No. I. represents the cylinder, divided into 145 parts for liquids heavier than water; in the adjoining column we see these divisions as numbered in Baumé's hydrometer; the third column gives the ratio which these degrees bear to water; and in the fourth column these fractions are reduced, showing the specific gravity. In the diagram No. II., the cylinder up to the water-line is divided into 140 parts, and then continued upwards as high as required; opposite is the corresponding Baumé's degrees, water being 10, next the ratio, and then the specific gravity.

We are thus enabled to see the relation existing between Baumé's degrees and their specific gravity, and also the rule by which one scale is reduced to the other.

For example, let it be desired to know the specific gravity of the tenth degree of Baumé for heavy liquids; we see by the diagram that this degree is 135 parts from the bottom, and, as has been shown, these 135 parts must equal in weight 145 parts of water, and therefore its specific gravity must be $\frac{145}{135}$ as great, or 1·074. Hence, the directions, subtract the given degree of Baumé from 145, and divide the remainder into 145, the quotient will be the corresponding specific gravity; expressed algebraically, the formula is—

$$\frac{145}{145 - \text{B.}^\circ} = \text{sp. gr.}$$

This is for liquids heavier than water; for lighter liquids, a variation of this formula is necessary, on account of the water-point being called 10. The principle is, however, identical in both cases; thus, to ascertain the sp. gr. of 50° Baumé, observe that this degree is but 40° above the water-line, and this, added to the 140 parts below that line, makes 180 parts in all below the fiftieth degree, and this sum divided into 140 will give the required specific gravity, or 0·7777.

The formula for this is—

$$\frac{140}{\text{B.}^\circ - 10 + 140},$$

or, which is the same—

$$\frac{140}{\text{B.}^\circ + 130} = \text{sp. gr.}$$

The converse of these rules, or to ascertain the degree of Baumé corresponding to any given specific gravity, is found by a simple algebraic transfer of terms, and is as follows:—For heavy liquids—

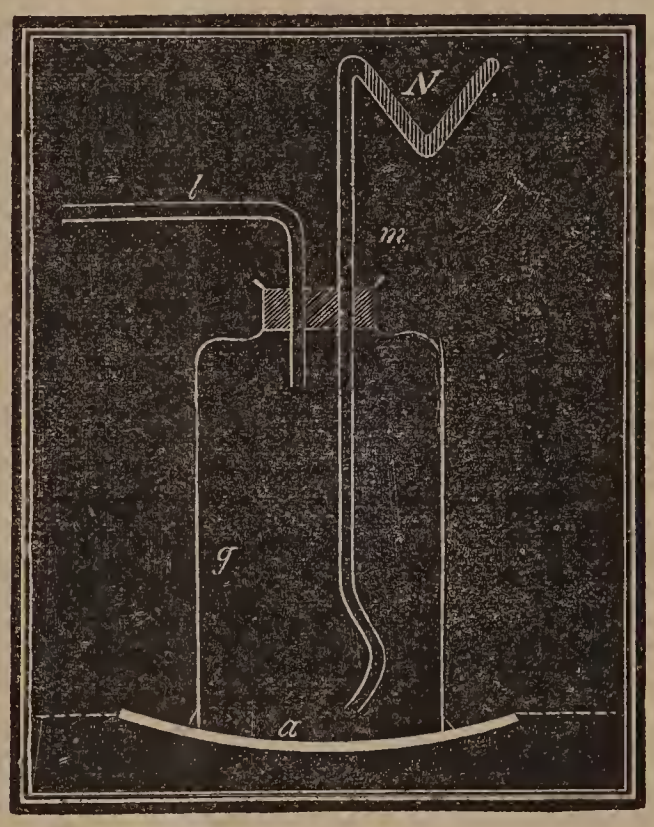
$$145 - \frac{145}{\text{sp. gr.}} = \text{B.},$$

and for light liquids—

$$\frac{140}{\text{sp. gr.}} - 130 = \text{B.}$$

A LECTURE EXPERIMENT.*

In the phenomenon of the spheroidal state, the globule will float when the vapour beneath it is able to support the pressure of the atmosphere plus the weight of the globule. If we remove the former factor, a much smaller vapour tension will be required to produce the phenomenon, as may be proved by the following experiment, described by E. Budde,† in which, with the aid of the air-pump, a Leidenfrost globule is supported upon a metal plate whose temperature is below 100° C. A bell-shaped glass vessel, *g*, is firmly cemented to a copper plate, *a*. Through the



stopper which closed the upper opening pass two glass tubes, *l* and *m*. The first attaches by caoutchouc tubing to the air-pump. The second reaches within the vessel nearly to the plate *a*, while above it is closed and bent into an N form. The bent portion is filled with water. The plate is now placed upon the water-bath, which soon imparts to it a temperature of from 80° to 100° C. The air-pump is now put in operation; the water in N evolves air-bubbles and vapours (gentle heating will facilitate the operation) which mainly accumulate in the upper end of the tube—and force a portion of the water through *m*. The water falls boiling, or very nearly so, upon the plate beneath, the temperature of which is, under the abnormal conditions, considerably above the boiling-point of the water—and all the conditions necessary for the production of the spheroidal state are present. If the rarefaction is carried until the barometer indicates 10 c.m. (about 4 inches) of mercury, and the water-bath is heated to about 90° C., the experiment will succeed without the slightest difficulty, and the spheroids obtained will evince an energetic movement.

The experiment is not a mere physical curiosity, but possesses an importance which our educated readers will doubtless have already appreciated, inasmuch as it is

* From advance-sheets of the *Journal of the Franklin Institute*. Communicated by the Editors.

† *Pogg. Ann.*, vol. ccxviii., p. 158.

decisive in confirming the theory of the spheroidal state. It proves that the force which sustains the globule obeys the laws which govern the tension of vapours.

ON THE

ESTIMATION OF PHOSPHORIC ACID.

By CHARLES E. MUNROE.

(Continued from p. 19).

Disodic Phosphate.—It is quite difficult to obtain this salt anhydrous. It becomes so between 30° and 40°, but as it fuses at 35°, it must be re-pulverised for analysis, and as it is quite hygroscopic, it is liable to change during the operation. A quantity dried over sulphuric acid was used, the phosphoric oxide being determined by ignition.

	Grms.		Grms.	
(1).	1·1130	gave	0·4576	$Na_4P_2O_7$ = 21·98 per cent P_2O_5
(2).	1·2355	,,	0·5075	,, = 21·97 ,, ,,

The mercurous oxide process with cupric oxide gave the following results:—

					Found.	Theory.
(1).	1·0245 grms.	gave	0·5124 grms.	P_2O_5 =	50·01	50·00
(2).	1·2198 ,,	,,	0·4716 ,,	,, =	38·66	21·97
(3).	0·9200 ,,	,,	0·2018 ,,	,, =	21·93	,,
(4).	1·2423 ,,	,,	0·2730 ,,	,, =	21·97	,,

No. 1 was a specimen of anhydrous phosphate. It will be noticed that the second analysis is much too high. In this one the nitro-mercurous phosphate was placed in a mass in the centre of the crucible and completely covered with cupric oxide. When the crucible was heated the cupric phosphate formed coated the outside of the pellet and prevented the further escape of the mercury. This proves the necessity of mixing thoroughly.

Care should be taken that the mercurous nitrate used is not basic. The salt used in this investigation was prepared in the following way. Pure mercury was dissolved, by aid of gentle heat in pure nitric acid in a flat, open vessel. More mercury was now added and the whole boiled until every trace of nitrous acid was driven off. The solution was then allowed to crystallise. To the solution formed from these crystals metallic mercury is added to prevent the formation of mercuric nitrate. By this method the salt is obtained perfectly free from mercuric nitrate and the nitrites.

Ammonio-Sodic Phosphate.—As the ammonia present decomposes the mercurous nitrate, it is well to boil with a little caustic soda until it is driven off. In the first analysis magnesic oxide was substituted for the cupric oxide, but in every other respect the process was the same.

					Found.	Required.
(1).	1·3500 grms.	gave	0·3991 grms.	P_2O_5 =	29·56	29·36
(2).	0·9832 ,,	,,	0·2902 ,,	,, =	29·51	,,
(3).	1·0803 ,,	,,	0·3181 ,,	,, =	29·44	,,

Mean 29·50

Ammonio-Magnesic Phosphate.—The solution was freed from ammonia as in the previous case. By ignition the following results were obtained.

	Grms.		Grms.	
(1).	0·5936	gave	0·3664	$Mg_2P_2O_7$ = 43·00 per cent P_2O_5
(2).	0·6135	,,	0·4123	,, = 42·99 ,, ,,

By the mercurous nitrate process I obtained the following results:—

(1).	1·0785 grms.	gave	0·4627 grms.	= 42·92	per cent P_2O_5
(2).	0·9500 ,,	,,	0·4084 ,,	= 42·98	,, ,,

Mean 42·95

Calcic Phosphate.—This salt was obtained by precipitating calcic chloride with an excess of disodic phosphate. The precipitate was then carefully washed and dried. This was dissolved in as little nitric acid as possible. If the solution is too acid the precipitate is not formed until sodic hydrate is added. The nitro-mercurous phosphate was ignited with magnesic oxide. By this means the following results were obtained:—

(1).	0·6190 grms.	gave	0·1606 grms.	P_2O_5 =	25·94 per cent
(2).	0·6765 ,,	,,	0·1755 ,,	,, =	25·96 ,,

Mean 25·95

Mr. Waldo Lincoln employed this process in making an analysis of bone earth, and permits me to cite his results. The nitro-mercurous phosphate was ignited with cupric oxide.

	I.	II.	III.	IV.
Weight taken ..	0·5586	0·4312	0·7025	0·6969
,, SiO_2 found	0·0009	0·0007	—	—
,, P_2O_5 ,,	0·2367	0·1487	0·2421	0·2396
Per cent SiO_2 ..	0·1600	0·1600	—	—
,, P_2O_5 ..	42·3700	34·4800	34·4600	34·3800

Mean of P_2O_5 in three analyses, 34·44

The first analysis presents another instance of failure on account of the precipitate not being properly mixed with the cupric oxide.

Aluminic Phosphate.—This was prepared by adding an excess of disodic phosphate to a solution of potash alum. The precipitate thus obtained was carefully washed and dried. The phosphate was dissolved in the least possible quantity of nitric acid and then treated as in the previous cases. An excess of nitric acid must be carefully avoided. The precipitate was ignited with cupric oxide.

(1).	0·5685 grms.	gave	0·1634 grms.	P_2O_5 =	28·77 per cent
(2).	0·5827 ,,	,,	0·1672 ,,	,, =	28·69 ,,
(3).	0·6720 ,,	,,	0·1927 ,,	,, =	28·68 ,,

Mean 28·71.

In order to test the process thoroughly it was thought best to determine the composition of this salt and then to compare the found with the calculated percentage. The water was estimated by simple ignition.

(1).	0·8689 grms.	gave	0·2624 grms.	H_2O =	30·18 per cent
(2).	0·8370 ,,	,,	0·2525 ,,	,, =	30·17 per cent

The aluminic oxide was taken by difference, yielding 41·12 per cent. These results lead to the formula

$$(Al_2O_3)_2(P_2O_5)+8H_2O$$
$$\text{or } Al_2O_3+Al_2P_2O_8+8H_2O$$

showing it to be a basic aluminic phosphate.

	Calc. per cents.	Found per cents.
P_2O_5	28·86	28·71
H_2O	29·27	30·17
Al_2O_3	41·87	41·12

I attempted to determine ferric and uranic phosphates in the same way, but on the addition of the sodic hydrate the metallic oxides were precipitated, rendering this method worthless for them. The iron solution was then very largely diluted and precipitated without the addition of sodic hydrate, but all of the phosphoric acid could not be thrown down. Next the ferric was reduced to the ferrous salt by the addition of metallic iron, by passing a stream of sulphydric acid through the solution, and by the addition of sulphurous acid, but without better results. The phosphate was dissolved in potassic cyanide and the ammonio-magnesian solution added to precipitate the phosphoric acid. I hoped that potassic ferrocyanide would be formed which would remain in solution and allow the phosphoric acid to combine with the potassium. The experiment, however, proved unsuccessful, and with these results the further investigation of ferric phosphate was suspended.

Although the ignition with cupric oxide leaves nothing to be desired in point of accuracy, and is a much quicker method than any now in use, yet it was thought that some other agent might be employed which would hasten the process still more.

Stannic oxide was tried for this purpose. To a weighed quantity of pure tin* the nitro-mercurous phosphate was added, then sufficient nitric acid, sp. gr. 1·170, was poured upon the mass to oxidise the tin completely. The whole was evaporated to dryness on a radiator, ignited and weighed. The plan seemed very promising, but the results, from some unknown cause, were far from being satisfactory.

Another idea was to fuse the nitro-mercurous phosphate with some substance which had a low fusing-point, so that the mercury might be volatilised, the phosphoric oxide remaining. Accordingly it was fused with free sulphur, but some of the phosphoric oxide was always volatilised. Potassic dichromate and plumbic chromate were both subjected to trial, but as the results were very unsatisfactory, further investigation in this direction was abandoned.

These results prove conclusively the value of this process for the estimation of phosphoric acid in all cases except those of ferric† and uranic phosphates.—*American Journal of Science.*

* Chemically pure tin can be obtained in considerable quantities and with very little trouble, in the following manner. Ammonio-stannic chloride is first produced by adding to one molecule of stannic chloride, two of sal-ammoniac. Dissolve in the least possible quantity of water and add an excess of chlorhydric acid, which causes the double chloride to crystallise out immediately. Purify completely by re-crystallisation from acid solutions. Dry the salt at 120°. Then fuse with an equal weight of a mixture of one part of potassic cyanide and one of potassic carbonate in a porcelain crucible. On cooling, a button of chemically pure tin will be found.

† Rose proposes in the case of ferric phosphate, to fuse the mercurous phosphate obtained with the mixed carbonates; then dissolve in dilute chlorhydric acid, and precipitate with the ammonio-magnesian solution. This will not effect a complete separation.

Otto's process of precipitating the phosphoric acid as ammonio-magnesic phosphate in the presence of tartaric acid was modified and tested as follows:—Ferric phosphate was prepared by precipitating ferric chloride with disodic phosphate. The precipitate was thoroughly washed by decantation and then evaporated to dryness. By this means the phosphate was obtained as a light yellow powder. A weighed quantity of this was dissolved in dilute chlorhydric acid, sufficient tartaric acid added to keep the whole of the iron in solution, next ammonia in excess, the solution was then heated till it boiled briskly, and the ammonio-magnesian solution was added. The precipitate was ignited and weighed as magnesic pyrophosphate. This method gave the following results:—

(1).	0·6084 grms.	gave	0·3437 grms.	$Mg_2P_2O_7$	=36·13	per cent	P_2O_5
(2).	0·7411	,,	,, 0·4173	,,	,,	=36·02	,,	,,
(3).	1·0294	,,	,, 0·5805	,,	,,	=36·11	,,	,,

Mean 36·09.

I would call especial attention to the fact, as it shortens the process considerably, that the phosphate solution was boiling when the ammonia-magnesian solution was added. Dr. Gibbs found that when the ammonio-magnesic and ammonio-manganic phosphates were precipitated from boiling solutions, that on cooling they came down as beautiful, highly crystalline precipitates, which, instead of requiring twenty-four hours for precipitation, were ready to be filtered within an hour. This method has been in use in this laboratory for the past six months, and has met with uniform success. It applies as well to the estimation of phosphoric acid as to that of magnesium and manganese.

With this additional treatment for the separation of iron, it is believed that this process will apply to the majority of cases met with in practice.

CORRESPONDENCE.

THE AMMONIA PROCESS.

To the Editor of the Chemical News.

Sir,—Will you allow me to call attention to the letter of Mr. Dugald Campbell, which appeared in the Chemical News of last week; and especially to the details, as far as they are given, of the experiment brought forward as a sample of many others.

Mr. Campbell took albumen, equivalent to 0·0014 grain or 0·0000909 grm. (9-100ths of a milligrm.) of dry albumen, and distilled from a litre of water. Now, as a matter of practical experiment, Messrs. Wanklyn, &c., state ("Water Analysis," p. 69) that 100 parts of dry albumen yield 10 parts of ammonia on distillation with potassic hydrate and potassic permanganate; consequently, from 9-100ths of a milligrm. of dry albumen Mr. Campbell might expect to obtain 9-1000ths of a milligrm. of ammonia. This struck me as an excessively small quantity, and, on hunting up the delicacy of the Nessler test, I find that Messrs. Wanklyn, &c. (who may fairly be supposed not to underestimate its delicacy), state ("Water Analysis," p. 45) that 1-200th of a milligrm. of ammonia in 100 c.c. of water, or 1-100th in 200 c.c., is the limit of accuracy to be relied on for quantitative work.

To distil off the whole of the ammonia from the albumen taken in the above experiment at least 200 c.c., or, better, 300 c.c., must be driven over. The least quantity of ammonia estimable in this distillate would be therefore 1-100th of a milligrm., so that Mr. Campbell took a trace of albumen which would yield him a quantity of ammonia—9-1000ths of a milligrm.—rather less than *the least quantity*—1-100th of a milligrm.—*that can be fairly estimated by the Nessler test in* 200 *c.c. of water*, and accordingly found in his distillate only a trace of colour on the addition of the Nessler reagent.

It seems to me that the above experiment of Mr. Campbell proves, in a most striking manner, the accuracy and delicacy of the method under discussion, since it has yielded, in Mr. Campbell's own hands, results slightly more delicate and accurate than those obtained by its authors.

Two rather important data are not given by Mr. Campbell. (1). He does not state whether the water he used was freed from ammonia, &c., before adding the albumen, and consequently leaves the question, as to whether ammonia was or was not obtained on boiling the albumen with sodic carbonate, unanswered. (2). He does not give the quantity distilled over after adding the potassic permanganate, &c.; at least 200 c.c. should have been distilled under the circumstances.—I am, &c.,

Scrutator.

July 18, 1871.

THE AMMONIA PROCESS.

To the Editor of the Chemical News.

Sir,—Mr. Campbell's statement, that a dilute solution of albumen yields its nitrogen in the form of ammonia when it is boiled with carbonate of soda, is an error. In reference to the experiment which Mr. Campbell brings forward, it is sufficient to remark that the total ammonia obtainable by our process from the white of egg taken by him did not exceed the 1-100th of a milligramme.—We are, &c.,

J. Alfred Wanklyn.
Ernest T. Chapman.

London, July 17, 1871.

CORRELATION OF ELECTRICAL AND CHEMICAL FORCE.

To the Editor of the Chemical News.

Sir,—Will you allow me, through the medium of your journal, to call the attention of chemists to one or two facts which seem to have been elicited in some experiments which I have been recently trying.

1. In a compound galvanic circuit, I have found that considerably more zinc is consumed in an electrolyte of chloride of sodium than in one of nitrate of soda and other electrolytes. Believing, as a general rule, in the law of changes in the same circuit in exact proportion to the chemical equivalents, I attributed this to a greater local action in chloride of sodium than in nitrate of soda. But in placing zinc for some days in solutions of nitrate of soda and of chloride of sodium, I found no appreciable

waste in either. I am aware there have been many facts which have seemed to militate against the law of change according to definite chemical equivalents; and, in this case, the difference of zinc consumed was so great as to suggest the idea that as zinc and chlorine produce much less heat in their combination than zinc and oxygen, and, consequently, I presume, less electricity, it might be possible that such equivalents might be consumed as would produce an equal amount of heat. The facts were not inconsistent with this supposition. But there are so many sources of error in these experiments, that I only wish to draw the attention to the subject of such chemists as have an opportunity of experimenting with greater accuracy than myself.

2. Though zinc is soluble in alkalies, I was surprised to find that zinc and carbon, in an electrolyte of caustic soda, or its carbonates, produce scarcely any action whatever, and what little they do produce very soon ceases altogether. In acids, or ordinary neutral salts, of course the action is very powerful, till weakened by polarisation. —I am, &c.,

H. Highton.

2, The Cedars, Putney,
July 15, 1871.

ESTIMATION OF PHOSPHORIC ACID.

To the Editor of the Chemical News.

Sir,—In Mr. Munroe's paper on the above subject (Chemical News, vol. xxiv., p. 18) the percentage of Al_2O_3 in "pure aluminic sulphate, $Al_2(SO_4)_3.18H_2O$," obtained by that gentleman is 17·88 per cent; the percentage of P_2O_5 obtained in "ammonio-sodic phosphate, $Na(NH_4)HPO_4.4H_2O$," is 29·36 per cent. As my calculations from these formulæ give very different results to the above, may I ask Mr. Munroe to explain the difference between his results and the theory.—I am, &c.,

B. J. Grosjean.

MISCELLANEOUS.

Quality of the Gas Supplied to the Metropolis.—Dr. Letheby, the Chief Gas Examiner appointed by the Board of Trade, has recently submitted to the Corporation of London and Metropolitan Board of Works his quarterly report of the gas supplied to London by the Chartered, the Imperial, and the South Metropolitan Gas Companies, from which it appears that the average illuminating power of the gas at the different testing stations has been as follows:—Chartered Gas, at Cannon Street, 17·70 sperm candles; at Gray's-Inn Road, 17·41 candles; at Friendly Place, Mile End, 17·56 candles; at Arundell Street, Haymarket, 17·49. Imperial Gas, at Oakley Square, 15·72; at Camden Street, 15·47; at Graham Street, 16·68. South Metropolitan, at Hill Street, Peckham, 15·88 candles. As regards the illuminating power of the Cannel gas it was equal to an average of 25·48 candles at Cannon Street, and 24·81 candles at Arundell Street. The gas of all the companies at all the testing places has been constantly free from excess of ammonia and from sulphuretted hydrogen, but the amount of sulphur in the gas has fluctuated to a large extent, as from an average of only 12·58 grains per 100 cubic feet of the Cannel gas of the Chartered Company at Cannon Street, to 40·73 grains per 100 feet of the common gas at Gray's-Inn Road. The average proportions of sulphur in the gas at the several testing places have been as follows:—Cannel gas of the Chartered Company, at Cannon Street, 12·58 grains per 100 cubic feet; at Arundell Street, 26·71 grains. Common gas of the Chartered Company, at Friendly Place, 22·47 grains; at Cannon Street, 28·32 grains; at Arundell Street, 30·66 grains; at Gray's-Inn Road, 40·73 grains. Imperial gas, at Camden Street, 25·02 grains; at Graham Street, 27·90 grains; at Oakley Square, 34·28 grains. South Metropolitan gas, at Hill Street, Peckham, 29·26 grains. Dr. Letheby reports that the most notable feature in the quality of the Chartered gas supplied during the quarter has been the excessively large proportion of sulphur, as compared with that contained in the gas at several of the testing places in the corresponding quarter of last year; and, as this increase has been coincident with the opening of the new works at Beckton, he thinks that the processes of manufacture and purification are not as perfect in the new works as they might be.

The Phenomena of Vibration.—A simple apparatus for the observance of some beautiful phenomena can be constructed as follows:—A disk of white cardboard, with apertures oblong in radial direction, is set on a spindle, so as to be rotated at any requisite speed. To examine, for instance, the flame of a gas light (in a glass tube, to prevent disturbance by air currents), place the disk in front of the light, so that the eye can see the light through each slit as it comes to a vertical position. If the speed of the disk's rotation is such that the interval of time between two slits passing the eye is just equal to the period of a vibration of the flame, the flame appears to be motionless; but if the velocity be reduced, the flame is seen to go slowly through its changes of form. If the interval be equal to, or one-half of, or one-third of the period of the vibration of the light, the illusory appearance of a disk having as many, or twice, or three times the number of slits really in the disk is seen. This phantom disk will appear to be motionless when the periods coincide; but when otherwise, it revolves in one direction or the other. It is obvious that the vibrations of the flame can be easily counted by this means. The inventor, Mr. Charles J. Watson, counted, with a sixteen inch tube, 453 vibrations of the flame per second. By this instrument, the undulation of the vibrations of a wire can be seen to travel up and down the wire; and if watched by both eyes through the slits, the spiral course of the undulations can be observed.—*Scientific American.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 11 1871.

This number contains the following original papers and memoirs:—

Hydrated Carbonate of Lime.—C. Rammelsberg.—The author's attention having been accidentally called to some very small crystals adhering to a conferva (a water plant) in a pond, he examined these crystals, and found them to consist of hydrated carbonate of lime, containing 5 molecules of water. This compound was first observed by Pelouze, in a solution of lime in sugar water. This hydrate is characterised by the property of losing its water of hydration at a temperature above 15°, even when it is kept under water.

Camphoric Acid.—F. Wreden.—The first portion of this paper is devoted to the record of the labours of other chemists on this subject, among them R. Brandes (who, as far back as 1823, described the compound of camphor with nitric acid), J. von Liebig, Kachler, and others. The author next describes his process for making camphoric acid, which essentially consists in treating camphor with nitric acid (1·27 sp. gr.) in a large glass flask fitted in the neck with a glass tube which reaches to the bottom of the flask, but is somewhat drawn out, while it is hermetically fastened in the neck by means of gypsum, the open end of the tube being bent, so as to communicate with a flue. The flask is heated for fifty hours in a water-bath; by this mode of preparation a larger quantity of camphoric acid is obtained, the nitric acid is more completely utilised, and the operator is not incommoded by the nitrous fumes.

Regularity of the Atomic Weights.—M. Zængerle.—The value of this excellent memoir depends chiefly on the contents of the tabulated form annexed to it, and far too lengthy to be here reproduced.

On Aurine.—R. S. Dale and C. Schorlemmer.—The substance first obtained in 1861 by Kolbe and Schmitt, by heating phenol along with oxalic and sulphuric acids, has, as is well known, become an article which is regularly prepared in this country on the large scale, and is sold under the name of aurine or yellow coralline. The authors, having investigated this substance, state that the article alluded to is a mixture of different substances. The colouring matter in a pure state is obtained by the action of strong acetic acid, either in the form of chrome-red brilliant diamond-like needles, or in the shape of very small acicular crystals exhibiting a deep red colour with a steel-blue hue; these contain water of crystallisation, which is driven off at 160°, the substance thereby assuming a deep greenish metallic hue. The formula of the anhydrous combination is $C_{24}H_{18}O_8$, that of the red crystals $C_{24}H_{18}O_8+2H_2O$, and that of the steel-blue crystals $C_{24}H_{18}O_8+2\frac{1}{2}H_2O$. By reducing agents, a colourless compound is obtained, which crystallises from an acetic acid solution in prismatic, transparent, yellow-coloured crystals, not containing any water; the formula of this body is $C_{24}H_{20}O_4$. The authors are engaged with other experiments on this subject.

Two Modifications of Benzo-Phenon.—Th. Zincke.—The contents of this lengthy paper record the author's experiments, made with the view to ascertain whether a substance obtained by him from diphenyl-methan is, or is not, a benzo-phenon. The result is that there exist two modifications of this body, both boiling at 300°—one of them crystallising in rhombic-shaped crystals fusing at 49°, the other belonging to the monoklinic crystal system, and fusing at 26°.

Action of Sodium Amalgam upon Oxalic Ether.—A. Eghis.—This paper contains chiefly the detailed description of a series of experiments made by the author in order to verify his former researches on this subject, which had led him to the conclusion that, by the action of sodium amalgam, there is formed glycolic acid, whereas S. Friedländer states that this is an error, and should be glycolinic acid. The author of this paper has, therefore, made a series of comparative investigations, the result of which is decidedly that glycolic acid is the result of the reaction alluded to. The formula of the calcium salt of this acid is $C_2H_3CaO_3+2H_2O$; this salt forms, with chloride of calcium, a double salt, $C_2H_3CaO_3+CaCl_2+3H_2O$, crystallising in octahedra.

Solubility of Sulphide of Carbon in Alcohol.—The text books on chemistry state that sulphide of carbon is soluble in (miscible with) alcohol in every proportion. This assertion is not, according to the authors, correct, since a point of saturation is reached which depends entirely upon the quantity of water contained in the alcohol. The authors describe in this paper a series of experiments on this subject, made also with the view of applying the degree of solubility of sulphide of carbon in alcohol to the determination of the strength of the latter fluid, it having been found that sulphide of carbon is only miscible in all proportions with perfectly anhydrous alcohol. The temperature, moreover, plays an important part in this matter, since below 15° the solubility of sulphide of carbon in alcohol is greatly decreased. From the extensive details quoted in this paper we give the following instances:—Temperature, 17°; quantity of alcohol employed, 10 c.c.; percentage, by weight, of alcohol, 98·5, dissolved 18·2 c.c. of sulphide of carbon; alcohol at 93·54 per cent dissolved 7·0 c.c. sulphide; alcohol at 84·12 dissolved 3·0 c.c.; alcohol at 48·40 dissolved 0·20 c.c.; alcohol at 47·9 dissolved 0·0 c.c. This paper further contains a series of algebraic formulæ by the aid of which the strength of alcohol may be calculated from experiments made in regard to its behaviour with sulphide of carbon.

Evolution of Heat by Neutralisation of Acids with Bases.—J. Thomsen.

Incorrectness of the Thermo-Chemical Researches made by Favre and Silbermann with the Mercurial Calorimeter.—J. Thomsen.

Some Observations and Critical Remarks.—J. Thomsen.

Researches on the Ether Derivatives of the Polyatomic Alcohols and Acids.—(Seventh part.)—L. Henry.—This portion of the monograph treats on the monochlorides of the biatomic and bibasic acids, and is divided into the following sections:—Oxalic ether-chloride—

$$C_2O_2 \begin{cases} Cl \\ C_2H_5O \end{cases}$$

succinic ether chloride—

$$C_2H_4C_2O_2 \begin{cases} Cl \\ C_2H_5O \end{cases}$$

oxamin-acid-ethyl; phenyl-oxamin-acid-ethyl; action of urea upon chloro-carbonic ether.

Propylen Compounds.—L. Henry.—This paper, as also the preceding one, is so filled with lengthy and complex formulæ, essentially required for the proper elucidation of the contents, that any useful abstraction is impossible.

Primary and Secondary Phosphine of the Methyl Series.—Dr. A. W. Hofmann.—In the lengthy introduction to this essay, the eminent author describes in detail the mode of preparation and purification of the phosphines of the methyl series. Methyl-phosphine—

$$CH_5P = \left\{ \begin{matrix} CH_3 \\ H \\ H \end{matrix} \right\} P,$$

is a colourless, transparent, very nasty smelling, non-permanent gas, which, by strong pressure, as well as by cold, becomes a colourless fluid, lighter than water, and boiling at −14°. The gas is insoluble in water, and nearly so in ether, but readily soluble in alcohol; it has a very great affinity for oxygen, and ignites spontaneously at a gentle elevation of temperature. Methyl-phosphine forms, with acids, salts, which are all decomposed by water, and have the property of bleaching vegetable colours as chlorine does. Two of these salts, the chlorhydrate and iodhydrate, are described at length as regards their preparation and properties. Dimethyl-phosphine—

$$C_2H_7P = \left\{ \begin{matrix} CH_3 \\ CH_3 \\ H \end{matrix} \right\} P,$$

is a colourless fluid, lighter than, and insoluble in, water; it boils at 25°, and is an exceedingly oxidisable body which, in contact with air, bursts violently into flame. This base also combines with acids, forming very readily salts soluble in water. Dimethyl-phosphine also combines with sulphur and sulphide of carbon. The author states that he intends to continue the researches on this subject next winter.

Azo-Compounds of Resorcin.—P. Weselsky.—Although the author states that this lengthy paper is only to be considered as a preliminary notice, we can only quote the headings of the sections into which it is divided, for the reason that the paper would require, for its proper understanding, the reproduction of very lengthy and complex formulæ. The author states that very many of the compounds he has discovered are dyes *par excellence*, and will, no doubt, at some future day, be prepared industrially on the large scale. The titles of the sections alluded to are—Diazo-resorcin, $C_{18}H_{12}N_2O_6$; diazo-resorufin, $C_{36}H_{18}N_4O_9$; salts of this base; tetra-azo compounds; nitric acid tetra-azo-resorcin, $[C_{18}H_6N_4O_6+3NO_3]$; nitric acid tetra-azorufin, $[C_{36}H_6N_8O_9+6NO_3]+6NO_2$; salts of this base; mono-nitro-resorcin.

Annalen der Chemie und Pharmacie, June, 1871.

This number contains the following original papers and memoirs:—

On Acridine.—C. Græbe and H. Caro.—The substance just named is obtained from crude anthracen, by treating that material with dilute sulphuric acid, and precipitation of this solution with bichromate of potassa. The dirty brown-coloured precipitate which ensues is repeatedly treated with boiling-water. From the cooled liquid, orange-yellow coloured crystals of chromate of acridine are deposited. These crystals, having been well washed, are next treated with ammonia, and the base thus set free is washed with cold water, and thus freed from chromate of ammonia. When quite pure, acridine is a colourless crystalline body; fuses at 107°; boils, without decomposition, at 360°; is very difficultly soluble in boiling water, and not at all in cold; readily soluble in alcohol, ether, sulphide of carbon, and hydrocarbons; its dilute solutions exhibit, in reflected light, a beautifully blue colour. Solutions of acridine (this name is given by the authors to this substance, owing to its corrosive biting action upon the skin of the hands and mucous membranes) exhibit, when tested with red-coloured litmus paper, distinctly an alkaline reaction. The formula of acridine is $C_{24}H_{18}N_2$, but the authors state that ulterior researches will be required to prove the correctness (in a structural and constitutional sense) of this composition. The main portion of this exhaustive monograph is further devoted to the following subjects:—Description of the salts of acridine; iodethyl combinations of acridine; nitro-derivatives of acridine; hydro-acridine, $C_{24}H_{20}N_2$; insoluble hydro-acridine.

Eugenol and Methoxybenzoic Acid.—C. Græbe and E. Borgmann.—The contents of this paper mainly record the result of the authors' experiments on the action of a mixture of bichromate of potassa and glacial acetic acid upon euginol-methyl-ether, the result being the formation of bimethoxybenzoic acid, just as happens with cresol-methyl-ether. The bimethoxybenzoic acid, $C_9H_{10}O_4$, is, in some respects, akin to anisic acid, is difficultly soluble in cold, but more readily so in boiling water, forms needle-shaped crystals, dissolves readily in alcohol and ether, and fuses at 180°. The formula of euginol is—

$$C_6H_3 \left\{ \begin{matrix} OH \\ OCH_3 \\ C_3H_5 \end{matrix} \right.;$$

the direct oxidation of this body to an acid did not succeed.

On Pyren.—C. Græbe.—This monograph contains the following sections:—Preparation of pyren. Composition of pyren; formula, $C_{16}H_{10}$. (The reader is also referred to Chemical News, vol. xxii., p. 192, where a brief abstract of a paper on this subject, by the same author, is given.) Pyren exhibits, in pure state, large rhombic-shaped crystals; fuses at 142°; boils at 360°, without decomposition; is difficultly soluble in cold alcohol, but more readily so in that liquid when boiling; and easily soluble in benzol and sulphide of carbon. Pyren is characterised by its behaviour with picric acid, forming therewith a compound, $C_6H_{10}+C_6H_2(NO_2)_3OH$. Nitro-derivatives of pyren; brom-derivatives; pyren-chinon, $C_{16}H_8(O_2)''$; pyren-hydride; pyren-hexahydride, $C_{16}H_{16}$; constitution of pyren.

On Chrysen.—C. Liebermann.—The author opens this lengthy memoir with a review of the labours of Laurent, Williams, Galletly, Vogel, and many other chemists on this subject, and next describes, at great length, the very laborious task of obtaining chrysen, in pure state, from coal-tar. When quite pure, chrysen is a colourless body, fusing at about 250°; it boils at a temperature higher than the boiling-point of mercury; formula, $C_{18}H_{12}$. This memoir contains, further, the following sections;—Mono-nitro-chrysen; tetra-nitro-chrysen;

brom-chrysen; chryso-chinon; chryso-hydro-chinon; dichlor-chryso-chinon and decachlor-chrysen; tetra-nitro-chryso-chinon.

Behaviour of Arsenic Acid with Hydrochloric Acid.—J. Mayrhofer.—This paper contains the record of the results of some experiments made with the view to ascertain under what conditions and in what state of combination arsenic is carried over by the distillation of hydrochloric acid which is contaminated with arsenic. It appears that the degree of concentration of the last-named acid, and the relative proportion of arsenic acid present, and also the care taken in cautiously distilling, are of influence in obtaining an arsenic-free distillate; but, moreover, the treatment of the hydrochloric acid with some chlorine, or, better still, sulphuretted hydrogen, previous to distillation, to be next carefully conducted, will ensure the distillate being free from arsenic.

Decomposition of Chloride of Phosphorus by Water.—K. Kraut.—It appears that, when chloride of phosphorus is poured into ice-cold water, it may be mixed therewith, forming a clear, or, at least, barely turbid liquid, from which phosphorus only separates after some days; but, if the same experiment be made with boiling water, there ensues a violent action, attended with combustion and the separation of a large quantity of amorphous phosphorus. With tepid water, the action is less violent, but the effect similar, and the same again happens when an excess of the chloride is treated with a small quantity of water.

Fourteenth Treatise on the Determination of the Chemical Position of some of the Toluol Derivatives.—F. Beilstein and A. Kuhlberg.—This portion of this very exhaustive monograph contains the following chapters:—Derivatives obtained by starting from dinitro-toluol; derivatives of para-toluidine; derivatives of meta-toluidine; derivatives of ortho-toluidine; isomeric toluylen-diamines.

Carnin, a new Base met with in Extract of Meat.—Dr. H. Weidel.—This treatise contains the record of the author's experiments made with large quantities of extract of meat with which Prof. von Liebig kindly supplied him, the chief result being the discovery of a new organic base, present to about 1 per cent in the extract. The mode of preparing carnin is a tedious and rather complicate process. Carnin is, in pure state, a crystalline solid, insoluble in cold, readily soluble in boiling water, and insoluble in alcohol and ether. Carnin has a bitter taste, a neutral reaction, and is not precipitated by neutral acetate of lead. Formula, $C_7H_8N_4O_3$; being different from the formula of theobromine, ($C_7H_8N_4O_2$), by only one atom of oxygen. The author describes a series of salts of carnin, and devotes a large portion of his paper to the description of physiological experiments made with this newly-discovered organic base.

Annales de Chimie et de Physique, November, 1870.

This number contains the following original papers:—

Memoir on the Acetic Derivatives of the Carbohydrates—viz., Mannite and some substances isomeric therewith—and of other Immediate Vegetable Principles.—Dr. Schützenberger.—The continuation and end of this lengthy essay.

Inequality of the Loss of Acid and of Salt in the Vicinity of the Poles of a Galvanic Battery.—E. Bourgoin.—The author first gives a review of the labours of Daniell, Miller, Pouillet, Hittorf, Grotthuss, d'Almeida, and others on this subject, and next describes at length a series of experiments, from which the following main results may be deduced:—When the galvanic current passes through acidulated water, it will be seen that, though the total effective work done by each pole is the same, the quantity of acid found in each compartment at the end of the experiment will be found to vary considerably. The three following cases may be distinguished:—(1) The acid is accumulated regularly at the positive pole; this occurs with sulphuric, nitric, phosphoric, benzoic, succinic, camphoric, &c., acids. (2) There is no loss at the positive pole; the loss is only experienced at the negative pole, since half of the electrolysed acid is regenerated in the other compartment. (3) The two compartments become simultaneously poorer; this occurs with lactic, tartaric, citric, and, in general, all the very readily oxidisable acids.

Chemico-Crystallographical Investigations on the Ferrocyanides.—Dr. Wybouroff.—The continuation of an essay commenced in the third series (the present number belongs to the fourth series) of this periodical. This portion is illustrated with a series of engravings, and the contents belong strictly to crystallography.

December, 1870.

The following original memoirs and papers are published in this number:—

Action of the Haloids in Free State, and of some Chlorides, upon Glucose.—A. Colley.—The contents of this lengthy essay describe the action of dry chlorine, bromine, and iodine upon anhydrous glucose, $C_6H_{12}O_6$. The result of the experiments is, that dextrogyrating glucose is a pentatomic compound—that is to say, that it contains five oxyhydryles, (OH), capable of being exchanged for acids, &c.; and, since glucose contains six atoms of oxygen, one of these must be combined in another manner than that of an oxyhydryl; but in what manner is not clearly elucidated by the author, who gives on this point some speculative theories not proved by experiment.

Superficial Tension of Liquids.—E. Duclaux.—A lengthy algebraico-physical essay illustrated with woodcuts exhibiting geometrical figures.

Heat Evolved by the Combustion of Coal.—A. Scheurer-Kestner and C. Meunier.—This extensive monograph, illustrated with woodcuts, is a most valuable specimen of the application of high scientific and practical knowledge, and exceeds any work hitherto done in this direction. This essay is, however, far too lengthy for either useful abstraction or for complete translation.

Journal für Gasbeleuchtung und Wasserversorgung, No. 11, 1871.

This number only contains matter strictly belonging to gas- and water-works' engineering and management.

Bulletin Mensuel de la Société Chimique de Paris, November, 1870.

From the *procès-verbaux* of the meetings of this Society published in this number, we abstract the following matter:—

Acetate of Alumina Useful for the Purpose of Rendering Woven Fabrics Waterproof without thereby Impeding the Passing Off of the Perspiration.—Prof. Balard.—The author prepares the acetate of alumina by dissolving 30 grms. of acetate of lead in ½ a litre of water (best distilled), and also 24 grms. of sulphate of alumina in half a litre of water. These solutions, having been mixed, are next filtered, after which the fabric is immersed therein for a quarter of an hour, and, after having been well drained, is dried in the air.

Substances which yield Nitrate of Potassa.—MM. Thiercelin and Willm.—It should hereby be observed that, at a comparatively remote period, saltpetre was regularly manufactured in most European countries by a process too long to be further alluded to here, and well known, undoubtedly, to most of our readers. The authors state that the richness of the saltpetre-yielding materials recently tested by them varies very much. They found that the efflorescence now and then met with, especially on the walls of old stables, contained as much as 67 per cent of saltpetre; but this material is rare. Old wood-ash yielded ½ per cent; the mortar of a wall covered with ivy yielded 2·6 per cent; and the mortar of the same wall at a spot not covered with that plant, 4·6 per cent of saltpetre.

This number contains, moreover, the following original papers and memoirs:—

Saltpetre Industry in France before the Nineteenth Century.—Dr. Berthelot.—This memoir, a valuable contribution to the history of industrial chemistry, is far too lengthy for any useful abstraction; it contains the following chapters:—History of the saltpetre manufacture in France from the oldest times up to the beginning of this present century; report on saltpetre by the Scientific Committee for the Defence of Paris; nature and richness of the materials capable of yielding saltpetre in Paris; processes to be applied for the collection of these substances; hints for utilising and properly collecting ash and other materials which may yield saltpetre.

Preliminary Notice relating to Etherification.—M. Lorin.—The polyatomic alcohols, properly so-called, decompose, under 100°, oxalic acid into water, carbonic and formic acids, yielding thereby *formine* of the alcohol employed, and aqueous formic acid, containing 56 per cent of formic acid, according to the following formula:—$C_4H_2O_8,4HO = C_2O_4 + C_2H_2O_4,4HO$.

Preliminary Notice on the Formation of the Amides of the Fatty Acids.—M. Lorin.—The decomposition of the tartrates of ammonia, either acid or neutral, yield, at 200°, among their products of decomposition, water, carbonate and acetate of ammonia, and formiamide. The details of these experiments will be published at a future date.

NOTES AND QUERIES.

Kelp Liquors.—(Reply to "Iodine Manufacturer.")—It is not easy to state precisely the cause of the action of kelp liquors upon the iron, since it would be necessary to know all the conditions of the case. It may be, and very probably is, caused by the decomposition of the chloride of magnesium, whereby some hydrochloric acid is set free, which, of course, will attack the iron and blacken the salts; but there may exist other causes, which depend upon conditions, which, without a special investigation, cannot be explained and remedied. It is in this instance, as in many others, "*cessante (sublata) causâ, cessat effectus.*"

Temperature of the Sea.—(Reply to "Thermo.")—This subject belongs to physical geography, and we need hardly call your attention to the fact that the temperature, especially at the surface, of the sea must, of necessity, vary, in consequence of a great many causes which influence it, as, for instance, the latitude, shallowness, surrounding coasts, and water discharged from rivers. It is, therefore, clear that no concise answer can be given to your query; but, by consulting either Berghaus's "Physikalischer Atlas," or other works on physical geography, or the article "Sea" in any encyclopædia, say Chambers's, vol. viii., p. 581, you will there find full information on this subject. The works herein alluded to may be inspected at the library of the Commissioners of Patents.

NOTICE TO AMERICAN SUBSCRIBERS.

In answer to numerous inquiries, the Publisher begs to state that Subscribers in the United States can be supplied with the CHEMICAL NEWS from this Office, post free, for the sum of £1 2s. 4d. per annum, payable in advance.

THE
QUARTERLY JOURNAL OF SCIENCE,
AND
ANNALS OF MINING, METALLURGY, ENGINEERING, INDUSTRIAL ARTS MANUFACTURES, AND TECHNOLOGY.

Edited by WILLIAM CROOKES, F.R.S., &c.

Now ready, No. XXXI., *July*, 1871, price 5s., Illustrated.

CONTENTS.

I. The Dawn of Light Printing.
II. Pneumatic Transmission. By FREDERIC CHARLES DANVERS, A.I.C.E.
III. An Essay towards Establishing a Science of Money. By A LONDON MERCHANT.
IV. Where are the Bones of the Men who made the Unpolished Flint Implements? By WILLIAM PENGELLY, F.R.S., F.G.S.
V. Experimental Investigation of a New Force. By WILLIAM CROOKES, F.R.S., &c.
VI. Molecules, Ultimates, Atoms, and Waves. By MUNGO PONTON, F.R.S.E.
VII. A New Mechanical Agent: a Jet of Sand.
VIII. British Service Ordnance. By S. P. OLIVER, Lieut. Royal Artillery.

Notices of Books. Progress of the Various Sciences. Recent Scientific Literature, &c., &c.

London: Offices of the Quarterly Journal of Science, 3, Horse-Shoe Court, Ludgate Hill, E.C.

Just published, demy 8vo., with 42 woodcuts, price 14s.,

The Antiseptic System: A Treatise on Carbolic Acid and its Compounds, with an Inquiry into the Germ-Theories of Putrefaction, Fermentation, and Infection, the Theory and Practice of Disinfection, and the Employment of Antiseptics in Practical Medicine and Surgery. By A. E. SANSOM, M.D., London, M.R.C.P.

London: HENRY GILLMAN, Boy Court, Ludgate Hill, E.C.

Now ready, price 6d.,

Notes of Professor Odling's Juvenile Lectures on BURNING AND UNBURNING, delivered at the Royal Institution of Great Britain, Christmas, 1870-71.

London CHEMICAL NEWS Office, Boy Court, Ludgate Hill, E.C.

Royal 8vo., pp. 388, price 7s. 6d. Third Edition.

The Patentee's Manual; being a Treatise on the Law and Practice of Letters Patent, especially intended for the use of Patentees and Inventors. By JAMES JOHNSON, Barrister-at-Law; and J HENRY JOHNSON, Assoc. Inst. C.E., Solicitor and Patent Agent.

The call for a Third Edition of this work is conclusive proof that it satisfies a want on the part of Patentees and Inventors, to whom a plain statement of the law bearing upon the subject of Letters Patent for Inventions is obviously a matter of great importance. Whilst the exposition of statutes and judicial decisions is expressed in plain and popular language, no sacrifice has been made of legal accuracy, and it will be found that the work contains a concise but ample and strictly correct enunciation of the law, with an examination of the decided cases to the latest date.

London: Longmans, Green, and Co.

Just published, price One shilling,

A Concise View of the Law connected with Letters Patent for Inventions. By JAMES JOHNSON, of the Middle Temple, Barrister-at-Law, and J. HENRY JOHNSON, Assoc. Inst. C.E., Solicitor and Patent Agent, Lincoln's Inn Fields and Glasgow. Authors of the "Patentees' Manual."

London: Longmans, Green and Co., Paternoster Row.

PRACTICAL CHEMISTRY.

Laboratory, 60, Gower Street, Bedford Square, W.C.

Mr. Henry Matthews, F.C.S., is prepared to give Instruction in all branches of PRACTICAL CHEMISTRY, particularly in its application to MEDICINE AGRICULTURE, and COMMERCE.

The Laboratory is open daily, except Saturday, from ten to five o'clock; on Saturday, from ten till one o'clock.

Mr. Matthews is also prepared to undertake ANALYSES of every description.

For Particulars and Prospectuses, apply to Mr. Henry Matthews, the Laboratory, 60, Gower Street, Bedford Square, W.C.

BERNERS COLLEGE of CHEMISTRY.—EXPERIMENTAL MILITARY and NAVAL SCIENCES, under the direction of Professor E. V. GARDNER, F.E.S., &c.: of the late Royal Polytechnic Institution and the Royal Naval College.

The Laboratory and Class Rooms are open daily.

Especial facilities for persons preparing for Government and other examinations.

Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

For particulars, &c., apply to Prof. E. V. G., 44, Berners-street, W.

North London School of Chemistry, Pharmacy, &c.—For Instruction in Practical Chemistry and Evening Classes for the Study of Chemistry, Botany, Materia Medica, &c. Conducted by Mr. J. C. BRAITHWAITE, *for thirteen years Principal Instructor* in the Laboratories of the Pharmaceutical Society of Great Britain, and Demonstrator of Practical Pharmacy, Pharmaceutical Latin, &c.

Mr. Braithwaite, having taken the premises adjoining his house, has been enabled *nearly to double the size of his Laboratories*, and, at the same time, procure a large piece of ground which *he has had laid out as a Botanic garden*. Every facility is, therefore, offered to Students desirous of acquiring a practical knowledge of this branch of their education.

The Session 1870—1871 will commence on the 3rd of October, when the Laboratories will be re-opened at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

THE CHEMICAL and TOXICOLOGICAL CLASS will meet as usual every Monday and Thursday evening, at 8 p.m., commencing October 3rd.

The LATIN CLASS for the reading of Physicians' Prescriptions Cæsar's Commentaries, &c., every Tuesday and Friday evening, at 8 p.m.

The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday evening, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will be continued every Saturday, until further notice, at 10 a.m.

Fee to either of the above Classes Half-a-Guinea per Month Pupils can enter at any period.

Gentlemen Privately Prepared for the Examinations of the Pharmaceutical Society, and the "Modified Examination for Assistants," &c

All Fees must be paid in advance.

Letters of inquiry should be accompanied with a stamped envelope.

Mr. Braithwaite receiv a few Pupils to Board in his house.

Address—54, KENTISH TOWN ROAD, N.W.

AMSTERDAM EXHIBITION, 1869.

The GRAND DIPLOMA of HONOUR, being the First Prize, and SUPERIOR to the Gold Medal.

Liebig Company's Extract of Meat.—Paris EXHIBITION, 1867, TWO GOLD MEDALS; HAVRE EXHIBITION, 1868, THE GOLD MEDAL.—Only sort warranted perfect and genuine by BARON LIEBIG, the Inventor. "A success and a boon."—Medical Press and Circular. One pint of delicious beef-tea for 2½d., which costs 1s. if made fresh from meat. Cheapest and finest-flavoured "stock" for soups, &c.

CAUTION.—Require BARON LIEBIG'S signature upon every jar Sold by all Italian Warehousemen, Grocers, Chemists, and Ships. Store Dealers; all Wholesale Houses; and of LIEBIG'S EXTRACT of MEAT COMPANY (LIMITED), 43, Mark Lane, E.C.

NOTICE.—Various chemical analyses have been published purporting to show a fraction more of moisture to exist in the Company's Extract than in some imitation sorts. It is extremely easy to evaporate the water almost to any extent, but it is quite as certain that the fine meaty flavour which distinguishes the Company's Extract from all others would be destroyed if the concentration of the Extract were carried beyond a certain degree. Beef-tea made from Liebig Company's Extract with *boiling-hot water* will be found to be greatly superior in flavour, strength, and clearness, to any other sort. This explains the universal preference it obtains in the market.

This Extract is supplied to the British, French, Prussian, Russian, and other Governments.

Methylated Spirits.—David Smith Kidd, Licensed Maker, Commercial Street, Shoreditch, N.E. Also FINISH, FUSEL OIL, and RECT. NAPHTHA.

Water-glass, or Soluble Silicates of Soda and Potash, in large or small quantities, and either solid or in solution, at ROBERT RUMNEY'S, Ardwick Chemical Works, Manchester.

Chloride of Calcium (Purified Muriate of Lime), total insoluble impurities under ¼ per cent.

CHLORIDE OF BARIUM (Muriate of Baryta), free from Iron and Lead, total impurities, water excepted, under ¼ per cent.

GASKELL, DEACON, & CO.,
ALKALI MANUFACTURERS, WIDNES, LANCASHIRE.

THE CHEMICAL NEWS.

Vol. XXIV. No. 609.

NOTES ON THE PRACTICAL PHOTOMETRY OF COAL-GAS.

By Dr. WALLACE,
Gas Examiner for the City of Glasgow.

The following arrangement of the different parts of the photometric apparatus has been found convenient, and has been so highly approved of by those who have seen it that it is thought worthy of a brief description. The meter is not placed at the end of the photometer bar at which the gas is burned, but towards the candle end, and immediately below that part of the bar where the observations are usually made; and attached to the outlet is a three-way stop-cock with lever handle, the side branch of which is connected by a few inches of pipe with the inlet, so that the gas may be passed through the meter, or direct to the burner, as may be desired, the gas being, in either case, kept constantly burning. At the candle end, and on a level with the photometer bar, is placed a small shelf supporting the candle balance; and this is arranged so that the candles have to be moved only a few inches into the receptacle at the end of the photometer. The gas is now passed through the meter until the hand comes to zero, and the stop-cock is turned so as to pass the gas direct to the jet. The clock, which is either attached to the meter or placed immediately beside it, is also adjusted, and the candles are nearly counterpoised. At the moment when the balance turns, the operator with one hand turns the stop-cock, with the other sets the clock in motion. The candles are now placed in position, and by the end of the first half minute the operator is ready to take the first observation. The sight-box has in front of it stereoscopic lenses, so as to shorten the focus of the eyes, and make the images of the two sides of the disc more distinct, at the same time that they coalesce or overlap one another. By this means great accuracy of observation is attained, and the influence of the different colours of the two flames is entirely removed. Two circular screens of very light wood, 18 inches in diameter, strengthened by cross-bars and having in the centre openings 4 inches square, are fixed on the photometer bar, one on either side of the sight-box and about 20 inches apart, and the sight-box is provided with two side flaps of thick vulcanised india-rubber; the object of these arrangements being to prevent the possibility of any light passing to the eyes of the operator but that reflected by the mirrors in the sight-box. At the end of the tenth minute the stop-cock of the meter is reversed, and, at the same moment, the candles are extinguished; after which the operator leisurely notes the consumption of gas and the loss of weight of the candles. The advantage obtained by this arrangement is that the gas examiner does not require to move from his position opposite the meter during the whole experiment, while the meter is read off only when stationary. The stereoscopic sight-box is not an essential part of the apparatus, and requires great care in the adjustment of the lenses, but when these are carefully fixed the results obtained are highly satisfactory.

In the arrangement above described, the governor is placed immediately to the right hand of the meter (supposing the gas to be burned at the right side of the photometer) and the King's pressure gauge at the left-hand side, so that both are readily observed or corrected. The pressure at which it has been found best to burn the Glasgow gas (28 to 30 candles) is from four to five-tenths, and the standard Cannel batswing supplied by Sugg is employed at all the testing stations. In order to prevent evaporation, the surface of the water in the meters, pressure gauges, and governors, is covered with a layer of about one-sixteenth of an inch of "intermediate" paraffin oil. This oil has a gravity of 850 to 860, and a firing-point of about 250° F., and does not affect the illuminating power of the gas, nor does it thicken by exposure to cold.

In the estimation of the sulphur in coal-gas it is usual to cut off the gas, by means of a pin acting on a lever, at 10 cubic feet, but it is more advantageous to adopt 13·7 cubic feet as the quantity, as in this case the number of grains and fractions of a grain of barium sulphate obtained represents the number of grains of sulphur in 100 cubic feet of the gas. The half of this quantity, or 6·85 cubic feet, may also be taken, but in this case the quantity of barium sulphate must be multiplied by two. The apparatus used in Glasgow is that of Dr. Letheby, with the addition of a second cylinder of about twice the capacity of the first.

The estimation of ammonia is made by means of a very simple apparatus. A tray of copper coated with paraffin, or, still better, one of porcelain, about 12 inches long by 4 wide, and 1 inch deep, has inverted in it a similar vessel 11½ inches long, 3½ inches wide, and nearly the same depth as the tray. At each end of the inverted vessel is a coupling, so that the gas to be used in the sulphur estimation can be passed through this apparatus before going to the burner. Into the tray is placed 100 measures of a test-liquid consisting of dilute sulphuric acid of such strength that this quantity would be exactly neutralised by 13·7 grains of ammonia, and water is added, if necessary, to give a depth of about a quarter of an inch of liquid. 13·7 cubic feet of gas are now passed through the apparatus in the usual manner, after which the contents of the tray are tansferred to a white porcelain basin, and the tray and inverted vessel washed by means of a washing bottle, and the washings added. Some tincture of litmus is now added, and from a burette is dropped, with constant stirring, a solution of caustic potash, 100 divisions of which correspond exactly to 100 divisions of the dilute acid. When the blue colour of the litmus is restored the number of divisions consumed is read off, and the difference between it and 100 divided by 10 gives the number of grains of ammonia in 100 cubic feet of gas. The absorption of the ammonia is so perfect that not a trace can be detected by afterwards passing the gas through the ordinary bulbs filled with beads or broken glass.

ACTION OF HEAT ON PROTOPLASMIC LIFE.

By F. CRACE-CALVERT, F.R.S., &c.

Those investigators of germ-life who favour the theory of spontaneous generation have assumed that a temperature of 212° F., or the boiling-point of the fluid which they experimented upon, was sufficient to destroy all protoplasmic life, and that the life they subsequently observed in these fluids was developed from non-living matter.

I therefore made several series of experiments, in the hope that they might throw some light on the subject.

The first series was made with a sugar solution, the second with an infusion of hay, the third with solution of gelatine, and the fourth with water that had been in contact with putrid meat. The hay and putrid-meat solutions were taken because they had often been used by other investigators; sugar was employed, being a well-defined organic compound free from nitrogen, which can easily be obtained in a state of purity; and gelatine was

used as a nitrogenised body which can be obtained pure and is not coagulated by heat.

To carry out the experiments, I prepared a series of small tubes made of very thick and well-annealed glass, each tube about four centimetres in length, and having a bore of five millimetres. The fluid to be operated upon was introduced into them, and left exposed to the atmosphere for sufficient length of time for germ-life to be largely developed. Each tube was then hermetically sealed and wrapped in wire gauze, to prevent any accident to the operator in case of the bursting of any of the tubes. They were then placed in an oil-bath, and gradually heated to the required temperature, at which they were maintained for half an hour.

Sugar Solution.—A solution of sugar was prepared by dissolving 1 part of sugar in 10 parts of water. This solution was made with common water, and exposed all night to the atmosphere, so that life might impregnate it. The fluid was prepared on the 1st of November, 1870, introduced into tubes on the 2nd, and allowed to remain five days. On the 7th of November twelve tubes were kept without being heated, twelve were heated to 200° F., twelve to 300°, and twelve to 400° F.

The contents of the tubes were microscopically examined on the 1st of December, twenty-four days after heating.

Sugar solution not heated.	Heated for half an hour at 212° F.	Heated for half an hour at 300° F.	Heated for half an hour at 400° F.	Heated for half an hour at 500° F.
There were about 30 animalcules under each field of the microscope, principally *small black vibrios*, 2 or 3 microzymes swimming slowly about, 3 or 4 *ordinary swimming vibrios*, and a few Bacteria.	A great portion of the life had disappeared, no animalcules were swimming; still this temperature had not completely destroyed life. 4 to 5 *small black vibrios* were observed moving energetically to and fro; 2 or 3 *ordinary vibrios* were also observed moving energetically in the same position of the field, that is, without swimming about.	The sugar was slightly charred, but the life was not entirely destroyed, as 1 or 2 *ordinary vibrios* and 1 or 2 *small black vibrios* were observed in motion under the field of the microscope.	The sugar was almost entirely decomposed; no trace of life was observed.	No life observed.

Remarks.—The black vibrios here referred to are far more opaque than the other varieties of vibrios, and are the most important of all, as I have found them to resist not only very high temperatures, but all chemical solutions. I shall, in my paper on putrefaction and the action of antiseptics, describe the various vibrios and give drawings of them.

Hay Infusion.—An infusion of hay was made by macerating it in common water for one hour, then filtering the liquor, and leaving it exposed to the atmosphere all night, when it was sealed in the small tubes, twelve of which were used for each experiment. The infusion was made on the 4th of November, sealed in tubes on the 5th, and heated on the 7th.

The results were examined on the 1st of December, 1870, twenty-four days after being heated.

Hay infusion not heated.	Heated for half an hour at 212° F.	Heated for half an hour at 300° F.	Heated for half an hour at 400° F.	Heated for half an hour at 500° F.
Fungus matter was observed growing on the surface of the fluids in two of the tubes. On subjecting the contents of some of the tubes to examination, from 20 to 25 animalcules were observed under each field of the microscope. This kind of life resembled small dots moving energetically to and fro; 1 or 2 ordinary vibrios were also present.	No fungus matter was noticed on the surface in any of the tubes. A few small black vibrios present in the original solution were also present in this.	No fungus matter present, but some of the small black vibrios were still present, although in less numbers.	No fungus matter observed. The fluid was filled with irregular masses of coagulated matter, and life had disappeared.	No life present.

Gelatine Solution.—A solution of gelatine, prepared of such strength that it remained liquid on cooling, was exposed for twenty-four hours to the atmosphere. It was then introduced into the small tubes, and the tubes sealed. The solution was made on the 4th of November, the tubes sealed on the 5th, and subjected to the different temperatures on the 7th.

The fluids were examined on the 1st of December, 1870, twenty-four days after being heated.

mediately after cooling and at all periods up to thirty days, and was unable in any instance to detect the slightest trace of life.

Not heated.	Heated for half an hour at 100° F.	Heated for half an hour at 212° F.	Heated for half an hour at 300° F.	Heated for half an hour at 400° F.	Heated for half an hour at 500° F.
A large quantity of life was present—namely, microzyma and several distinct species of vibrios, among which were a number of the small black ones frequently mentioned.	This temperature had but slightly affected the life present, the animalcules being as numerous as in the liquid not heated, and moving as usual. However, one species of very long vibrios appeared to be considerably affected, as they were much more languid in their movements.	This liquor differed from all the others in being turbid and coagulated. Life was still present; and although heat had deprived the animalcules of the power of locomotion, still they retained a sufficient amount of vital force to place it beyond a doubt that life was not destroyed.	The liquid was quite clear, the albumen (which is coagulated at 200°) appearing to be re-dissolved. A large quantity of the life in the fluid was destroyed, but some vibrios still remained, the small black ones being the most numerous.	All life had disappeared.	All life had disappeared.

This important result corroborates those recorded in my previous paper, and proves that the spontaneous-generation theory is not yet by any means established.

It occurred to me that it might be interesting to examine the influence on pure albumen of the putrid-meat fluids that had been heated, and note whether they still possessed the property of propagating life. A solution was prepared by mixing the albumen of a new-laid egg with pure distilled water free from life (prepared as described in my previous paper). Equal volumes of this solution were placed in six small test-tubes, which had been cleansed with hot vitriol and well washed with pure water. To one tube two drops were added of the putrid-meat solution that had been heated to 100° F., to a second two drops of that heated to 212° F., to a third two drops of that heated to 300° F., to a fourth an equal bulk of fluid heated to 400° F., and to a fifth the same quantity heated to 500° F. In the sixth, the albuminous solution, without anything added, was kept for comparison.

The tubes were sealed, and kept from the 1st of February to the 9th.

Gelatine solution not heated.	Gelatine solution heated for half an hour at 100° F.	Heated for half an hour at 212° F.	Heated for half an hour at 300° F.	Heated for half an hour at 400° F.
There were 7 or 8 animalcules under each field, 5 or 6 of which were quite different to any thing observed in the other fluids. They had long thin bodies, swimming with a peristaltic motion. 1 or 2 ordinary swimming vibrios were also present; but the small black vibrios were absent.	Life seemed to have only slightly decreased, and none of the animalcules were swimming. The peculiar animalcule mentioned in the first column appeared to retain still its peristaltic motion, but not sufficient power to move across the field, a few ordinary vibrios being also observed moving to and fro.	A very decided diminution in the quantity of life present was noticeable.	No life present.	No life present.

Putrid-Meat Fluid.—Water was placed in an open vessel, and a piece of meat suspended in it until it became putrid and contaminated with myriads of animalcules. This fluid was placed in the usual tubes, which were sealed on the 7th of November, and heated on the same day.

The contents of the tubes were subjected to examination on the 1st of December, or twenty-four days after having been heated. (See Table in next column.)

The results recorded in the above Tables show that protoplasmic life is but slightly affected by a temperature of 212° F., and that, even at a temperature of 300° F., it is not entirely destroyed, excepting in the case of gelatine. In all the other fluids a temperature of 400° F. is necessary to completely destroy the life. These experiments, therefore, clearly show that the life found by previous experimenters in fluids which have been submitted to heat was not due to heterogenesis but to life which had remained in the fluids, as I have seen no experiment reported where the temperature to which the fluids were exposed exceeded 300° F.*

I am the more justified in making this statement, as I have repeatedly examined the contents of tubes which had been submitted to a temperature of 400° F., both im-

* It is with pleasure that I find these experiments to confirm the suggestion of Dr. Beale, in his work entitled "Disease Germs, their Supposed Origin," page 50 (which I read a few weeks ago), that "living forms might live though exposed, under certain conditions, to a temperature of 350° F."

Results of Examination.

Albumen solution.	Albumen solution, with putrid-meat liquor, heated to 100° F.	Albumen solution, with putrid-meat liquor, heated to 212° F.	Albumen solution, with putrid-meat liquor, heated to 300° F.	Albumen solution, with putrid-meat liquor, heated to 400° F.	Albumen solution, with putrid-meat liquor, heated to 500° F.
In each drop 2 or 3 small black vibrios, moving to and fro.	Abundance of life.	Abundance of life.	Much less life than in the two fluids previously examined.	In each drop 2 or 3 small black vibrios, moving to and fro.	In each drop 2 or 3 small black vibrios, moving to and fro.

These results clearly show that, at the temperature of 100°, 212°, and 300° F., life and its germs had not been destroyed, whilst at 400° F. they had; for the results of the examination were in this case exactly identical with those of the albumen solution itself; and the life found was doubtless introduced in the preparation of the solution, and was not due to any life having remained in the fluids that had been heated.

Although perfectly aware of the interesting researches of Professor Melsens, proving that the most intense cold does not destroy the active power of vaccine lymph, still I thought it desirable to ascertain the effect of a temperature of 15° F. on well-developed germ-life, similar to that which had been subjected to the action of heat.

Some putrid-meat liquor, therefore, containing a large quantity of microzyma and vibrios, was subjected for twenty hours to the influence of a temperature ranging between the freezing-point of water and 17° below that point, when the ice was melted and the liquor examined. The animalcules retained their vitality, but appeared very languid, and their power of locomotion was greatly decreased.

Two hours after melting the ice the liquor was again examined, when the animalcules appeared to be as energetic as before.

ON THE ORIGIN OF THE DIAMOND.*

By the Rev. W. B. CLARKE, M.A., F.G.S.

(Continued from p. 18).

Diamonds in Brazil.

Brazil seems naturally to claim our first attention. It has been found that in a certain Brazilian rock called *itacolumite*, diamonds have been found *in situ*, and, therefore, all diamonds are assumed to have been derived in a similar way, wherever a rock imagined to be itacolumite exists.

In 1846, Professor Shepherd, of South Carolina (*A. S. J.*, ii., 253), announced the extensive development of the rock in that State, and he gives a figure and description of a diamond from gold washings in that formation. In Brazil, however, they occur in great numbers, in the lower itacolumite beds. According to Humboldt this rock belongs to the very oldest sedimentary deposits.

So far as my own observation has gone this rock does not occur in New South Wales, and even in Brazil, as I will show, diamonds are not confined to it. My friend Mr. Ulrich, late of the Victorian Survey, says the same of the sister colony, and assures me he had very good opportunities of satisfying himself by examining the Brazilian specimens at the last International Exhibition at Paris. Humboldt (*Essai Gèognostique Paris*, 1820, p. 89), includes itacolumite in the quartz rock series parallel with his primitive clay slate.

Von Cotta places it among the crystalline schists, and describes it as a fine-grained micaceous talcose or chloritic schist, *sometimes* flexible, holding occasional quartz pebbles with magnetic iron and gold, as well as diamond. According to Eschwege, it passes into *itabirite*, which belongs to the red hæmatitic group. Other writers include it with "mica schist," "quartz of the mica slate," and "elastic sandstone." Heusser and Claraz consider it a "granular quartz," sometimes bearing quartz veins with pyrophillite lime. Eschwege says it attains in Brazil a thickness of many thousand feet, ranging for hundreds of miles. The North Carolina species lies between limestone and clay slate. It is said that it occurs in Portugal, Spain, and on the Rhine. But this is doubtful. On the whole, it may be held to be a transmuted sedimentary rock—a friable quartz or sandstone.

M. Damour (*Bull. S. G. de France*, vol. xiii., 2nd series, p. 543), mentions the occurrence in Brazil of diamond bearing sand near Bahia, containing numerous minerals and ores, and states that the diamonds often contain spangles of gold in their cavities. He enumerates thirty-two mineral species, among them very minute rhombohedral dodecahedrons of garnet of a topaz yellow colour; a similar occurrence to that of Two Mile Flat, noticed by Mr. Norman Taylor, where *brown* garnets of the same form occur.

M. Damour suggests, in relation to the statements of M. Favre (referred to above), that the occurrence of the same minerals with diamond in different countries would throw some light on the formation. I may add that this is the principal reason which induces me now to enter so fully into this discussion.

Mr. Taylor instances as many varieties as M. Damour; but the so-called gems in the list given by the latter are confined to quartz, zircon, garnet, and tourmaline; ruby, sapphire, and corundum being absent, and euclase having been since added. The metals seem to predominate.

There is, according to M. Claussen, another solid matrix of diamond in Brazil, which he calls *itacolumite sandstone* (a secondary red sandstone), which overlies the crystalline beds, and once had an enormous development; to its denudation he attributes a considerable portion of the materials forming the mixed erratic diamond-bearing deposits; but in this he finds neither gold nor platinum. M. d'Archiac gives a very clear abstract of Claussen's remarks in his *Progrès de Géologie* (vol. ii., 379—383).

In the province of Matto Grosso, at the waterparting of the basins of the Amazon and Parana Rivers, a little south of 14° S. latitude, and at an elevation of some 1200 feet above the sea, is the diamond field of the Sierra Diamantina.

But the most important field in a geological, if not commercial view, is that which, ranging at a distance fully 900 miles S.E. of the former, stretches through the province of Minas Geraes, between 16° and 26° S. latitude, and even comes down to the coast at San Joao do Barro, where, in 1850, a chance washing of the underlying schist disclosed the presence of many diamonds. The deposit is not confined to the beds of rivers or ravines, but covers the slopes and tops of the hills. This deposit ceases exactly at the boundary of the bituminous beds of the coal measures of St. Catherine.

Is this, then, I would ask, any indication of the origin of diamond in carboniferous rocks? if so, ought not those rocks to contain diamond?

In the north part of Minas Geraes, jurassic calcareous formations cover the red sandstone, and these are, in turn, subordinate to gypseous marls and rock salt. Yet in the ravines, cut down to the sandstone, through the overlying beds, diamonds are found, *i.e.*, *above* the carboniferous formation.

Moreover, in 1839, diamonds were discovered in the psammite of Serro de Santo-Antonio de Grammagoa *imbedded* in the rock, whereas in the preceding itacolumite sandstone they occur between the plates of mica, just as garnets occur in mica-schist. The edges of these are

* From the Anniversary Address delivered to the Royal Society of New South Wales.

rounded, whilst in the psammite the angles are *uninjured*, proving that the transmutation of the sandstone into itacolumite has also affected the diamond crystallisation. For a long period the red psammite and the secondary itacolumite sandstone have been regarded as the sole matrices of diamond, whence it has been derived by the detrital erratic deposits; but since then, it has been found in the true itacolumite subordinate to the talc schists with quartz. The diamonds in the derived deposits are more numerous the nearer deposits are to the solid rocks. The detrital beds are classified according to their character.

Thus *Groupiara* is a drift not due to the present system of drainages. *Burgalho* or *Gurgalhoa* consists of superficial fragments of underlying rock. The decomposed schist of the latter is called *barro*. A sandy mass between these is spoken of as *terra*. Another bed of granular itacolumite is known as *pizarro*; but all belong to the decomposed rocks.

Cascalhao represents the sand, clay, and pebbles in the beds of rivers, torrents, lakes, and of the hollows in their courses through the solid rocks. *Tahoa-canga* or *tapahan-canga* is what we call in Australia *cement*.

The cascalhao of the old watercourses goes by the name of *guipara*; that at the heads of rivers *tabuleira*; and the partly rounded pebbles of the present streams are denominated *corrido*.

The assemblage of all the minerals associated with the diamond is, according to Heusser and Claraz, from whom the last four terms are taken, called "*the formation*."

We learn further from these authors that though diamond belongs undoubtedly in Brazil to itacolumite and metamorphic schist, yet it is not so necessarily; for the itacolumite mountains do not always contain diamond, and in that of Itacolumi itself none are found.

The minerals seem to follow a choice as to their matrix and associations. Thus anatase occurs with suboxide of iron—rutile and brookite. Euclase is found with topaz, in a whitish clay of decomposed rock.

Specular iron ore, rutile, black tourmaline, hyaline, and smoky quartz are associated. Topaz (sometimes "rotten") is abundant, but is no longer, in comparison with euclase, an object of search.

Ores of tellurium, as well as sulphur, occur in some localities. In the crystalline schists crystals of lime, arragonite, magnetic iron pyrites, copper pyrites, manganese ores, and chromate of lead are met with. Scorodite and pseudomorphs of the same also occur in the schists and in the "*tapahan-canga*." Amethyst is found in veins in schists and gneiss, whilst chrysolite, cymophane, and green tourmaline collect in the cascalhao of the crystalline schist rivers.

Mr. Heuland, in 1823, exhibited to the Geological Society of London (*Transactions*, second series, i., p. 119), a diamond in cascalhao surrounded by scorodite (a cupreous arseniate of iron), which I do not see in M. Damour's lists, but which was found by Eschwege; and Dana says it encrusts quartz and beryl, and is found in Victoria with gold and arseno-pyrites. Of the latter mineral Mr. Ulrich gives three localities. It has not yet been found on the Cudgegong. But Schorl rock does occur there, and in the sands of Bahia, at Diamantina, in Minas Geraes; and this mineral, there called *feijao*, as well as hydrophosphate of alumina, is considered an indication of diamond.

It is stated by Mawe ("Travels in Brazil") that the mines of Cerro-do-Trio annually produced, between 1801 and 1806, to the amount of from 20,000 to 25,000 carats, and that the weight of those sent to the Treasury in Rio Janeiro was 115,675 carats.

As an encouragement to diamond seekers in this colony may be mentioned that numbers of the Brazilian crystals are so small that four or five make only a grain, so that it takes sometimes seventeen to twenty to weigh a carat. There are rarely in the course of the year more than two or three of the latter weight, and it takes two years to find one of 30 carats; so that when a negro workman found one of 17½ carats, called an *octavo*, he was crowned with flowers, conducted in triumph to the manager, fresh clad, and set at liberty. This is reported by Malte Brun (*Précis*, vol. iii., p. 293). Dr. Thompson has ascertained that up to January 12th, 1870, 9-10ths of the diamonds at the Two-mile Flat weighed less than a carat, and that 497 together weighed 120 carat grains; but as they were different in size, the average is assumed at one carat each, the largest being 1⅜ carats. One, however, had been found weighing 5⅝ carats.

These facts are interesting as correlating, so far as is known, the prospects of this colony and those of Brazil.

To prevent reference to it hereafter, I may mention now that a new and valuable work on precious stones ("Handbuch der Edelstein") was published in Vienna last year by Dr. Albrecht Schrauf. I found a notice of it in the *Quarterly Journal of Science* for January, 1870. In it is given a formula for calculating the value of diamonds, which tested by the price actually paid for the Sancy stone (£20,000), taking the weight at 53 carats, and the price of the first carat at £15 and which is near to the theoretical result (£21,862 10s.), appears to be tolerably correct. It is this:—

$$\frac{m}{2}(m+2)a = \text{value},$$

where m is the number of carats, and a the value of one.

I have already noticed some of the facts stated by Messrs. Heusser and Claraz.

There are one or two others which may be quoted by way of relieving the dryness of these details. But I would mention that much compact information is given by these authors, in relation to their physical and geological researches in the interior of Brazil in Dr. Petermann's "Mittheilungen" (1859, Heft. xi.)

The previous and following quotations are taken from a paper read before the Geological Society of Berlin. Herodotus, we remember, tells (iii., 102), a ridiculous story, repeated by authors as late as the sixteenth century, of gold being brought up by ants as big as dogs that guarded it when obtained, and pursued the man that took it from them; but Messrs. Heusser and Claraz tell a far more probable story of diamonds having been found among the little pebbles with which some wormlike insects" cover their tubular coverings—a fact quite paralleled by the Phryganea of Auvergne, which covered their indusiæ with the shells of *Bulimus atomus* or a small *paludina*, forming strata which cover nearly 800 square miles, and are from eight to ten feet thick (*Scrope*, "Central France," p. 11).

There is, however, another statement of even greater interest. In the cascalhao are found fragments of quartz shaped like an anvil. These were used as earrings by the ancient inhabitants of Brazil. One of these ornaments was found in cascalhao that had never been disturbed, in a dry watercourse, covered by 18 feet of vegetable soil, on which many fine palm trees were growing. Arrow-heads and bones were also found with it. This cascalhao must, therefore, be comparatively recent, or the race to whom such implements belonged must have been very ancient.

According to M. Hockeder, the first diamond in Minas Geraes was discovered in the year 1827. But I believe Brazil was known to possess diamond just a century before.

The effect was much like that which takes place in Australia when a new lead is discovered. The gold workings were all deserted by what is called here "a rush," and the greatest excitement followed. M. Hockeder's memoir, though now little known, made also a stir at the time. [*Ueber des vorkommen der diamantem*]. There are other documents referred to in the *Bull. Soc. Geol. de France* (xiv., 232; i., 19; ii., 659).

Further particulars relating to the diamond beds of Brazil may be found in a paper by M. Pissis in the journal just cited (Tom. xiii).

One passage seems to bear upon certain facts observable in Australia. He says, "to these stratified rocks we must add compact diorites, which show themselves abundantly

distributed on the surface, sometimes forming long lines of hills, sometimes simple *mamelons* in which the matter appears to have been poured out in the manner of basalts, producing long sheets which cover the last beds of the limestones, whether siliceous or schistose." He then goes on to speak of the sandstones which underlie the limestones, and which are to be regarded as the true matrix of the diamond. "Thus, of all the rivers of the province of St. Paul those only which flow over the *sandstones* are diamond bearing." And instancing the Rio Guarahi, he says it leaps over the escarpment, where it forms several cataracts, cutting through the various beds of sandstones and psammites, and it is only below the cascades that you begin to find diamonds, a similar remark to that of M. Claussen in relation to the coal measures.

Other facts worthy of mention may occur in Captain Burton's work on the "Highlands of Brazil," but as I have never yet seen a copy of that work, I have not referred to it.

(To be continued).

ASSAY OF GOLD AND SILVER,

AS PRACTISED AT THE LABORATORY OF THE SCHOOL OF MINES, COLUMBIA COLLEGE.

By T. M. BLOSSOM, E.M.

(Continued from p. 16).

The Charge.

The weight of ore taken for an assay depends upon its supposed richness or poverty, since it is required to obtain finally a bead of precious metal of convenient size for weighing, and, at the same time, neither too large for cupellation (*vide* Cupellation) nor so small as seriously to affect the calculated results, through losses sustained in the assay. As a rule, it is usual to take one-third assay ton for silver ores, and one, two, or four assay tons for gold ores.

A special method will be given for galena. All other ores require the following reagents:—Litharge, carbonate of soda, and one of the reducing agents, argol and charcoal, or an oxidising agent, as nitre, with invariably a cover of salt one-quarter to half an inch in depth. Borax, silica, and other reagents are very useful at times, but no general rule can be given for their employment. This matter must be left to the judgment of the assayer, guided by the known properties of the reagents and by the composition of the ore. It is well, in this connection, to bear in mind the principle that for basic impurities, an acid flux is needed, and for an acid gangue a basic flux. As a rule, employ a weight of litharge twice that of the ore, and of carbonate of soda, the same as of ore. These proportions also may be modified to advantage, according to the composition of the ore. The proportion of nitre, or of reducing agent, depends upon the reducing power of the ore, hence it is variable in every case. These reagents are added to control the size of the lead button.

Size of the Lead Button.—There are two limits to the size of the button: (1) it must be large enough, or, in other words, enough litharge must be reduced throughout the mass to collect all the precious metal, and, at the same time (2) there should not be a useless excess of lead, which would occasion loss of silver in the subsequent cupellation.

These two conditions cannot always be fulfilled, but in this case the latter must be sacrificed. It has been found that a button of 15 to 20 grammes is the best size for a weight of ore from one-third to four assay tons. This is also a convenient size for a cupellation. A button that is too large for cupellation can, however, always be reduced in size by scorifying.

These requirements necessitate, in many instances, a preliminary assay of the ore to determine its reducing power. The reducing power of an ore is due to the presence of sulphur, arsenic, antimony, zinc, &c., but generally to sulphur contained in pyrites, &c.

Preliminary Assay of Ore.

Charge.	Ore	2 grms.
	Litharge	25 ,,
	Carb. soda	10 ,,
	Salt	Cover.

A duplicate assay need not be made.

Warm the crucible before placing it in the fire, which should be perfectly bright and should be urged to effect complete fusion in the shortest possible time. When the contents of the crucible are in quiet fusion, it must be withdrawn, to prevent farther reducing action of the furnace gases. Tap the crucible gently, and when cold break it open.

Three cases may arise here. Two grammes of ore may yield—

1. No lead, or less than three grammes.
2. Three grammes lead.
3. More than three grammes.

The reducing power is stated thus:—2 grms. ore = — grms. lead. Let us suppose that we shall take for the regular assay $\frac{1}{3}$ A. T. of silver ore and that the reducing power is found to be 2 grms. ore = 1·5 grms. lead: $\frac{1}{3}$ A. T., or 10 grms. (about) ore will in this case reduce 7·5 grms. lead, and as the required button is 15 grms., we must add enough argol, or charcoal, to reduce 7·5 grms. in addition; taking argol as 8·5, we shall require $7·5 \div 8·5$ grms. or 0·882 grms., say 1 grm., or charcoal $7·5 \div 28 = 0·268$, say 0·3 grm.

If the reducing power correspond to the third case, a similar calculation will indicate how much nitre is needed to oxidise part of the sulphur, arsenic, or other reducing agent, and thus prevent the reduction of a button larger than 15 grammes. In the second case, ten grammes of ore would reduce a button of 15 grms. and neither argol nor nitre would be required.

The character of slag obtained in the preliminary assay may also suggest some modification of the regular charge. If it be earthy, for instance, we would add borax glass or silica. Experience will often enable the assayer to judge of the reducing power with sufficient exactness, without an extra assay. Cases will arise, however, in which he must make a preliminary assay, or roast the ore, and it is always best to roast when there is a large amount of sulphur in the ore. He will then have an ore of no reducing power.—(Case I.)

Ores to be Roasted.

Ores containing a large amount of sulphur or arsenic, antimony or zinc, should always be roasted. In the former case, if the ore be not roasted, there will be danger of the formation of oxysulphurets, which are very fusible, but are not decomposed even at a white heat, and enter the slag carrying silver with them. A large quantity of nitre also subjects the contents of the crucible to the liability of boiling over; even should this mishap not occur, the great evolution of nitrous and sulphurous vapours puffs up the mass throughout the crucible, and the globules of lead afterward reduced may be left adhering to the sides, not being washed down by the retreating charge. Arsenic and antimony produce arseniates and antimoniates, which carry silver into the slag. Zinc increases the loss of silver by volatilisation and also in the slag.

Roasting the Ore.

The ore may be roasted conveniently in a cast-iron pan over the crucible furnace. There ought to be a hood over the furnace, to carry off the fumes of sulphurous, arsenious, and other acids. The pan should be covered with a coating of red ochre, or, still better, of chalk. The former is put on wet with a brush. An excellent even coating of the latter may be obtained by

making a chalk paste, of proper consistence, in the pan, and turning with the hand so as to spread the paste while the pan is being held over the fire to dry. The coating prevents a loss of ore and injury to the pan through the sulphides attacking the iron.

The weighed sample must be spread over the pan and stirred with a bent wire until all danger of fusion is past. The pan must be heated gradually at first, not above a dull red heat for some time, and may be brought, finally, to a full red, or higher heat. Too high a heat at the outset might cause the fusion of sulphides and the formation of mattes troublesome to roast. A rapid disengagement of arsenic, antimony, or zinc, would cause, also, a mechanical loss of silver, by carrying it off in their vapours. Should fusion take place, it is better to weigh out a fresh portion of ore and roast again with more care. If this be not done the fused portions must be pulverised in a mortar and re-roasted. Generally, in roasting sulphides, the operation may be considered finished when, after keeping the pan at a full red heat for some time, no more fumes of sulphurous acid can be perceived. As there is danger, however, of the formation of sulphates, especially if copper pyrites be present, it is best always to mix some carbonate of ammonia with the ore, after the fumes have ceased, and to cover the pan. The ore is thus confined in an atmosphere of carbonate of ammonia, which decomposes the sulphates with formation of volatile sulphate of ammonia.

Arsenic and antimony require the addition of fine charcoal, to reduce any arseniates and antimoniates that may have been formed during the roasting. Care must be taken to burn out all the charcoal.

If the ore contain a very fusible sulphide, as antimony-glance or galena, it may be mixed with some fine sand previous to roasting.

The roasting of ores may also be done in the muffle in an earthen saucer.

Fusion.

The charge prepared according to the foregoing directions is thoroughly mixed and placed in a crucible, which it should not more than two-thirds fill. A hot fire should be employed, and the crucible removed when complete fusion has taken place. This ought to require from twenty to twenty-five minutes. The crucible is tapped, as usual, and broken when cold.

b. Scorification Assay.—

The reagents necessary for a scorification assay are test-lead and borax glass. The ore is mixed with these in suitable proportions, the mixture put in a scorifier and fused in a muffle. The operation affords an alloy of lead with the precious metals, and a slag composed of litharge with the impurities and gangue of the ore. The assay might be made with lead only, but it is advantageous, as will appear, to add some borax. There will be required of lead only enough to render the slag liquid and to furnish lead for the button. The proportions of both lead and borax will vary, and should be greater in proportion as the gangue and metallic oxides are more difficult of fusion. The following table exhibits the proportions found by experience to be best adapted to the different gangues. The proportions are referred to one part of ore.

Character of Gangue.	Parts Test-Lead.	Parts Borax.
Quartzose	8	
Basic (Fe_2O_3,Al_2O_3,CaO), &c.	8	0·25-1·00
Galena	5-6	0·15
Arsenical	16	0·10-0·50
Antimonial	16	0·10-1·00
Fahlerz	12-16	0·10-0·15
Iron pyrites	10-15	0·10-0·20
Blende	10-15	0·10-0·20

No preliminary roasting is required. As in the crucible assay, the weight of ore taken depends very much upon its richness, but is generally a third, sixth, or tenth of an assay ton. If one scorifier will not contain the charge, it is best to weigh equal fractional parts for the number required, rather than to weigh the whole charge and roughly divide it between the scorifiers. In case of an accident to one of the scorifiers, the known loss can easily be restored, if the former course be followed. The exact parts that lead and borax perform in scorification can be understood best from a description of the operation in detail.

Three distinct periods may be noted in the working:—

1. Roasting; 2. Fusion; 3. Scorification. A strong heat is maintained, at first, in order to melt the lead. This is effected by closing the muffle and regulating the draught. As soon as the lead is fused the muffle is opened, and the ore is seen floating upon the surface of the lead.

1. The roasting now commences, and is continued at a moderate heat until no more fumes are seen, and the ore has disappeared.

2. The heat should now be raised in order to fuse thoroughly all the material in the scorifier. When the fusion is complete, clear white fumes of lead may be seen arising from the scorifier, there is an intermittent play of colours across the bright surface of the lead, and the slag produced encircles the metallic bath like a ring. The borax plays an important part just here, by giving liquidity to the slag, thus permitting it to be thrown to the side as fast as formed, exposing a clear surface of lead for oxidation. If borax be not added and the ore contain a difficultly fusible gangue, the scoriæ will float in detached masses over the lead, impeding the oxidation, until sufficient litharge has been formed to give it liquidity.

3. When the fusion is complete, the heat may be lowered and the third period of scorification continued until the ring of slag, which is continually growing smaller, close over the residue of metallic lead. The heat should again be raised, to liquefy the slag and allow the metallic lead to settle, after which the scorifier is removed from the furnace. If the button is wanted immediately for cupellation, the contents of the scorifier may be poured into an iron or copper mould coated with red ochre. It is thus soon cooled. Otherwise allow the contents to solidify in the scorifier, and break this for the button when cold. Hammer the button as usual.

The whole assay occupies about thirty-five minutes.

In making the charge, it is customary to mix the ore with a part of the test-lead and with borax, and to cover this in the scorifier with the rest of the lead. This will prevent loss of ore prior to fusion. Too much borax should not be added at first. If a large amount is needed, it is better to mix only a portion with the ore, one gramme, for instance, and to introduce the rest wrapped up in paper, as needed during the operation. Some of it may be reserved for the final heating after the lead is slagged over. If too much were added at first, the lead would be slagged over before the necessary reactions had taken place.

The Lead Button.—The lead button submitted to cupellation must be malleable and of the proper size for the cupel. A good cupel will absorb its own weight of litharge, but it is better to use a cupel one-quarter to a third as heavy again as the lead button. The cupels in ordinary use weigh about 18 grammes, hence a button of 12 to 15 grammes is the proper size for them. If the button be too large it may be reduced in size by scorification. In case of doubt it is better to scorify, since there is less loss in this operation than in cupellation. A brittle button may be due to the presence of sulphur, arsenic, antimony, zinc, or litharge. In either case it must be scorified before cupellation, and with test-lead if necessary. If the button contain copper it must be scorified until no more copper can be seen on hammering out the button. If nickel be present the button cannot be cupelled. This, however, will occur but rarely.

3. *Cupellation.*—

The lead button obtained by the foregoing operations is next cupelled. This operation is similar in many respects to scorification, but differs from it in that the scoriæ formed are absorbed entirely by the cupel, leaving a pure bead of the precious metals. This property of the absorption of scoriæ is an indispensable condition in cupellation, so that, unlike scorification, it is limited to a few substances capable of being absorbed by the cupel. The oxides of lead and bismuth alone can be absorbed in a state of purity, but they can carry along with them certain proportions of other substances which, by themselves, would form infusible scoriæ. It is thus that we are enabled to get rid of small amounts of copper, iron, arsenic, &c., remaining in the lead button. Bismuth is seldom, if ever, used for this purpose. The proportion of lead required to carry off the different impurities varies according to circumstances. In the case of lead buttons from an assay, there is always an excess of lead, if they have been properly purified. Other cases will be treated under the head of Assay of Alloys, where the necessary tables will be given.

The operation of cupelling a lead button is conducted as follows:—

The cupels must be carefully dried before use, and must be free from cracks, which would cause a loss of precious metal. The bottom of the muffle should be covered with sand, to prevent injury to it in case of the upsetting of a cupel. A cupel having been selected, it should be wiped carefully with the finger, and all extraneous matter blown out. It may then be placed in the muffle. Before the introduction of the lead button, the muffle should have attained a reddish-white heat, and the cupel should be of the same temperature. This being attained, the button is placed in the cupel with a pair of forceps, gently, so as not to injure it. The muffle should now be closed, either by a door or by a piece of lighted charcoal, to bring the fused button to the same temperature. This done, the muffle is opened and air allowed to enter; the button, which at first appears bright and uncovered, is soon covered with a film of oxide moving in luminous patches over the surface, and being continually thrown toward the edge, where it is absorbed by the cupel. White fumes of lead arise, and the button is surrounded by a ring of the absorbed litharge, which continually widens until it reaches the edge of the cupel. The button thus gradually diminishes in size by oxidation and absorption, and becomes more convex; the luminous patches become larger and move more quickly; and when, finally, the last of the lead is absorbed, the button appears to revolve rapidly on its axis, becomes very brilliant, and is suffused with all the tints of the rainbow; the movement is suddenly checked, the button becomes dull for a few instants, and then presents the appearance of the pure precious metals. The latter part of the operation is called the "brightening" of the button. Should the bead be large, and composed, in great part at least, of silver, it must be removed slowly and gradually from the furnace, to prevent loss by "spitting," which might happen if the cupel were removed at once from the muffle. When a cupel is withdrawn directly after brightening, the button is liable to be covered by mammilated and crystalline protuberances, and is then said to have "vegetated" or "spit." Portions of the metal are sometimes thrown off and lost. Whatever the cause may be, this does not occur if the button be withdrawn gradually, so as to permit a slow and gradual cooling. In case the bead be very large, say 100—300 milligrammes, it is well to cover it with a hot cupel, which will retard the cooling and prevent the loss of small particles that may be thrown off despite all care. If the bead is not larger than the head of an ordinary pin, the danger of vegetation is slight, and no great precautions need be taken in its removal.

Two causes have been assigned for this "spitting." One is that molten silver absorbs oxygen from the atmosphere and gives it up at the moment of solidifying, thereby occasioning the vegetation. Another is, that by rapid cooling a crust is formed on the outside, which contracts upon the liquid interior and is broken, forcing the molten metal through the rents thus made. The latter is simple and plausible; the former is supported, apparently, at least, by elaborate experiments.

It is well to raise the heat of the furnace just before the brightening, or to push the cupel into a hotter part of the muffle, in order to aid the brightening and get rid of the last traces of lead, which are somewhat difficult to remove. The button should also, for the latter purpose, be heated strongly a few seconds after brightening.

Silver is sensibly volatile at a high heat; the loss of gold is slight, and may be disregarded. In the assay of ores this loss need not be considered, but in bullion assay a correction is necessary, for which a table will be given under Assays of Alloys. The loss of silver increases with the temperature, but we must avoid, in cupellation, the two extremes of a high heat and quick work and a low heat with prolonged work. Of the two extremes the latter is worse. The following are indices of favourable working:—The muffle is reddish-white, the cupel is red, the fused metal very luminous and clear, the lead fumes rise slowly to the top of the muffle, and the litharge is completely absorbed by the cupel.

The heat is too great when the cupels are whitish, when the fused metal is seen with difficulty, and the scarcely-visible fumes rise rapidly in the muffle.

The heat is too low when the fumes are thick and fall in the muffle, and when the unabsorbed litharge is seen forming lumps and scales about the button.

The degree of heat should bear some relation to the richness of the alloy, and may be greater according as the lead is poorer in silver. By bearing this in mind the assayer may often hasten the operation without detriment to the assay. The draught of air through the muffle must also be regulated. Too strong a current cools the cupel and oxidises the lead faster than it can be absorbed, thus endangering the assay. Too slow a current prolongs the operation and increases the loss by volatilisation. In ordinary work this matter, however, occasions very little trouble.

It happens sometimes that the material in the cupel becomes solidified in the midst of an operation, stopping all farther action. This disaster is called the "freezing" of the button, and is occasioned by the following conditions; a production of litharge more rapidly than it can be absorbed by the cupel, and infusible scoriæ, due to a cold furnace, or to an excess of foreign oxides. In either case the scoriæ gradually extend over the surface of the button until it is entirely covered, when farther movement ceases. This disaster may sometimes be prevented or remedied by raising the heat of the muffle; if this fails, or if the accident be due to foreign oxides, an addition of pure lead must be made to the assay; in either case, the results are unreliable.

An assay that has *passed* well, furnishes a bead well rounded and clear, crystalline below, and readily to be detached from the cupel. If the bead contain lead, it is brilliant below, and does not adhere at all to the cupel. If the bead exhibits rootlets passing down into the substance of the cupel, the results are inaccurate.

(To be continued.)

MISCELLANEOUS.

Stevens's Institute of Technology, Hoboken, N.J.—The first session of this institute, of which Professor Henry Morton is the President, will commence on the 26th of September. Apparatus, &c., already purchased amounts to upwards of £5000.

Trial of the Pyx of the Mint.—On Tuesday, July 18th, this ancient and interesting trial was held at the Goldsmiths' Hall, the proceedings, commencing at nine o'clock, a.m. The following is an extract from the verdict of the

Jury:—"We then assayed the six sovereigns, and three half-sovereigns separately, and we found the millesimal fineness of such sovereigns to be 916·9, 916·7, 916·7, 916·8, 916·7, 916·7 respectively, and the millesimal fineness of such half-sovereigns to be 916·6, 916·6, 916·5 respectively." The true standard of gold is 916·66 parts of fine gold in 1000 of alloy; therefore the result of the trial is truly wonderful, and reflects great credit on the responsible officer, Mr. W. Chandler Roberts, the chemist to the Mint. The bulk of the silver coins agreed exactly with the standard trial plate, although the law allows a variation of eight parts in the thousand.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, June 26, 1871.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences;—

Memoir on the Transport of some Salts by Electrical Discharge.—Dr. Becquerel.—This lengthy essay treats on some phenomena observed by the author while experimenting on the effect of only moderately strong electrical discharges when certain chemical compounds are placed in the route of the electric current. As results from these experiments, the author finds that the undermentioned salts and other chemicals are transported by electrical discharges in the direction from the negative electrode to the positive electrode, but not again the reverse way. These salts and substances are ferricyanide of potassium, bichromate of potassa, chloride of barium, chloride of sodium, chloride of potassium, sulphuric acid, phosphoric acid, chloride of ammonium, and protochloride of iron. The following are among the substances which are not transported by any electric current, whatever its direction:—Chloride of cobalt, chloride of platinum, nitrate of silver, caustic potassa, and sulphate of potassa.

Relation existing in the Sun between the Faculæ, Protuberances, and Corona.—Rev. A. Secchi, S.J.—A lengthy letter by the eminent *savant* communicating his latest discoveries on the physical constitution of the sun. This preliminary notice is to be followed by a complete essay on this subject.

Experimental Researches on the Preparation and Properties of the Propylic and Butylic Chlorides.—J. Pierre and E. Puchot.—This very lengthy memoir describes exhaustively the various methods of preparation employed by the authors for obtaining—(1) Propylic chloride, C_6H_7Cl, a liquid which, in a pure state, is colourless, very mobile, exhibiting a not unpleasant, yet somewhat alliaceous (garlic-like), odour, and boils at 46·5°; its density at 0° is 0·9156, and at 39° 0·8671. (2) Butylic chloride, C_8H_9Cl; also a liquid which, in many of its properties, is similar to that just alluded to, but boils at 69°, and has at 0° a sp. gr. of 0·8953. The authors are engaged in making further researches on some of the products of decomposition of these fluids, only briefly alluded to in this paper.

Researches on Animal Amidon, a Starch-Like Substance.—C. Dareste—This paper is a physiological essay on the occurrence of a microscopically-small granular substance which has been observed by the author to be present in the yolk of eggs, the ovary, liver, and other organs of animals, and which substance, in many of its chemical and physical properties, exhibits a similarity to starch.

Second Memoir on the Heat Evolved by the Combustion of Magnesium, Indium, Cadmium, and Zinc.—A. Ditté.—An algebraico-physical memoir.

This number contains also several important meteorological papers, and an interesting account of the fate of the balloons started from Paris during the siege of that city by the Germans.

July 3, 1871.

This number opens with a very lengthy and highly valuable memoir on the—

Heating and Ventilation of the Palace of the Corps Législatif during the Session 1869-70.—General Morin.

The other original papers and memoirs relating to chemistry and collateral sciences are—

Reactions which take place between Oxide of Carbon under the Joint Action of Metallic Iron and the Oxides of that Metal.—L. Gruner.—Reserved for translation and full reproduction.

Monochlorides of the Bibasic Acids.—L. Henry.—This essay, however valuable in a scientific point of view, is not well suited for any useful abstraction, owing to the large number of formulæ absolutely required for the proper elucidation of the subject.

Properties and Industrial Manufacture of Nitroglycerine.—P. Champion.—From this very lengthy memoir we quote the following particulars bearing upon the properties of nitroglycerine, which is absolutely insoluble in water, but soluble, in all proportions, in ether, methylic alcohol, and ordinary alcohol (but, as regards the latter, only at a temperature above 50°). Nitroglycerine is somewhat volatile, without decomposition, above 100°, and is not liable to spontaneous decomposition when pure. When exposed for several hours to a temperature of −15°, nitroglycerine becomes thick, but not solid; while a prolonged continuation of cold of only −2° freezes this body, converting it into a crystalline mass. Fuming nitric acid dissolves, but also decomposes this fluid; and the same effect is produced by concentrated sulphuric acid, and also by the mixture of sulphuric and nitric acids employed for the preparation of nitroglycerine. This latter fact explains the deficiency of the theoretical quantity (246) which is obtained in the preparation of nitroglycerine from 100 parts of glycerine. Nitroglycerine is also decomposed by aqua regia, by ordinary nitric acid at 50°, and by a concentrated solution of caustic soda, a nitrate of that base being formed. The author's experiments prove that pure nitroglycerine boils, but does not explode violently, at 185°; volatilises slowly at 194°, rapidly at 200°; deflagrates violently at 217°; detonates difficultly at 241°, but violently and completely at 257°; at a higher temperature the detonation is less violent, and at 287° is accompanied by flame. At low red heat, nitroglycerine assumes the spheroidal state, and is volatilised without detonation. While nitroglycerine detonates with great violence by a smart blow, it is not affected by electrical shocks.

Iodo-Chromate of Potassa.—P. Guyot.—The author describes, at some length, the mode of preparation of the salt alluded to, $2(CrO_3)IK$, or—

$$CrO_2'' \left\{ \begin{matrix} OK \\ I \end{matrix} \right.$$

stating that this salt usually contains an excess of iodine, and is decomposed in contact with water. The best mode of preparation of this salt, so as to obviate excess of iodine and obtain the salt crystallised, is to heat gradually, but without ebullition, a saturated solution of iodhydric acid with pulverised chromate of potassa, to be added by small portions at a time, and to cool slowly the porcelain vessel wherein the operation is performed.

Xanthine, and its Detection in Vesical Calculi.—G. Lebon.—A physiologico-chemical paper. Xanthine, ($C_{10}H_4N_4O_4$), is a substance found in very small quantity in urine, but very rarely met with in vesical calculi.

Moniteur Scientifique, Nos. 347 and 348 (double number), June 1 and 15, 1871.

This number opens with an exhaustive essay on the—

Treatment to be Adopted in Cases of Adder Bites.—Dr. A. Viaud-Grand-Marais.—This essay contains a large amount of useful and well-digested matter. Fortunately, in the United Kingdom poisonous snakes are rare; whereas, in many parts of France they are so abundantly met with as to make it necessary for the authorities to pay a premium of from 1 to 2 francs for every killed snake exhibited and given up during a certain period of the year.

The original papers bearing upon chemistry and collateral sciences are the following:—

Separation of Silver from Argentiferous Lead.—Dr. E. Kopp.—This lengthy memoir treats first on the process of extracting silver from lead by means of zinc, and contains next a description of MM. Rothschild's large works established at Havre for the purpose of refining every month some 500 tons of Spanish lead by means of zinc, followed by descriptions of similar works established in the Harz and Upper Silesia, and, lastly, the description of the works of MM. Herbst Bros., at Call. This excellent essay is too lengthy to admit of any useful abstraction, and, unfortunately, also for translation in full.

Use made of Finely-Divided Metallic Tin.—Dr. E. Kopp.—Very finely-divided tin is prepared by the decomposition of a solution of a proto-salt of tin, by means of metallic zinc, in the following manner:—Into some 15 to 20 cylindrically-shaped earthenware jars capable of containing 12 litres are poured from 8 to 10 litres of a solution of chloride of zinc at a density of from 10° to 15° B. (sp. gr., 1·070 to 1·109), to which are added from 40 to 70 grms. of tin-salt (protochloride of tin), after which stout pieces of sheet zinc are placed in this liquid. The reduction of the tin takes place gradually; and as soon as the reaction is finished the liquid is cautiously poured on a fine silk sieve. The filtrate is again used, and the metallic tin is first washed by decantation, and the very finely-divided metal is next collected on a filter, washed once more with distilled water, and afterwards dried. The substance thus obtained is chiefly used in the production of the so-called argentine printing, either upon silk or fine cotton fabrics (fine muslins and *mousselines de laines*), the very finely-divided metal being fixed either by means of albumen or an ammoniacal solution of caseine. After printing and dressing, the fabric, in order to give the metallic silvery gloss, is hot-pressed. A very large quantity of this finely-divided tin is also used in the manufacture of surface-metallised paper, and for the purpose of ornamenting gilt picture-frames.

Method of Rendering Wooden Taps Impervious for Liquids and Preventing their Cracking.—Dr. E. Kopp.—The taps are placed in molten paraffin heated to from 110° to 120°; by this means

the water is eliminated from the wood, and the wood becomes thoroughly impregnated with paraffin. The taps are not removed from this bath until all the aqueous vapour has been expelled and left, after the removal of the vessel from the fire, in the molten liquid up to the very moment the paraffin begins to solidify. Wooden taps thus prepared are very durable, do not become soaked with liquids, keep very tight, and are not liable to become mouldy. The excess of paraffin is wiped off with care, and the taps are next rubbed clean with a piece of flannel.

Animal Charcoal, and its Use in Sugar Refining.—A. Vivien.—This valuable essay contains a very large amount of useful practical matter, but the paper is too lengthy to admit of any useful abstraction.

Testing by means of the Blowpipe.—F. Jean.—The author states that sulphuret of sodium is one of the best blowpipe tests, if used in the following manner:—First, a bead is made with borax and the substance to be tested, and this bead, having been made very fluid within the reduction-flame, there is added to it some dry and pulverised polysulphuret of sodium, and the bead again heated in the reduction-flame. If the substance under investigation can form a sulpho-acid, there will be formed a soluble sulpho-salt and a clear bead; but when no such salt can be formed, with lead, for instance, an opaque bead will be formed. Iron, lead, bismuth, nickel, cobalt, palladium, thallium, silver, copper, uranium, &c., fused in a bead of borax, to which, afterwards, sulphuret of sodium is added, will yield a black or brown-coloured opaque bead; zinc yields a white opaque bead; cadmium, while yet hot, scarlet-red, and yellow after cooling; manganese a dirty chestnut-brown; gold and platinum, a clear, transparent, mahogany-brown bead; tin, a clear, transparent, yellowish-brown bead; chromium, a green bead; arsenic and antimony, colourless clear beads; vanadium and iridium, blood-red beads; a slight excess of the sulphuret of sodium is required, and the bead should be heated carefully, but steadily, and with a good blast in the reduction-flame.

La Revue des Scientifique de la France et de l'Etranger, July 15, 1871.

This number does not contain any original papers on chemistry and collateral sciences.

Polytechnisches Journal von Dingler, first number for June, 1871.

The original papers and memoirs relating to chemistry and collateral sciences contained in this number are—

Phosphorus Bronze.—MM. Montefiori-Levy and Kimtzel.—This paper treats on a subject which (as proved, also, in the appendix added to this paper by the editor of this periodical) has been frequently a subject of research and of trials on the large scale—to wit, the addition of a certain proportion of phosphorus to either copper alone, or to an alloy of copper and tin with or without any zinc. It appears that the authors have hit upon a plan for manufacturing an alloy, of which phosphorus is one of the constituents; but this paper does not give any information on the chemical composition of this alloy, which appears, however, from experiments made with it, to be exceedingly well adapted for the construction of some parts of machinery, and also for the purpose of making carbine and rifle barrels.

Separation of Oxide of Iron from Oxide of Uranium, and the Estimation of Phosphoric Acid by means of Uranium.—H. Rheineck.—Reserved for full translation.

Best Means of Improving Fireclays, so as to render them more Suited for the Manufacture of Glass, as well as for General Purposes.—Dr. C. Bischof.—The contents of this paper altogether bear upon matters of practical detail in respect of the manufacture of fireclay articles. Among the means of rendering these less readily fusible, and acted upon by the constituents of glass, the author mentions the judicious application of the powder of broken seggars and glass pots.

Flückiger's Reactions of Water-Glass.—Dr. Thüssing.—In order to understand the contents of this paper, we refer our readers to Chemical News, vol. xxii., pp. 239 and especially 263, where Dr. Flückiger's experiments are quoted. The author of this paper, having repeated some of these experiments, states that a chemical action between the neutral salts of the fixed alkalies and water-glass, whereby free silica should be separated, is not at all likely to occur, but that it is more probable that these salts will behave with water-glass in a manner akin to their behaviour with soaps, and that, consequently, the precipitate, instead of being free hydrated silica, is an alkaline silicate. This the author has proved by experiment, for, on treating, according to Dr. Flückiger's plan, a solution of water-glass with ammonia, the gelatinous precipitate, properly washed by means of Bunsen's pump, was, on analysis, found to consist, in 100 parts, of—Silica, 79·38; soda, 20·62; corresponding to a formula, $4SiO_2 1Na_2O$. Water-glass (silicate of soda), treated with nitrate of soda, yielded a precipitate consisting, in 100 parts, of—Silica, 53·81; soda, 13·90; water, 32·29. Formula, $4SiO_2 1Na_2O 8H_2O$.

Estimation of the Value of Oil-Seeds.—Dr. H. Vohl.—This paper is an appendix to the author's former paper on this subject (see Chemical News, vol. xxiii., p. 287). From the contents of the paper now before us, we learn that the average quantity of oil contained in the following seeds is, in 100 parts—Linseed, 27·153; hemp-seed, 25·875; poppy-seed, 49·403; walnuts, 50·06; almonds, 52·416; seeds of grapes, 17·956. The sp. gr. of these oils, in pure state, at 15° is—For linseed oil, 0·9347; hemp-seed, 0·9276; poppy-seed, 0·9247; walnut oil, 0·9264; almond oil, 0·9180; grape-seed oil, 0·9222. There are added to this paper some particulars on the mode of conducting the quantitative extraction of the oils from the seed, and a very useful tabulated index for calculating the quantity of oil contained in the oil-bearing seeds according to the specific gravity of the Canada oil extract of the seeds at 15°. By Canada oil is meant a kind of petroleum spirit of 0·680 sp. gr.

Although not strictly belonging to the subjects usually treated of in our journal, we think it may interest some of our readers to have their attention called to—

General Police Regulations concerning the Construction and Measures for Safety of Steam-Boilers for the North-German Confederation.—This document, clearly and concisely written, is a valuable contribution to what is properly and tersely termed *Administration de la sureté et salubrité publique.*

Malleable Iron Gas Retorts.—Dr. Dingler.—The author states that such retorts, forged at the ironworks at Kaiserslautern (Bavaria), are now in use at several large German gasworks, inclusive of that newly built at Frankfort-on-the-Maine, and that these retorts, besides being far less heavy, are also far more durable than cast-iron retorts.

Contamination of Chloride of Barium with Hyposulphite of Baryta.—Dr. Wittstein.—The author found this impurity in the chloride of barium employed in his laboratory; he explains the presence of this substance in chloride of barium in the following manner:—When chloride of barium is prepared from sulphuret of barium, and this latter not quite completely decomposed by hydrochloric acid, any undecomposed sulphuret of barium is gradually converted into hyposulphite of baryta, which, unless the chloride is purposely re-crystallised, remains mixed with the chloride.

Application of Neutral Water-Glass (Silicate of Soda or of Potassa) for the Purpose of Washing Wool.—Von Baerle and Co.—This paper mainly states that neutral water-glass (as purposely prepared by the parties just named), 1 part, and 40 of water, heated to from 50° to 57°, is one of the best and also cheapest means of washing wool. The same substance (viz., this water-glass) is recommended instead of soda and soap for domestic washing purposes.

Tannin as a Substitute for Hops in certain kinds of Beer.—Dr. Dingler.—The use of hops in brewing is partly necessitated by the clarifying action it exercises. Now the author states that 15 grms. of tannic acid have in that respect the same effect as 1 lb. of hops, and that, therefore, where it is desired to brew a sweet-tasted beer, hops may be replaced by tannin previously dissolved in from eight to ten times its weight of water.

American Journal of Pharmacy, July, 1871.

Besides papers and memoirs more directly relating to pharmacy, this number contains the following original ones relating to chemistry:—

On Cundurango.—Dr. T. Antisell.—The contents of this paper describe some experiments made by the author with samples of a vegetable product, wood and bark, obtained from Loja, a province of the State of Ecuador, known locally as *cundurango*, and stated to be a remedy of great value in cancer, fungus hæmatodes, and constitutional syphilis. The bark (the medicinal virtues of the product appear to be therein contained) was found to consist of—Water at (100°), 8 per cent; mineral matter, 12 per cent; vegetable substance, 80 per cent; this latter being separable into—Fatty matter, soluble in ether and partially in strong alcohol, 0·7; yellow resin, soluble in alcohol, 2·7; gum and glucose from starch, 0·5; tannin, yellow and brown colouring matters (extractive), 12·6; cellulose, lignin, &c., 63·5; no crystal, alkaloid, or active principle was found, and no volatile oil. The botanical characters of the cundurango-producing tree or shrub are unknown.

Examination of Sub-Nitrate of Bismuth.—J. D. Owen.—The author, having been requested to make an examination of the substance just named—the *bismuthum hydrico nitricum* of the Pharmacopœæ; formula, $4BiO_3 3NO_5 9HO$—tested four samples, the composition of which was found to be as follows:—BiO_3NO_5—79·20, 77·07, 73·44, 76·90; $BiO_3 3HO$—18·33, 21·24, 23·88, 15·48; $BiCl_3+2(HO,BiO_3)$—1·36, 5·94 (two other samples, only a trace); AgCl—0·37 (other three samples, only a trace); arsenic in all, only a trace; water uncombined—0·74, 1·69, 2·68, 1·68.

Synanthrose, a New Carbo-Hydrate.—O. Popp.—From dahlia tubers the author has prepared a substance which he calls synanthrose, a white, amorphous, deliquescent substance, readily soluble in water and dilute alcohol, insoluble in ether, insipid, and without action upon polarised light; it is decomposed by dilute acids into dextrose and levulose, has then a sweet taste, and is then directly fermentable; it is coloured black by concentrated sulphuric acid in the cold, but is not turned brown by caustic potassa at the ordinary temperature. Nitrate of silver produces, in the cold, a white flocculent precipitate; on heating, reduction takes place. Mercurous salts are reduced in the cold. The compounds with lime and baryta are soluble in water, but insoluble in alcohol. The formula of synanthrose is $C_{12}H_{22}O_{11}$; that of the baryta compound, $C_{12}H_{20}BaO_{11}$. This substance (synanthrose) prevents the precipitation of cupric, ferric, and chromic oxides by alkalies; freshly-precipitated ferric oxide is dissolved by a solution of synanthrose.

Programm der Königlichen Rheinisch-Westphälischen Polytechnischen Schule zu Aachen, für den Cursus, 1871-72.

We owe to the politeness of the excellent director of this establishment the opportunity of once more calling attention to the Royal Rhenish-Westphalian Polytechnic School founded at Charlemagne's ancient and favourite city of Aix-la-Chapelle (Aachen). The pro-

gramme before us, a volume of 112 large octavo pages, exclusive of two large-sized tabulated forms, is valuable also as an example of what polytechnic instruction really means. The course of instruction intended to be given at the Polytechnic School at Aachen, from the 9th of October next, is plainly described in this volume, to which a loose sheet is added containing well drawn up hints and good advice for those who desire to attend the instruction of a polytechnicum, as it is properly termed. The various subjects on which lectures and practical instruction are given embrace no less than sixty different branches, and include, not only all matters relating to mathematics, geometry, and physical sciences, but also everything required by the civil and mechanical engineer, architect, industrial and technical chemist, metallurgist, and mining engineer, including a subject for which there is no single equivalent word in English—"salinenkunde"—that is to say, all things relating to the extraction of salt from saline springs and the working of salt deposits; further, also, electrical telegraphy, practical instruction in the construction of chemical and metallurgical works; political economy, stenography, anatomy, and physiology; special "*gewerbe sanitäts polizei*"—that is to say, the manufacturing industry considered in its relation to, and bearing upon, the health and well-being, as well of the workmen, artisans, and labourers employed as of the rest of the population, and also treating on the requirements of public and other buildings in respect of ventilation, lighting, heating, &c. The Polytechnic School possesses excellent libraries, laboratories, workshops, museums, and collections of various kinds, to which donations of high value from various countries and private individuals (185 in number) have been added during the past year, a complete catalogue of which is published at the end of the programme. Space forbids us to enter here into more details, but we must not omit to state that, according to the *palmam qui meruit ferat*, everything has been and is being done to make this Polytechnic School a focus of attraction, not only for Germans, but for students from all parts of the world who are desirous of obtaining sound theoretical and practical instruction, as applied to arts, manufactures, mines, and engineering.

Journal für Gasbeleuchtung und Wasserversorgung, No. 12, 1871.

This number does not contain any other original papers than those strictly relating to the subjects of gas- and water-works' management and engineering. For those who may be interested in such matters, we call attention to a paper on the—

Yield and Consumption of Petroleum in America and other parts of the World.—Dr. Schilling.—This paper contains, in a condensed form, a valuable amount of statistical information on the subject alluded to.

NOTES AND QUERIES.

Anthracene.—Would you kindly inform me of a good method of separating anthracene for the heavy oil of tar, a method of purifying the same, and its uses?—Henry Dorsett.

Cement to Resist Nitric Acid.—Will you kindly inform me what is the best cement to make the joints of a stone cistern to resist nitric acid?—T. Kenyon, jun.

A New Form of Mariner's Compass.—I understand that, at a recent sitting of the French Academy of Sciences, a curious communication was received from M. Zalewski, which, if borne out in practice, would be invaluable to navigation. He states that if a hollow cylinder made of thin materials, open at the top, and provided with a sharp-edged bottom, be properly ballasted, and then put into a tub or other vessel filled with water, it will soon move in a never-varying direction from west to east! The round tin boxes in which concentrated milk is preserved will do perfectly for the experiment, which will become more and more perceptible the oftener the same cylinder is employed in the experiment. Can any of your readers give me additional information on this subject?—Alpha.

TO CORRESPONDENTS.

*** Vol. XXIII. of The Chemical News, containing a copious index is now ready, price 11s. 4d., by post, 12s., 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. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxiv. commenced on July 7th, and will be complete in twenty-six numbers. Reading Cases, price 1s. 6d. each, post free, may also be obtained at the Office.

J. B.—Dr. R. Angus Smith, of All Saints, Manchester, is the principal inspector under the Alkali Act.

J. Reddrop.—It should have been "carbon;" the meaning is, however, apparent.

Agri. Chem.—In the *Journal of the Chemical Society*.

H. B. Yardley.—Roscoe's "Spectrum Analysis."

NOTICE TO AMERICAN SUBSCRIBERS.

In answer to numerous inquiries, the Publisher begs to state that Subscribers in the United States can be supplied with the CHEMICAL NEWS from this Office, post free, for the sum of £1 2s. 4d. per annum, payable in advance.

Royal 8vo., pp. 388, price 7s. 6d. Third Edition.

The Patentee's Manual; being a Treatise on the Law and Practice of Letters Patent, especially intended for the use of Patentees and Inventors. By James Johnson, Barrister-at-Law; and J Henry Johnson, Assoc. Inst. C.E., Solicitor and Patent Agent.

The call for a Third Edition of this work is conclusive proof that it satisfies a want on the part of Patentees and Inventors, to whom a plain statement of the law bearing upon the subject of Letters Patent for Inventions is obviously a matter of great importance. Whilst the exposition of statutes and judicial decisions is expressed in plain and popular language, no sacrifice has been made of legal accuracy, and it will be found that the work contains a concise but ample and strictly correct enunciation of the law, with an examination of the decided cases to the latest date.

London: Longmans, Green, and Co.

Just published, price One shilling,

A Concise View of the Law connected with Letters Patent for Inventions. By James Johnson, of the Middle Temple, Barrister-at-Law, and J. Henry Johnson, Assoc. Inst. C.E., Solicitor and Patent Agent, Lincoln's Inn Fields and Glasgow. Authors of the "Patentees' Manual."

London: Longmans, Green and Co., Paternoster Row.

Chemical Technology, or Chemistry in its Applications to the Arts and Manufactures. By Thomas Richardson and Henry Watts. Second Edition, illustrated with numerous Wood Engravings.

Vol. I., Parts 1 and 2, price 36s., with more than 400 Illustrations.

Nature and Properties of Fuel: Secondary Products obtained from Fuel: Production of Light: Secondary Products of the Gas Manufacture.

Vol. I., Part 3, price 33s., with more than 300 Illustrations.

Sulphur and its Compounds: Acidimetry: Chlorine and its Bleaching Compounds: Soda, Potash: Alkalimetry: Grease.

Vol. I., Part 4, price 21s., 300 Illustrations.

Aluminium and Sodium: Stannates, Tungstates, Chromates, and Silicates of Potash and Soda: Phosphorus, Borax: Nitre: Gun-Powder: Gun Cotton.

Vol. I., Part 5, price 36s.

Prussiate of Potash: Oxalic, Tartaric, and Citric Acids, and Appendices containing the latest information and specifications relating to the materials described in Parts 3 and 4.

Bailliere and Co., 20, King William Street, Strand.

PRACTICAL CHEMISTRY.

Laboratory, 60, Gower Street, Bedford Square, W.C.

Mr. Henry Matthews, F.C.S., is prepared to give Instruction in all branches of PRACTICAL CHEMISTRY, particularly in its application to MEDICINE AGRICULTURE, and COMMERCE.

The Laboratory is open daily, except Saturday, from ten to five o'clock; on Saturday, from ten till one o'clock.

Mr. Matthews is also prepared to undertake ANALYSES of every description.

For Particulars and Prospectuses, apply to Mr. Henry Matthews the Laboratory, 60, Gower Street, Bedford Square, W.C.

AMSTERDAM EXHIBITION, 1869.

The GRAND DIPLOMA of HONOUR, being the First Prize, and superior to the Gold Medal.

Liebig Company's Extract of Meat.—Paris EXHIBITION, 1867, TWO GOLD MEDALS; HAVRE EXHIBITION, 1868, THE GOLD MEDAL.—Only sort warranted perfect and genuine by Baron Liebig, the Inventor. "A success and a boon."—Medical Press and Circular. One pint of delicious beef-tea for 2½d., which costs 1s. if made fresh from meat. Cheapest and finest-flavoured "stock" for soups, &c.

CAUTION.—Require Baron Liebig's signature upon every jar Sold by all Italian Warehousemen, Grocers, Chemists, and Ships. Store Dealers; all Wholesale Houses; and of LIEBIG'S EXTRACT of MEAT COMPANY (LIMITED), 43, Mark Lane, E.C.

NOTICE.—Various chemical analyses have been published purporting to show a fraction more of moisture to exist in the Company's Extract than in some imitation sorts. It is extremely easy to evaporate the water almost to any extent, but it is quite as certain that the fine meaty flavour which distinguishes the Company's Extract from all others would be destroyed if the concentration of the Extract were carried beyond a certain degree. Beef-tea made from Liebig Company's Extract with *boiling-hot water* will be found to be greatly superior in flavour, strength, and clearness, to any other sort. This explains the universal preference it obtains in the market.

This Extract is supplied to the British, French, Prussian, Russian, and other Governments.

OWEN'S COLLEGE, MANCHESTER,

IN CONNECTION WITH THE UNIVERSITY OF LONDON.

Principal—J. G. GREENWOOD, B.A.

PROFESSORS AND TEACHERS:—

GREEK.	Prof. J. G. Greenwood, B.A., Fellow of University College, London.
LATIN & COMPARATIVE PHILOLOGY.	Prof. A. S. Wilkins, M.A., Fellow of University College, London.
ENGLISH LANGUAGE AND LITERATURE, ANCIENT & MODERN HISTORY.	Prof. A. W. Ward, M.A., Fellow of St. Peter's College, Cambridge.
MATHEMATICS.	Prof. Thomas Barker, M.A., Fellow of Trinity College, Cambridge. *Assistant Lecturer*—A. T. Bentley, M.A.
NATURAL PHILOSOPHY.	Prof. Balfour Stewart, LL.D., F.R.S. Prof. Thomas H. Core, M.A.
PHYSICAL LABORATORY.	*Director*—Prof. Balfour Stewart, LL.D., F.R.S. Prof. Thomas H. Core, M.A. *Assistant*—Francis Kingdon.
CIVIL & MECHANICAL ENGINEERING, GEOMETRICAL AND MECHANICAL DRAWING.	Prof. Osborne Reynolds, M.A., Fellow of Queen's College, Cambridge. *Assistant*—J. B. Millar, B.E.
LOGIC AND MENTAL AND MORAL PHILOSOPHY. POLITICAL ECONOMY.	Prof. W. Stanley Jevons, M.A., F.S.S., Fellow of University College, London
JURISPRUDENCE AND LAW.	Prof. James Bryce, D.C.L., Fellow of Oriel College, Oxford.
CHEMISTRY.	Prof. H. E. Roscoe, B.A., Ph.D., F.R.S.
CHEMICAL LABORATORY.	Prof. H. E. Roscoe, B.A., F.R.S. *Senior Assistant*—C. Schorlemmer, F.R.S. *Junior Assistant*—Francis Jones.
NATURAL HISTORY.	Prof. W. C. Williamson, F.R.S.
ORIENTAL LANGUAGES.	Prof. T. Theodores.
MODERN LANGUAGES.	Prof. Theodores. Hermann Breymann, Ph.D.
MINERALOGY.	C. A. Burghardt, Ph.D.
FREE-HAND DRAWING.	William Walker.

The Session commences on the 2nd of October. Persons seeking Admission as Students must be not under fourteen years of age.

Prospectuses of the Day or Evening Classes, and of the Scholarships and Entrance Exhibitions tenable at the College, will be sent on application.

J. HOLME NICHOLSON, Registrar.

St. Mary's Hospital Medical School.—Open SCHOLARSHIP AND EXHIBITION IN NATURAL SCIENCE.

A SCHOLARSHIP of the value of £40, tenable for three years, and an EXHIBITION of the value of £20, for one year, will be awarded by open competitive Examination in Natural Science, at St. Mary's Medical School, on September 26th and following days.

Any person will be eligible as a candidate who has passed an Examination qualifying him to register as a Medical Student, provided he has not previously completed a full year of medical study at a recognised Hospital.

Candidates are requested to call personally upon the Dean at the School, on Monday, Sept. 25th, betwen the hours of 3 and 5 p.m., and to bring with them a certificate of having passed the required preliminary Examination.

Further information as to the subjects of Examination, and the conditions under which the Scholarship and Exhibition will be held, may be obtained from Dr. Cheadle, the Dean, or from Mr. Knott, the Registrar, at the Hospital.

W. B. CHEADLE, M.D., Dean of the School.

Chloride of Calcium (Purified Muriate of Lime), total insoluble impurities under ¼ per cent.

CHLORIDE OF BARIUM (Muriate of Baryta), free from Iron and Lead, total impurities, water excepted, under ¼ per cent.

GASKELL, DEACON, & CO.,
ALKALI MANUFACTURERS, WIDNES, LANCASHIRE.

Water-glass, or Soluble Silicates of Soda and Potash, in large or small quantities, and either solid or in solution, at ROBERT RUMNEY'S, Ardwick Chemical Works, Manchester.

STEATITE.

Above can be had in quantity, free on board or rail, Portsoy, Banffshire, N.B.—Apply to W. Ross Hutton and Co., Chemical Works, Burghead.

ESTABLISHED 1798.

ROBERT DAGLISH & CO.,

BOILER MAKERS, ENGINEERS, AND MILL-WRIGHTS,

BRASS AND IRONFOUNDERS,

ST. HELEN'S FOUNDRY, LANCASHIRE.

Manufacturers of every description of Chemical Plant, as supplied to the largest Alkali Makers in England, Ireland, Scotland, and Wales

Makers of the latest Improved Revolving Black Ash Furnace, with Siemens's Patent Gas Arrangement, and as used in the Manufacture of Soda.

Improved Vertical Blowing Engines (which have given a much higher Blast than any others have yet obtained), and as supplied to the entire satisfaction of some of the largest Bleaching Powder Manufacturers who have adopted "Weldon's Patent Process."

Plans and Estimates of the whole of this Plant supplied in accordance with the Patentee's instructions.

Photographs, Prices, and other information, given on receipt of Order.

OXIDE OF IRON.

We are prepared to supply, on moderate terms,

HYDRATED PEROXIDE OF IRON (BOG OCHRE),

Same quality as supplied by us to several of the most extensive Gas Companies, and which has given entire satisfaction.

FRANCIS RITCHIE AND SONS, BELFAST.

PARIS UNIVERSAL EXHIBITION, 1867.

THE SILVER PRIZE MEDAL

HAS BEEN AWARDED TO

LEWIS DEMUTH & CO.,

TAR DISTILLERS,

SPRINGFIELD CHEMICAL WORKS,

OLDBURY, NEAR BIRMINGHAM.

FOR THE

BEST CARBOLIC ACID

AND BENZINE EXHIBITED.

CRUDE NAPHTHA AND LIGHT OIL PURCHASED.

W. NEILL & SON'S

PATENT BLOWING ENGINES,

ACID PUMPS, AND DONKEY PUMPS,

ESPECIALLY ADAPTED FOR

WELDON'S PATENT CHLORINE PROCESS.

W. NEILL and SON have just Patented most important improvements in the Air-Valves of Blowing-Engines, which enable them to secure the most perfect "Cut-off" at the termination of each stroke, together with a perfectly free inlet and outlet for the Air at the proper time, thus securing a much better result from each stroke of the Air-Piston, with greater freedom of action, also a very great saving in the wear and tear of valves.

These improvements are of especial advantage to Engines working under the comparatively high pressure of blast required in the Weldon Process.

W. Neill and Son have supplied Blowing Engines and Pumps to all the principal Alkali Makers who have adopted the Weldon Process, and are ready to furnish Plans and Estimates for the erection (with the latest improvements) of the whole of the Plant required.

Efficiency and Simplicity of Construction, with the best workmanship, guaranteed. References on application.

W. NEILL and SON, ENGINEERS, &c.,
BOLD, ST. HELEN'S JUNCTION, LANCASHIRE.

Silicates of Soda and Potash in the state of Soluble glass, or in CONCENTRATED SOLUTION of first quality, suited for the manufacture of Soap and other purposes, supplied on best terms by W. GOSSAGE and Sons, Widnes Soapery, Warrington.

London Agents, CLARKE and COSTE, 19 and 20, Water Lane, Tower Street, E.C. who hold stock ready for delivery.

THE CHEMICAL NEWS.

Vol. XXIV. No. 610.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Edinburgh Meeting, August 2, 1871.

INAUGURAL ADDRESS OF THE PRESIDENT,

Sir William Thomson, Knt., LL.D., F.R.S., &c.,
Professor of Natural Philosophy in the University of Glasgow.

My Lords, Ladies, and Gentlemen,—

For the third time of its forty years' history the British Association is assembled in the metropolis of Scotland. The origin of the Association is connected with Edinburgh in undying memory through the honoured names of Robison, Brewster, Forbes, and Johnston.

In this place, from this chair, twenty-one years ago, Sir David Brewster said:—"On the return of the British Association to the metropolis of Scotland I am naturally reminded of the small band of pilgrims who carried the seeds of this Institution into the more genial soil of our sister land. . . . . Sir John Robison, Professor Johnston, and Professor J. D. Forbes were the earliest friends and promoters of the British Association. They went to York to assist in its establishment, and they found there the very men who were qualified to foster and organise it. The Rev. Mr. Vernon Harcourt, whose name cannot be mentioned here without gratitude, had provided laws for its government, and, along with Mr. Phillips, the oldest and most valuable of our office-bearers, had made all those arrangements by which its success was ensured. Headed by Sir Roderick Murchison, one of the very earliest and most active advocates of the Association, there assembled at York about 200 of the friends of Science."

The statement I have read contains no allusion to the real origin of the British Association. This blank in my predecessor's historical sketch I am able to fill in from words written by himself twenty years earlier. Through the kindness of Professor Phillips, I am enabled to read to you part of a letter to him at York, written by David Brewster from Allerly by Melrose, on the 23rd of February, 1831:—

"Dear Sir,—I have taken the liberty of writing you on a subject of considerable importance. It is proposed to establish a British Association of men of science similar to that which has existed for eight years in Germany, and which is now patronised by the most powerful sovereigns of that part of Europe. The arrangements for the first meeting are in progress; and it is contemplated that it shall be held in York, as the most central city for the three kingdoms. My object in writing you at present is to beg that you would ascertain if York will furnish the accommodation necessary for so large a meeting (which may, perhaps, consist of above 100 individuals), if the Philosophical Society would enter zealously into the plan, and if the Mayor and influential persons in the town and in the vicinity would be likely to promote its objects. The principal object of the Society would be to make the cultivators of science acquainted with each other, to stimulate one another to new exertions, and to bring the objects of science more before the public eye, and to take measures for advancing its interests and accelerating its progress."

Of the little band of four pilgrims from Scotland to York not one now survives. Of the seven first Associates, one more has gone over to the majority since the Association last met. Vernon Harcourt is no longer with us; but his influence remains, a beneficent, and surely, therefore, never dying, influence. He was a geologist and chemist, a large-hearted lover of science, and an unwearied worker for its advancement. Brewster was the founder of the British Association; Vernon Harcourt was its law-giver. His code remains to this day the law of the Association.

On the eleventh of May last, Sir John Herschel died in the eightieth year of his age. The name of Herschel is a household word throughout Great Britain and Ireland—yes, and through the whole civilised world. We of this generation have, from our lessons of childhood upwards, learned to see in Herschel, father and son, a *præsidium et dulce decus* of the precious treasure of British scientific fame. When geography, astronomy, and the use of the globes were still taught, even to poor children, as a pleasant and profitable sequel to "reading, writing, and arithmetic," which of us did not revere the great telescope of Sir William Herschel (one of the hundred wonders of the world), and learn with delight, directly or indirectly from the charming pages of Sir John Herschel's book, about the sun and his spots, and the fiery tornadoes sweeping over his surface, and about the planets, and Jupiter's belts, and Saturn's rings, and the fixed stars with their proper motions, and the double stars, and coloured stars, and the nebulæ discovered by the great telescope? Of Sir John Herschel it may indeed be said, *nil tetigit quod non ornavit.*

A monument to Faraday, and a monument to Herschel, Britain must have. The nation will not be satisfied with anything, however splendid, done by private subscription. A national monument, the more humble in point of expense the better, is required to satisfy that honourable pride with which a high-spirited nation cherishes the memory of its great men. But, for the glory of Faraday or the glory of Herschel, is a monument wanted? No!

> What needs my Shakespere for his honoured bones
> The labour of an age in piled stones?
> Or that his hallowed reliques should be hid
> Under a star-ypointing pyramid?
> Dear son of memory, great heir of fame,
> What need'st thou such weak witness of thy name!
> Thou, in our wonder and astonishment,
> Hast built thyself a live-long monument.
> * * * * *
> And, so sepúlchred, in such pomp dost lie,
> That kings for such a tomb would wish to die.

With regard to Sir John Herschel's scientific work, on the present occasion I can but refer briefly to a few points which seem to me salient in his physical and mathematical writings. First, I remark that he has put forward, most instructively and profitably to his readers, the general theory of periodicity in dynamics, and has urged the practical utilising of it, especially in meteorology, by the harmonic analysis.

Sir John Herschel's discovery of a right or left-handed asymmetry in the outward form of crystals, such as quartz, which, in their inner molecular structure, possess the heliçoidal rotational property in reference to the plane of polarisation of light, is one of the notable points of meeting between natural history and natural philosophy. His observations on "epipolic dispersion" gave Stokes the clue by which he was led to his great discovery of the change of periodic time experienced by light in falling on certain substances and being dispersively reflected from them. In respect to pure mathematics, Sir John Herschel did more, I believe, than any other man to introduce into Britain the powerful methods and the valuable notation of modern analysis. A remarkable mode of symbolism had freshly appeared, I believe, in the works of Laplace, and possibly of other French mathematicians; it certainly appeared in Fourier, but whether before or after Herschel's work I cannot say. Of Herschel's gigantic work in astronomical observation I need say nothing. Doubtless a careful account of it will be given in the *Proceedings of the Royal Society of London* for the next anniversary meeting.

In the past year, another representative man of British science is gone. Mathematics had no steadier supporter for half a century than De Morgan. His great book on the differential calculus was, for the mathematical student of thirty years ago, a highly-prized repository of all the best things that could be brought together under that title. I do not believe it is less valuable now; and if it is less valued, may this not be because it is too good for examination purposes, and because the modern student, labouring to win marks in the struggle for existence, must not suffer himself to be beguiled from the stern path of duty by any attractive beauties in the subject of his study?

One of the most valuable services to science which the British Association has performed has been the establishment, and the twenty-nine year's maintenance, of its Observatory. The magnificent services which it has rendered to science are so well known that any statement of them which I could attempt on the present occasion would be superfluous. Their value is due in a great measure to the indefatigable zeal and the great ability of two Scotchmen, both from Edinburgh, who successively held the office of Superintendent of the Observatory of the British Association—Mr. Welsh for nine years, until his death in 1859, and Dr. Balfour Stewart from then until the present time. Fruits of their labours are to be found all through our volumes of Reports for these twenty-one years.

The institution now enters on a new stage of its existence. The noble liberality of a private benefactor, one who has laboured for its welfare with self-sacrificing devotion unintermittingly from within a few years of its creation, has given it a permanent independence, under the general management of a Committee of the Royal Society. Mr. Gassiot's gift of £10,000 secures the continuance at Kew of the regular operation of the self-recording instruments for observing the phenomena of terrestrial magnetism and meteorology, without the necessity for further support from the British Association.

The success of the Kew Magnetic and Meteorological Observatory affords an example of the great gain to be earned for science by the foundation of physical observatories and laboratories for experimental research, to be conducted by qualified persons, whose duties should be, not teaching, but experimenting. Whether we look to the honour of England, as a nation which ought always to be the foremost in promoting physical science, or to those vast economical advantages which must accrue from such establishments, we cannot but feel that experimental research ought to be made with us an object of national concern, and not left, as hitherto, exclusively to the private enterprise of self-sacrificing amateurs, and the necessarily inconsecutive action of our present Governmental Departments and of casual Committees. The Council of the Royal Society of Edinburgh has moved for this object in a memorial presented by them to the Royal Commission on Scientific Education and the Advancement of Science.

The physical laboratories which have grown up in the Universities of Glasgow and Edinburgh, and in Owen's College, Manchester, show the want felt of Colleges of Research; but they go but infinitesimally towards supplying it, being absolutely destitute of means, material or personal, for advancing science except at the expense of volunteers, or securing that volunteers shall be found to continue even such little work as at present is carried on.

The whole of Andrews's splendid work in Queen's College, Belfast, has been done under great difficulties and disadvantages, and at great personal sacrifices; and up to the present time there is not a student's physical laboratory in any one of the Queen's Colleges in Ireland—a want which surely ought not to remain unsupplied. Each of these institutions (the four Scotch Universities, the three Queen's Colleges, and Owen's College, Manchester) requires two professors of Natural Philosophy—one who shall be responsible for the teaching, the other for the advancement of science by experiment. The University of Oxford has already established a physical laboratory. The munificence of its Chancellor is about to supply the University of Cambridge with a splendid laboratory, to be constructed under the eye of Professor Clerk Maxwell. On this subject I shall say no more at present, but simply read a sentence which was spoken by Lord Milton in the first Presidential Address to the British Association, when it met at York in the year 1831:—"In addition to more direct benefits, these meetings [of the British Association], I hope, will be the means of impressing on the Government the conviction that the love of scientific pursuits, and the means of pursuing them, are not confined to the metropolis; and I hope that when the Government is fully impressed with the knowledge of the great desire entertained to promote science in every part of the empire, they will see the necessity of affording it due encouragement, and of giving every proper stimulus to its advancement."

Besides abstracts of papers read, and discussions held, before the Sections, the Annual Reports of the British Association contain a large mass of valuable matter of another class. It was an early practice of the Association, a practice that might well be further developed, to call occasionally for a special report on some particular branch of science from a man eminently qualified for the task. The reports received in compliance with these invitations have all done good service in their time, and they remain permanently useful as landmarks in the history of science. Some of them have led to vast practical results; others of a more abstract character are valuable to this day as powerful and instructive condensations and expositions of the branches of science to which they relate. I cannot better illustrate the two kinds of efficiency realised in this department of the Association's work than by referring to Cayley's Report on Abstract Dynamics* and Sabine's Report on Terrestrial Magnetism† (1838).

In referring to recent advances in several branches of science, I simply choose some of those which have struck me as most notable.

Accurate and minute measurement seems to the non-scientific imagination a less lofty and dignified work than looking for something new. But nearly all the grandest discoveries of science have been but the rewards of accurate measurement and patient long-continued labour in the minute sifting of numerical results. The popular idea of Newton's grandest discovery is that the theory of gravitation flashed into his mind, and so the discovery was made. It was by a long train of mathematical calculation, founded on results accumulated through prodigious toil of practical astronomers, that Newton first demonstrated the forces urging the planets towards the sun, determined the magnitudes of those forces, and discovered that a force following the same law of variation with distance urges the moon towards the earth. *Then* first, we may suppose, came to him the idea of the universality of gravitation; but when he attempted to compare the magnitude of the force on the moon with the magnitude of the force of gravitation of a heavy body of equal mass at the earth's surface, he did not find the agreement which the law he was discovering required. Not for years after would he publish his discovery as made. It is recounted that, being present at a meeting of the Royal Society, he heard a paper read, describing geodesic measurement by Picard, which led to a serious correction of the previously accepted estimate of the earth's radius. This was what Newton required. He went home with the result, and commenced his calculations, but felt so much agitated that he handed over the arithmetical work to a friend; then (and not when sitting in a garden he saw an apple fall) did he ascertain that gravitation keeps the moon in her orbit.

Faraday's discovery of specific inductive capacity, which inaugurated the new philosophy tending to discard action

* Report on the Recent Progress of Theoretical Dynamics, by A. Cayley (Report of the British Association 1857, p. 1).

† Report on the Variations of the Magnetic Intensity observed at different points of the Earth's Surface, by Major Sabine, F.R.S. (forming part of the 7th Report of the British Association).

at a distance, was the result of minute and accurate measurement of electric forces.

Joule's discovery of thermo-dynamic law through the regions of electro-chemistry, electro-magnetism, and elasticity of gases was based on a delicacy of thermometry which seemed simply impossible to some of the most distinguished chemists of the day.

Andrews's discovery of the continuity between the gaseous and liquid states was worked out by many years of laborious and minute measurement of phenomena scarcely sensible to the naked eye.

Great service has been done to science by the British Association in promoting accurate measurement in various subjects. The origin of exact science in terrestrial magnetism is traceable to Gauss's invention of methods of finding the magnetic intensity in absolute measure. I have spoken of the great work done by the British Association in carrying out the application of this invention in all parts of the world. Gauss's colleague in the German Magnetic Union, Weber, extended the practice of absolute measurement to electric currents, the resistance of an electric conductor, and the electromotive force of a galvanic element. He showed the relation between electrostatic and electro-magnetic units for absolute measurement, and made the beautiful discovery that resistance, in absolute electro-magnetic measure, and the reciprocal of resistance, or, as we call it, "conducting power," in electrostatic measure, are each of them a velocity. He made an elaborate and difficult series of experiments to measure the velocity which is equal to the conducting power, in electrostatic measure, and at the same time to the resistance in electro-magnetic measure, in one and the same conductor. Maxwell, in making the first advance along a road of which Faraday was the pioneer, discovered that this velocity is physically related to the velocity of light, and that, on a certain hypothesis regarding the elastic medium concerned, it may be exactly equal to the velocity of light. Weber's measurement verifies approximately this equality, and stands in science *monumentum ære perennius*, celebrated as having suggested this most grand theory, and as having afforded the first quantitative test of the recondite properties of matter on which the relations between electricity and light depend. A remeasurement of Weber's critical velocity on a new plan by Maxwell himself, and the important correction of the velocity of light by Foucault's laboratory experiments, verified by astronomical observation, seem to show a still closer agreement. The most accurate possible determination of Weber's critical velocity is just now a primary object of the Association's Committee on Electric Measurement; and it is at present premature to speculate as to the closeness of the agreement between that velocity and the velocity of light. This leads me to remark how much science, even in its most lofty speculations, gains in return for benefits conferred by its application to promote the social and material welfare of man. Those who perilled and lost their money in the original Atlantic Telegraph were impelled and supported by a sense of the grandeur of their enterprise, and of the world-wide be nefits which must flow from its success; they were at the same time not unmoved by the beauty of the scientific problem directly presented to them; but they little thought that it was to be immediately, through their work, that the scientific world was to be instructed in a long-neglected and discredited fundamental electric discovery of Faraday's, or that, again, when the assistance of the British Association was invoked to supply their electricians with methods for absolute measurement (which they found necessary to secure the best economical return for their expenditure, and to obviate and detect those faults in their electric material which had led to disaster), they were laying the foundation for accurate electric measurement in every scientific laboratory in the world, and initiating a train of investigation which now sends up branches into the loftiest regions and subtlest ether of natural philosophy. Long may the British Association continue a bond of union, and a medium for the interchange of good offices between science and the world!

The greatest achievement yet made in molecular theory of the properties of matter is the Kinetic theory of Gases, shadowed forth by Lucretius, definitely stated by Daniel Bernoulli, largely developed by Herapath, made a reality by Joule, and worked out to its present advanced state by Clausius and Maxwell. Joule, from his dynamical equivalent of heat, and his experiments upon the heat produced by the condensation of gas, was able to estimate the average velocity of the ultimate molecules or atoms composing it. His estimate for hydrogen was 6225 feet per second at temperature 60° F., and 6055 feet per second at the freezing-point. Clausius took fully into account the impacts of molecules on one another, and the kinetic energy of *relative* motions of the matter constituting an individual atom. He investigated the relation between their diameters, the number in a given space, and the mean length of path from impact to impact, and so gave the foundation for estimates of the absolute dimensions of atoms, to which I shall refer later. He explained the slowness of gaseous diffusion by the mutual impacts of the atoms, and laid a secure foundation for a complete theory of the diffusion of fluids, previously a most refractory enigma. The deeply penetrating genius of Maxwell brought in viscosity and thermal conductivity, and thus completed the dynamical explanation of all the known properties of gases, except their electric resistance and brittleness to electric force.

When the theory, of which we have the first instalment in Clausius and Maxwell's work, is complete, we are but brought face to face with a superlatively grand question, What is the inner mechanism of the atom?

In the answer to this question we must find the explanation not only of the atomic elasticity, by which the atom is a chronometric vibrator according to Stokes's discovery, but of chemical affinity and of the differences of quality of different chemical elements, at present a mere mystery in science. Helmholtz's exquisite theory of vortex-motion in an incompressible frictionless liquid has been suggested as a finger-post, pointing a way which may possibly lead to a full understanding of the properties of atoms, carrying out the grand conception of Lucretius, who "admits no subtle ethers, no variety of elements with fiery, or watery, or light, or heavy principles; nor supposes light to be one thing, fire another, electricity a fluid, magnetism a vital principle, but treats all phenomena as mere properties or accidents of simple matter." This statement I take from an admirable paper on the atomic theory of Lucretius, which appeared in the *North British Review* for March, 1868, containing a most interesting and instructive summary of ancient and modern doctrine regarding atoms. Allow me to read from that article one other short passage finely describing the present aspect of atomic theory:—"The existence of the chemical atom, already quite a complex little world, seems very probable; and the description of the Lucretian atom is wonderfully applicable to it. We are not wholly without hope that the real weight of each such atom may some day be known—not merely the relative weight of the several atoms, but the number in a given volume of any material; that the form and motion of the parts of each atom and the distances by which they are separated may be calculated: that the motions by which they produce heat, electricity, and light may be illustrated by exact geometrical diagrams; and that the fundamental properties of the intermediate and possibly constituent medium may be arrived at. Then the motion of planets and music of the spheres will be neglected for a while in admiration of the maze in which the tiny atoms run."

Even before this was written some of the anticipated results had been partially attained. Loschmidt in Vienna had shown, and not much later Stoney independently in England showed, how to deduce from Clausius and Maxwell's kinetic theory of gases a superior limit to the number of atoms in a given measurable space. I was unfor-

tunately quite unaware of what Loschmidt and Stoney had done when I made a similar estimate on the same foundation, and communicated it to *Nature* in an article on "The Size of Atoms." But questions of personal priority, however interesting they may be to the persons concerned, sink into insignificance in the prospect of any gain of deeper insight into the secrets of nature. The triple coincidence of independent reasoning in this case is valuable as confirmation of a conclusion violently contravening ideas and opinions which had been almost universally held regarding the dimensions of the molecular structure of matter. Chemists and other naturalists had been in the habit of evading questions as to the hardness or indivisibility of atoms by virtually assuming them to be infinitely small and infinitely numerous. We must now no longer look upon the atom, with Boscovich, as a mystic point endowed with inertia and the attribute of attracting or repelling other such centres with forces depending upon the intervening distances (a supposition only tolerated with the tacit assumption that the inertia and attraction of each atom is infinitely small and the number of atoms infinitely great), nor can we agree with those who have attributed to the atom occupation of space with infinite hardness and strength (incredible in any finite body); but we must realise it as a piece of matter of measurable dimensions, with shape, motion, and laws of action, intelligible subjects of scientific investigation.

The prismatic analysis of light discovered by Newton was estimated by himself as being "the oddest, if not the most considerable, detection which "hath hitherto been made in the operations of nature."

Had he not been deflected from the subject, he could not have failed to obtain a pure spectrum; but this, with the inevitably consequent discovery of the dark lines, was reserved for the nineteenth century. Our fundamental knowledge of the dark lines is due solely to Fraunhofer. Wollaston saw them, but did not discover them. Brewster laboured long and well to perfect the prismatic analysis of sunlight; and his observations on the dark bands produced by the absorption of interposed gases and vapours laid important foundations for the grand superstructure which he scarcely lived to see. Piazzi Smyth, by spectroscopic observation performed on the Peak of Teneriffe, added greatly to our knowledge of the dark lines produced in the solar spectrum by the absorption of our own atmosphere. The prism became an instrument for chemical qualitative analysis in the hands of Fox Talbot and Herschel, who first showed how, through it, the old "blowpipe test" or generally the estimation of substances from the colours which they give to flames, can be prosecuted with an accuracy and a discriminating power not to be attained when the colour is judged by the unaided eye. But the application of this test to solar and stellar chemistry had never, I believe, been suggested, either directly or indirectly, by any other naturalist, when Stokes taught it to me in Cambridge at some time prior to the summer of 1852. The observational and experimental foundations on which he built were:—

(1). The discovery by Fraunhofer of a coincidence between his double dark line D, of the solar spectrum and a double bright line which he observed in the spectra of ordinary artificial flames.

(2). A very rigorous experimental test of this coincidence by Professor W. H. Miller, which showed it to be accurate to an astonishing degree of minuteness.

(3). The fact that the yellow light given out when salt is thrown on burning spirit consists almost solely of the two nearly identical qualities which constitute that double bright line.

(4). Observations made by Stokes himself, which showed the bright line, D, to be absent in a candle-flame when the wick was snuffed clean, so as not to project into the luminous envelope, and from an alcohol flame when the spirit was burned in a watch-glass. And

(5). Foucault's admirable discovery (*L'Institut*, Feb. 7, 1849) that the voltaic arc between charcoal points is "a medium which emits the rays D on its own account, and at the same time absorbs them when they come from another quarter."

The conclusions, theoretical and practical, which Stokes taught me, and which I gave regularly afterwards in my public lectures in the University of Glasgow, were:—

(1). That the double line D, whether bright or dark, is due to vapour of sodium.

(2). That the ultimate atom of sodium is susceptible of regular elastic vibrations, like those of a tuning-fork or of stringed musical instruments; that like an instrument with two strings tuned to approximate unison, or an approximately circular elastic disk, it has two fundamental notes or vibrations of approximately equal pitch; and that the periods of these vibrations are precisely the periods of the two slightly different yellow lights constituting the double bright line D.

(3). That when vapour of sodium is at a high enough temperature to become itself a source of light, each atom executes these two fundamental vibrations simultaneously; and that, therefore, the light proceeding from it is of the two qualities constituting the double bright line D.

(4). That when vapour of sodium is present in space across which light from another source is propagated, its atoms, according to a well-known general principle of dynamics, are set to vibrate in either or both of those fundamental modes, if some of the incident light is of one or other of their periods, or some of one and some of the other; so that the energy of the waves of those particular qualities of light is converted into thermal vibrations of the medium and dispersed in all directions, while light of all other qualities, even though very nearly agreeing with them, is transmitted with comparatively no loss.

(5). That Fraunhofer's double dark line D of solar and stellar spectra is due to the presence of vapour of sodium in atmospheres surrounding the sun and those stars in whose spectra it had been observed.

(6). That other vapours than sodium are to be found in the atmospheres of sun and stars by searching for substances producing in the spectra of artificial flames bright lines coinciding with other dark lines of the solar and stellar spectra than the Fraunhofer line D.

The last of these propositions I felt to be confirmed (it was, perhaps, partly suggested) by a striking and beautiful experiment admirably adapted for lecture illustrations, due to Foucault, which had been shown to me by M. Duboscque Soleil, and the Abbé Moigno, in Paris in the month of October, 1850. A prism and lenses were arranged to throw upon a screen an approximately pure spectrum of a vertical electric arc between charcoal poles of a powerful battery, the lower one of which was hollowed like a cup. When pieces of copper and pieces of zinc were separately thrown into the cup, the spectrum exhibited, in perfectly definite positions, magnificent well-marked bands of different colours characteristic of the two metals. When a piece of brass, compounded of copper and zinc, was put into the cup, the spectrum showed all the bands, each precisely in the place in which it had been seen when one metal or the other had been used separately.

It it much to be regretted that this great generalisation was not published to the world twenty years ago. I say this, not because it is to be regretted that Ångström should have the credit of having in 1853 published independently the statement that "an incandescent gas emits "luminous rays of the same refrangibility as those which it can absorb;" or that Balfour Stewart should have been unassisted by it when, coming to the subject from a very different point of view, he made, in his extension of the "Theory of Exchanges,"* the still wider generalisation that the radiating power of every kind of substance is equal to its absorbing power for every kind of ray; or that Kirchhoff also should have in 1859 independently discovered the same proposition, and shown its application to solar and stellar chemistry; but because we might now

* *Edin. Transactions*, 1858-59.

be in possession of the inconceivable riches of astronomical results which we expect from the next ten years' investigation by spectrum analysis, had Stokes given his theory to the world when it first occurred to him.

To Kirchhoff belongs, I believe, solely the great credit of having first actually sought for and found other metals than sodium in the sun by the method of spectrum analysis. His publication of October, 1859, inaugurated the practice of solar and stellar chemistry, and gave spectrum analysis an impulse to which, in a great measure, is due its splendidly successful cultivation by the labours of many able investigators within the last ten years.

Plücker and Hittorf opened ground in advancing the physics of spectrum analysis and made the important discovery of changes in the spectra of ignited gases produced by changes in the physical condition of the gas. The scientific value of the meetings of the British Association is well illustrated by the fact that it was through conversation with Plücker at the Newcastle meeting that Lockyer was first led into the investigation of the effects of varied pressure on the quality of the light emitted by glowing gas which he and Frankland have prosecuted with such admirable success. Scientific wealth tends to accumulation according to the law of compound interest. Every addition to knowledge of properties of matter supplies the naturalist with new instrumental means for discovering and interpreting phenomena of nature, which, in their turn, afford foundations for fresh generalisations, bringing gains of permanent value into the great storehouse of philosophy. Thus Frankland, led, from observing the want of brightness of a candle burning in a tent on the summit of Mont Blanc, to scrutinise Davy's theory of flame, discovered that brightness without incandescent solid particles is given to a purely gaseous flame by augmented pressure, and that a dense ignited gas gives a spectrum comparable with that of the light from an incandescent solid or liquid. Lockyer joined him; and the two found that every incandescent substance gives a continuous spectrum—that an incandescent gas under varied pressure gives bright bars across the continuous spectrum, some of which, from the sharp, hard, and fast lines observed where the gas is in a state of extreme attenuation, broaden out on each side into nebulous bands as the density is increased, and are ultimately lost in the continuous spectrum when the condensation is pushed on till the gas becomes a fluid no longer to be called gaseous. More recently they have examined the influence of temperature, and have obtained results which seem to show that a highly attenuated gas, which at a high temperature gives several bright lines, gives a smaller and smaller number of lines, of sufficient brightness to be visible, when the temperature is lowered, the density being kept unchanged. I cannot refrain here from remarking how admirably this beautiful investigation harmonises with Andrews's great discovery of continuity between the gaseous and liquid states. Such things make the life-blood of science. In contemplating them we feel as if led out from narrow waters of scholastic dogma to a refreshing excursion on the broad and deep ocean of truth, where we learn from the wonders we see that there are endlessly more and more glorious wonders still unseen.

Stokes's dynamical theory supplies the key to the philosophy of Frankland and Lockyer's discovery. Any atom of gas, when struck and left to itself, vibrates with perfect purity its fundamental note or notes. In a highly attenuated gas each atom is very rarely in collision with other atoms, and therefore is nearly at all times in a state of true vibration. Hence the spectrum of a highly attenuated gas consists of one or more perfectly sharp bright lines, with a scarcely perceptible continuous gradation of prismatic colour. In denser gas, each atom is frequently in collision, but still is for much more time free, in intervals between collisions, than engaged in collision; so that not only is the atom itself thrown sensibly out of tune during a sensible proportion of its whole time, but the confused jangle of vibrations in every variety of period during the actual collision becomes more considerable in its influence. Hence, bright lines in the spectrum broaden out somewhat, and the continuous spectrum becomes less faint. In still denser gas, each atom may be almost as much time in collision as free, and the spectrum then consists of broad nebulous bands crossing a continuous spectrum of considerable brightness. When the medium is so dense that each atom is always in collision, that is to say, never free from influence of its neighbours, the spectrum will generally be continuous, and may present little or no appearance of bands, or even of maxima of brightness. In this condition the fluid can be no longer regarded as a gas, and we must judge of its relation to the vaporous or liquid states according to the critical conditions discovered by Andrews.

While these great investigations of properties of matter were going on, naturalists were not idle with the newly-recognised power of the spectroscope at their service. Chemists soon followed the example of Bunsen, in discovering new metals in terrestrial matter by the old blowpipe and prism test of Fox Talbot and Herschel. Biologists applied spectrum analysis to animal and vegetable chemistry, and to sanitary investigations. But it is in astronomy that spectroscopic research has been carried on with the greatest activity, and been most richly rewarded with results. The chemist and the astronomer have joined their forces. An astronomical observatory has now appended to it a stock of reagents such as hitherto was only to be found in the chemical laboratory. A devoted corps of volunteers of all nations, whose motto might well be *ubique*, have directed their artillery to every region of the universe. The sun, the spots on his surface, the corona, and the red and yellow prominences seen round him during total eclipses, the moon, the planets, comets, auroras, nebulæ, white stars, yellow stars, red stars, variable and temporary stars, each tested by the prism, was compelled to show its distinguishing prismatic colours. Rarely before in the history of science has enthusiastic perseverance, directed by penetrative genius, produced within ten years so brilliant a succession of discoveries. It is not merely the *chemistry* of sun and stars, as first suggested, that is subjected to analysis by the spectroscope. Their whole laws of being are now subjects of direct investigation; and already we have glimpses of their evolutional history through the stupendous power of this most subtle and delicate test. We had only solar and stellar chemistry; we now have solar and stellar physiology.

It is an old idea that the colour of a star may be influenced by its motion relatively to the eye of the spectator, so as to be tinged with red if it moves from the earth, or blue if it moves towards the earth. William Allen Miller, Huggins, and Maxwell showed how, by aid of the spectroscope, this idea may be made the foundation of a method of measuring the relative velocity with which a star approaches to, or recedes from, the earth. The principle is, first to identify, if possible, one or more of the lines in the spectrum of the star, with a line or lines in the spectrum of sodium, or some other terrestrial substance, and then (by observing the star and the artificial light simultaneously by the same spectroscope) to find the difference, if any, between their refrangibilities. From this difference of refrangibility the ratio of the periods of the two lights is calculated, according to data determined by Fraunhofer from comparisons between the positions of the dark lines in the prismatic spectrum and in his own "interference spectrum" (produced by substituting for the prism a fine grating). A first comparatively rough application of the test by Miller and Huggins to a large number of the principal stars of our skies, including Aldebaran, α Orionis, β Pegasi, Sirius, α Lyræ, Capella, Arcturus, Pollux, Castor (which they had observed rather for the chemical purpose than for this), proved that not one of them had so great a velocity as 315 kilometres per second to or from the earth, which is a *most momentous result in respect to cosmical dynamics.* Afterwards, Huggins made

special observations of the velocity test, and succeeded in making the measurement in one case, that of Sirius, which he then found to be receding from the earth at the rate of 66 kilometres per second. This, corrected for the velocity of the earth at the time of the observation, gave a velocity of Sirius, relatively to the sun, amounting to 47 kilometres per second. The minuteness of the difference to be measured, and the smallness of the amount of light, even when the brightest star is observed, renders the observation extremely difficult. Still, with such great skill as Mr. Huggins has brought to bear on the investigation, it can scarcely be doubted that velocities of many other stars may be measured. What is now wanted is, certainly not greater skill, perhaps not even more powerful instruments, but *more instruments and more observers*. Lockyer's applications of the velocity test to the relative motions of different gases in the sun's photosphere, spots, chromosphere, and chromospheric prominences, and his observations of the varying spectra presented by the same substance as it moves from one position to another in the sun's atmosphere, and his interpretations of these observations, according to the laboratory results of Frankland and himself, go far towards confirming the conviction that in a few years all the marvels of the sun will be dynamically explained according to known properties of matter.

During six or eight precious minutes of time, spectroscopes have been applied to the solar atmosphere and to the corona seen round the dark disc of the moon eclipsing the sun. Some of the wonderful results of such observations, made in India on the occasion of the eclipse of August, 1868, were described by Professor Stokes in a previous address. Valuable results have, through the liberal assistance given by the British and American Governments, been obtained also from the total eclipse of last December, notwithstanding a generally unfavourable condition of weather. It seems to have been proved that at least some sensible part of the light of the "corona" is a terrestrial atmospheric halo or dispersive reflection of the light of the glowing hydrogen and "helium"* round the sun. I believe I may say, on the present occasion, when preparation must again be made to utilise a total eclipse of the sun, that the British Association confidently trusts to our Government exercising the same wise liberality as heretofore in the interests of science.

For a few years Mayer's theory of solar heat had seemed to me probable; but I had been led to regard it as no longer tenable, because I had been in the first place driven, by consideration of the very approximate constancy of the earth's period of revolution round the sun for the last 2000 years, to conclude that "The principal source, perhaps the sole appreciably effective source, of sun-heat, is in bodies circulating round the sun at present inside the earth's orbit;"† and because Le Verrier's researches on the motion of the planet Mercury, though giving evidence of a sensible influence attributable to matter circulating as a great number of small planets within his orbit round the sun, showed that the amount of matter that could possibly be assumed to circulate at any considerable distance from the sun must be very small; and therefore "if the meteoric influx taking place at present is enough to produce any appreciable portion of the heat radiated away, it must be supposed to be from matter circulating round the sun, within very short distances of his surface. The density of this meteoric cloud would have to be supposed so great that comets could scarcely have escaped as comets actually have escaped, showing no discoverable effects of resistance, after passing his surface within a distance equal to one-eighth of his radius. All things considered, there seems little probability in the hypothesis that solar radiation is compensated to any appreciable degree, by heat generated by meteors falling in, at present; and, as it can be shown that no chemical theory is tenable,* it must be concluded as most probable that the sun is at present merely an incandescent liquid mass cooling."†

Thus, on purely astronomical grounds, was I long ago led to abandon as very improbable the hypothesis that the sun's heat is supplied dynamically from year to year by the influx of meteors. But now spectrum analysis gives proof finally conclusive against it.

Each meteor circulating round the sun must fall in along a very gradual spiral path, and before reaching the sun must have been for a long time exposed to an enormous heating effect from his radiation when very near, and must thus have been driven into vapour before actually falling into the sun. Thus, if Mayer's hypothesis is correct, friction between vortices of meteoric vapours and the sun's atmosphere must be the immediate cause of solar heat; and the velocity with which these vapours circulate round equatorial parts of the sun must amount to 435 kilometres per second. The spectrum test of velocity applied by Lockyer showed but a twentieth part of this amount as the greatest observed relative velocity between different vapours in the sun's atmosphere.

At the first Liverpool meeting of the British Association (1854), in advancing a gravitational theory to account for all the heat, light, and motions of the universe, I urged that the immediately antecedent condition of the matter of which the sun and planets were formed, not being fiery, could not have been gaseous; but that it probably was solid, and may have been like the meteoric stones which we still so frequently meet with through space. The discovery of Huggins, that the light of the nebulæ, so far as hitherto sensible to us, proceeds from incandescent hydrogen and nitrogen gases, and that the heads of comets also give us light of incandescent gas, seems at first sight literally to fulfil that part of the Nebular hypothesis to which I had objected. But a solution, which seems to me in the highest degree probable, has been suggested by Tait. He supposes that it may be by ignited gaseous exhalations proceeding from the collision of meteoric stones that nebulæ and the heads of comets show themselves to us, and he suggested, at a former meeting of the Association, that experiments should be made for the purpose of applying spectrum analysis to the light which has been observed in gunnery trials, such as those at Shoeburyness, when iron strikes against iron at a great velocity, but varied by substituting for the iron various solid materials, metallic or stony. Hitherto this suggestion has not been acted upon; but surely it is one the carrying out of which ought to be promoted by the British Association.

Most important steps have been recently made towards the discovery of the nature of comets; establishing with nothing short of certainty the truth of a hypothesis which had long appeared to me probable—that they consist of groups of meteoric stones;—accounting satisfactorily for the light of the nucleus; and giving a simple and rational explanation of phenomena presented by the tails of comets which had been regarded by the greatest astronomers as almost preternaturally marvellous. The meteoric hypothesis to which I have referred remained a mere hypothesis (I do not know that it was even ever published), until, in 1866, Schiaparelli calculated, from observations on the August meteors, an orbit for these bodies which he found to agree almost perfectly with the orbit of the great comet of 1862 as calculated by Oppolzer; and so discovered and demonstrated that a comet consists of a group of meteoric stones. Professor Newton, of Yale College, United States, by examining ancient records, ascertained that in periods of about thirty-three years, since the year 902, there have been exceptionally brilliant displays of the November meteors. It had long been believed that these interesting visitants came from a train

* Frankland and Lockyer find the yellow prominences to give a very decided bright line not far from D, but hitherto not identified with any terrestrial flame. It seems to indicate a new substance, which they propose to call Helium.

† "On the Mechanical Energies of the Solar System." *Transactions of the Royal Society of Edinburgh*, 1854; and *Phil. Mag.*, 1854, second half year.

* "Mechanical Energies," &c.

† "Age of the Sun's Heat," *Macmillan's Magazine*, March, 1862.

of small detached planets circulating round the sun all in nearly the same orbit, and constituting a belt analogous to Saturn's ring, and that the reason for the comparatively large number of meteors which we observe annually about the 14th of November is, that at that time the earth's orbit cuts through the supposed meteoric belt. Professor Newton concluded from his investigation that there is a denser part of the group of meteors which extends over a portion of the orbit so great as to occupy about one-tenth or one-fifteenth of the periodic time in passing any particular point, and gave a choice of five different periods for the revolution of this meteoric stream round the sun, any one of which would satisfy his statistical result. He further concluded that the line of nodes, that is to say, the line in which the plane of the meteoric belt cuts the plane of the earth's orbit, has a progressive sidereal motion of about 52·4″ per annum. Here, then, was a splendid problem for the physical astronomer; and, happily, one well qualified for the task took it up. Adams, by the application of a beautiful method invented by Gauss, found that of the five periods allowed by Newton just one permitted the motion of the line of nodes to be explained by the disturbing influence of Jupiter, Saturn, and other planets. The period chosen on these grounds is 33¼ years. The investigation showed further that the form of the orbit is a long ellipse, giving for shortest distance from the sun 145 million kilometres, and for longest distance 2895 million kilometres. Adams also worked out the longitude of the perihelion and the inclination of the orbit's plane to the plane of the ecliptic. The orbit which he thus found agreed so closely with that of Temple's Comet I. 1866 that he was able to identify the comet and the meteoric belt. The same conclusion had been pointed out a few weeks earlier by Schiaparelli, from calculations by himself on data supplied by direct observations on the meteors, and independently by Peters from calculations by Le Verrier on the same foundation. It is therefore thoroughly established that Temple's Comet I. 1866 consists of an elliptic train of minute planets, of which a few thousands or millions fall to the earth annually about the 14th of November, when we cross their track. We have probably not yet passed through the very nucleus or densest part; but thirteen times, in Octobers and Novembers, from October 13, A.D. 902 to November 14, 1866, inclusive (this last time having been correctly predicted by Prof. Newton), we have passed through a part of the belt greatly denser than the average. The densest part of the train, when near enough to us, is visible as the head of the comet. This astounding result, taken along with Huggins's spectroscopic observations on the light of the heads and tails of comets, confirm most strikingly Tait's theory of comets, to which I have already referred; according to which the comet, a group of meteoric stones, is self-luminous in its nucleus, on account of collisions among its constituents, while its "tail" is merely a portion of the less dense part of the train illuminated by sunlight, and visible or invisible to us according to circumstances, not only of density, degree of illumination, and nearness, but also of tactic arrangement, as of a flock of birds or the edge of a cloud of tobacco smoke!

The essence of science, as is well illustrated by astronomy and cosmical physics, consists in inferring antecedent conditions, and anticipating future evolutions, from phenomena which have actually come under observation. In biology the difficulties of successfully acting up to this ideal are prodigious. The earnest naturalists of the present day are, however, not appalled or paralysed by them, and are struggling boldly and laboriously to pass out of the mere "Natural History stage" of their study, and bring zoology within the range of Natural Philosophy. A very ancient speculation, still clung to by many naturalists (so much so that I have a choice of modern terms to quote in expressing it), supposes that, under meteorological conditions very different from the present, dead matter may have run together or crystallised or fermented into "germs of life," or "organic cells," or "protoplasm." But science brings a vast mass of inductive evidence against this hypothesis of spontaneous generation, as you have heard from my predecessor in the Presidential chair. Careful enough scrutiny has, in every case up to the present day, discovered life as antecedent to life. Dead matter cannot become living without coming under the influence of matter previously alive. This seems to me as sure a teaching of science as the law of gravitation. I utterly repudiate, as opposed to all philosophical uniformitarianism, the assumption of "different meteorological conditions"—that is to say, somewhat different vicissitudes of temperature, pressure, moisture, gaseous atmosphere—to produce or to permit that to take place by force or motion of dead matter alone, which is a direct contravention of what seems to us biological law. I am prepared for the answer, "Our code of biological law is an expression of our ignorance as well as of our knowledge." And I say "Yes; search for spontaneous generation out of inorganic materials; let any one not satisfied with the purely negative testimony of which we have now so much against it, throw himself into the inquiry." Such investigations as those of Pasteur, Pouchet, and Bastian are among the most interesting and momentous in the whole range of Natural History, and their results, whether positive or negative, must richly reward the most careful and laborious experimenting. I confess to being deeply impressed by the evidence put before us by Professor Huxley, and I am ready to adopt, as an article of scientific faith, true through all space and through all time, that life proceeds from life, and from nothing but life.

How, then, did life originate on the earth? Tracing the physical history of the earth backwards, on strict dynamical principles, we are brought to a red-hot melted globe on which no life could exist. Hence when the earth was first fit for life, there was no living thing on it. There were rocks solid and disintegrated, water, air all round, warmed and illuminated by a brilliant sun, ready to become a garden. Did grass and trees and flowers spring into existence, in all the fulness of ripe beauty, by a fiat of creative power? or did vegetation, growing up from seed sown, spread and multiply over the whole earth? Science is bound, by the everlasting law of honour, to face fearlessly every problem which can fairly be presented to it. If a probable solution, consistent with the ordinary course of nature, can be found, we must not invoke an abnormal act of creative power. When a lava stream flows down the sides of Vesuvius or Etna it quickly cools and becomes solid; and after a few weeks or years it teems with vegetable and animal life, which for it originated by the transport of seed and ova and by the migration of individual living creatures. When a volcanic island springs up from the sea, and after a few years is found clothed with vegetation, we do not hesitate to assume that seed has been wafted to it through the air, or floated to it on rafts. Is it not possible, and if possible, is it not probable, that the beginning of vegetable life on the earth is to be similarly explained? Every year thousands, probably millions, of fragments of solid matter fall upon the earth—whence came these fragments? What is the previous history of any one of them? Was it created in the beginning of time an amorphous mass? This idea is so unacceptable that, tacitly or explicitly, all men discard it. It is often assumed that all, and it is certain that some, meteoric stones are fragments which had been broken off from greater masses and launched free into space. It is as sure that collisions must occur between great masses moving through space as it is that ships, steered without intelligence directed to prevent collision, could not cross and re-cross the Atlantic for thousands of years with immunity from collisions. When two great masses come into collision in space it is certain that a large part of each is melted; but it seems also quite certain that in many cases a large quantity of débris must be shot forth in all directions, much of which may have

experienced no greater violence than individual pieces of rock experience in a land-slip or in blasting by gunpowder. Should the time when this earth comes into collision with another body, comparable in dimensions to itself, be when it is still clothed as at present with vegetation, many great and small fragments carrying seed and living plants and animals would undoubtedly be scattered through space. Hence and because we all confidently believe that there are at present, and have been from time immemorial, many worlds of life besides our own, we must regard it as probable in the highest degree that there are countless seed-bearing meteoric stones moving about through space. If at the present instant no life existed upon this earth, one such stone falling upon it might, by what we blindly call *natural* causes, lead to its becoming covered with vegetation. I am fully conscious of the many scientific objections which may be urged against this hypothesis, but I believe them to be all answerable. I have already taxed your patience too severely to allow me to think of discussing any of them on the present occasion. The hypothesis that life originated on this earth through moss-grown fragments from the ruins of another world may seem wild and visionary; all I maintain is that it is not unscientific.

From the earth stocked with such vegetation as it could receive meteorically, to the earth teeming with all the endless variety of plants and animals which now inhabit it, the step is prodigious; yet, according to the doctrine of continuity, most ably laid before the Association by a predecessor in this chair (Mr. Grove), all creatures now living on earth have proceeded by orderly evolution from some such origin. Darwin concludes his great work on "The Origin of Species" with the following words:—"It is interesting to contemplate an entangled bank clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent on each other in so complex a manner, have all been produced by laws acting around us. . . . . There is grandeur in this view of life with its several powers, having been originally breathed by the Creator into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning, endless forms, most beautiful and most wonderful, have been and are being evolved." With the feeling expressed in these two sentences I most cordially sympathise. I have omitted two sentences which come between them, describing briefly the hypothesis of "the origin of species by natural selection," because I have always felt that this hypothesis does not contain the true theory of evolution, if evolution there has been, in biology. Sir John Herschel, in expressing a favourable judgment on the hypothesis of zoological evolution, with, however, some reservation in respect to the origin of man, objected to the doctrine of natural selection, that it was too like the Laputan method of making books, and that it did not sufficiently take into account a continually guiding and controlling intelligence. This seems to me a most valuable and instructive criticism. I feel profoundly convinced that the argument of design has been greatly too much lost sight of in recent zoological speculations. Reaction against the frivolities of teleology, such as are to be found, not rarely, in the notes of the learned commentators on Paley's "Natural Theology," has, I believe, had a temporary effect in turning attention from the solid and irrefragable argument so well put forward in that excellent old book. But overpoweringly strong proofs of intelligent and benevolent design lie all around us; and if ever perplexities, whether metaphysical or scientific, turn us away from them for a time, they come back upon us with irresistible force, showing to us, through nature, the influence of a free will, and teaching us that all living beings depend on one ever-acting Creator and Ruler.

Section B.

ADDRESS
TO THE
CHEMICAL SECTION.
August 3, 1871.

By Dr. ANDREWS, F.R.S.

Gentlemen,—

Amidst the vicissitudes to which scientific theories are liable, it was scarcely to be expected that the discarded theory of phlogiston should be resuscitated in our day, and connected with one of the most important generalisations of modern science. The phlogistic theory, elaborated nearly two hundred years ago by Beccher and Stahl, was not, it now appears, wholly founded in error; on the contrary, it was an imperfect anticipation of the great principle of energy, which plays so important a part in physical and chemical changes. The disciple of phlogiston, ignorant of the whole history of chemical combination, connected, it is true, his phlogiston with one only of the combining bodies, instead of recognising that it is eliminated by the union of all. "There can be no doubt," says Dr. Crum Brown, who first suggested this view, "that potential energy is what the chemists of the 17th century meant when they spoke of phlogiston." "Phlogiston and latent heat," playfully remarks Volhard, "which formerly opposed each other in so hot a combat, have entered into a peaceful compact, and, to banish all recollection of their former strife, have assumed in common the new name of energy." But, as Dr. Odling well remarks, "in interpreting the phlogistic writings by the light of modern doctrine, we are not to attribute to their authors the precise notion of energy which now prevails. It is only contended that the phlogistians had, in their time, possession of a real truth in nature, which altogether lost sight of in the intermediate period has since crystallised out in a definite form."

But, whatever may be the true value of the Stahlian views, there can be no doubt that the discoveries which have shed so bright a lustre round the name of Black mark an epoch in the history of science, and gave a mighty impulse to human progress. A recent attempt to ignore the labours of Black and his great contemporaries, and to attribute the foundation of modern chemistry to Lavoisier alone, has already been amply refuted in an able inaugural address, delivered a short time ago from the chair formerly occupied by Black. The statements of Dr. Crum Brown may, indeed, be confirmed on the authority of Lavoisier himself. Through the kindness of Dr. Black's representatives, I have been permitted to examine his correspondence, which has been carefully preserved, and I have been so fortunate as to find in it three original letters from Lavoisier to Dr. Black. They were written in 1789 and 1790, and they appear to comprise the whole of the correspondence on the part of Lavoisier which passed between those distinguished men. Some extracts from these letters were published soon after Dr. Black's death by his friends, Dr. Adam Ferguson and Dr. Robison, but the letters themselves, as far as I know, have never appeared in an entire form; I will crave permission to have them printed as an appendix to this address. Lavoisier, it will be seen, addresses Black as one whom he was accustomed to regard as his master, and whose discoveries had produced important revolutions in science. It may, indeed, be said with truth that Lavoisier completed the foundation on which the grand structure of modern chemistry has since arisen; but Black, Priestley, Scheele, and Cavendish were before Lavoisier, and their claims to a share in the great work are not inferior to those of the illustrious French chemist.

Among the questions of general chemistry, few are

FIG. 1.

FIG. 2.

FIG. 3.

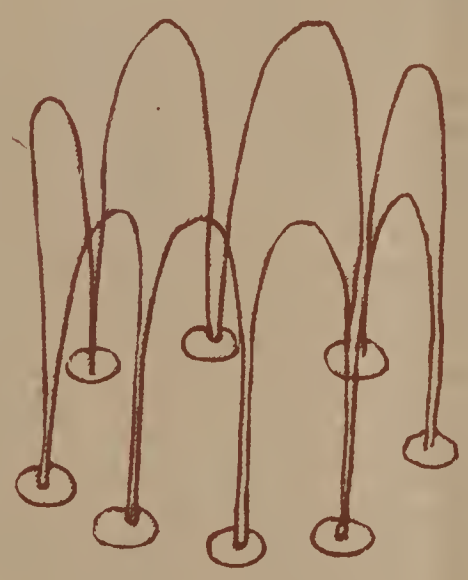


FIG. 4.

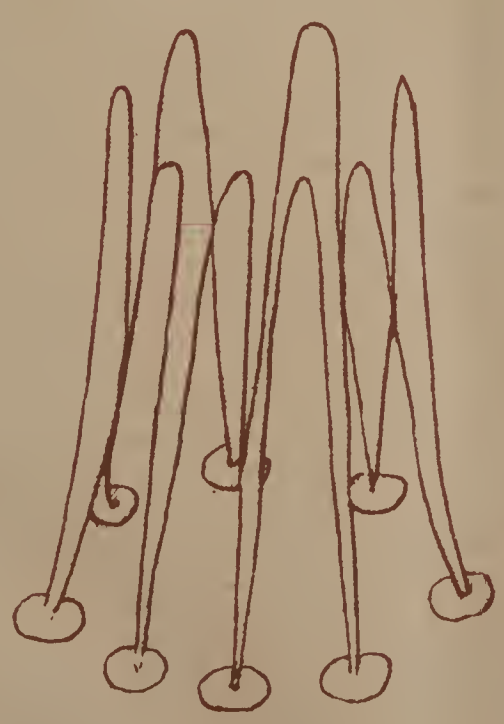


FIG. 5.

FIG 6.

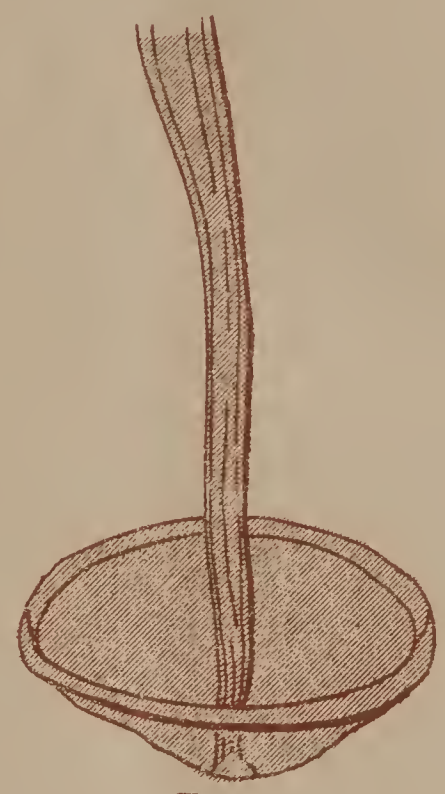


FIG 8.

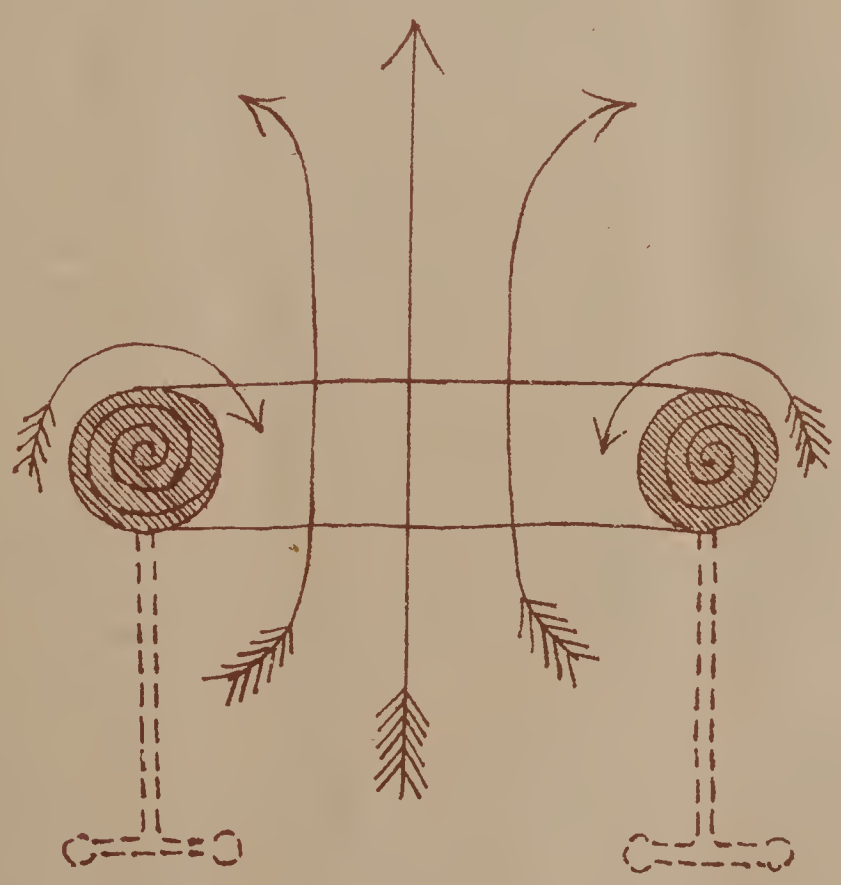


FIG. 7.

RING VORTICES IN WATER

HENRY DEACON.

WIDNES, 25TH JULY, 1871.

more interesting, or have of late attracted more attention, than the relations which subsist between the chemical composition and refractive power of bodies for light. Newton, it will be remembered, pointed out the distinction between the refractive power of a medium and its refractive index, and gave for the former the expression—

$$\frac{\mu_2 - 1}{d},$$

where μ is the refractive index and d the density of the refracting medium. Sir J. Herschel, anticipating later observations, remarked, in 1830, that Newton's function only expresses the intrinsic refractive power on the supposition of matter being infinitely divisible, but that, if material bodies consist of a finite number of atoms, differing in weight for different substances, the intrinsic refractive power of the atoms of any given medium will be the product of the above function by the atomic weight. The same remark has since been made by Bertholet. Later observations have led to an important modification in the form of Newton's function. Beer showed that the experiments of Biot and Arago, as well as those of Dulong, on the refractive power of gases, agree quite as well with a simpler expression as with that given by Newton; and Gladstone and Dale proposed, in 1863, the formula—

$$\frac{\mu - 1}{d}$$

as expressing more accurately than any other, the results of their experiments on the refractive power of liquids. The researches of Landolt and Wüllner have fully confirmed the general accuracy of the new formula. An important observation, made about twenty years ago by Delffs, has been the starting-point for all subsequent investigations on this subject. Delffs remarked that the refractive indices of the compound ethers increase with the atomic weight, and that isomeric ethers have the same refractive indices. The later researches of Gladstone and of Landolt have, on the whole, confirmed these observations, and have shown that the specific refractive power depends chiefly on the atomic composition of the body, and is little influenced by the mode of grouping of the atoms. These inquiries have gone further, and have led to the discovery of the refraction equivalents of the elements. By comparing the refractive power of compound bodies differing from one another by one or more atoms of the same element, Landolt succeeded in obtaining numbers which express the refraction equivalents of carbon, hydrogen, and oxygen, and corresponding numbers have been obtained for other elements by Gladstone and Haagen. The whole subject has been recently discussed and enriched with many new observations in an able memoir by Gladstone. As might be expected in so novel and recondite a subject, some anomalies occur which are difficult to explain. Thus hydrogen appears in different classes of compounds with at least two refraction equivalents, one three times as great as the other, and the refraction equivalents of the aromatic compounds and their derivatives, as given by observation, are in general higher than the calculated numbers.

A happy modification of the ice calorimeter has been made by Bunsen. The principle of the method—to use, as a measure of heat, the change of volume which ice undergoes in melting—had already occurred to Herschel, and, as it now appears, still earlier to Hermann; but their observations had been entirely overlooked by physicists, and had led to no practical result. Bunsen has, indeed, clearly pointed out that the success of the method depends upon an important condition which is entirely his own, The ice to be melted must be prepared with water free from air, and must surround the source of heat in the form of a solid cylinder, frozen artificially *in situ*. Those who have worked on the subject of heat know how difficult it is to measure absolute quantities with certainty, even where relative results of great accuracy may be attained. The ice calorimeter of Bunsen will therefore be welcomed as an important addition to our means of research. Bunsen has applied his method to determine the specific heats of ruthenium, calcium, and indium, and finds that the atomic weight of indium must be increased by one-half in order to bring it into conformity with the law of Dulong and Petit. He has also made a new determination of the density of ice, which he finds to be 0·9167.

In a Report on the Heat of Combination which was made to this Association in 1849, the existence of a group of isothermal bases was pointed out. "As some of the bases—potash, soda, baryta, strontia—" it was remarked "form what we may, perhaps, designate an isothermal group, such bases will develope the same, or nearly the same, heat in combining with an acid, and no heat will be disengaged during their mutual displacements." The latest experiments of Thomsen have given a remarkable extension to this group of isothermal bases. He finds that the hydrates of lithium, thallium, calcium, and magnesium produce, when all corrections are made, the same amount of heat, on being neutralised by sulphuric acid, as the four bases before mentioned. The hydrate of tetra-methyl-ammonium belongs to the same class of bases. Æthylamin, on the other hand, agrees with ammonia, which, as has been long known, gives out less heat in combining with the acids than potash or soda. An elaborate investigation of the amount of heat evolved in the combustion of coal of different kinds has been made by Scheurer-Kestner and Meunier, accompanied by analyses of the coal. Coal rich in carbon and hydrogen disengages more heat in burning than coal in which those elements are partially replaced by oxygen. After deducting the cinders, the heat produced by the combustion of 1 grm. of coal varied from 8215 to 9622 units.

Tyndall has given an extended account of his experiments on the action of a beam of strong light on certain vapours. He finds that there is a marked difference in the absorbing power of different vapours for the actinic rays. Thus the nitrite of amyl in the state of vapour absorbs rapidly the rays of light competent to decompose it, while iodide of allyl in the same state allows them freely to pass. Morren has continued these experiments in the South of France, and among other results he finds that sulphurous acid is decomposed by the solar beam.

Roscoe has prosecuted the photo-chemical investigations which Bunsen and he began some years ago. For altitudes above 10° the relation between the sun's altitude and the chemical intensity of light is represented by a straight line. Till the sun has reached an altitude of about 20°, the chemical action produced by diffused daylight exceeds that of the direct sun-light; the two actions are then balanced; and at higher elevations the direct sun-light is superior to the diffused light. The supposed inferiority of the chemical action of light under a tropical sun to its action in higher latitudes proves to be a mistake. According to Roscoe and Thorpe, the chemical intensity of light at Para under the equator in the month of April is more than three times greater than at Kew in the month of August.

Hunter has given a great extension to the earlier experiments of Saussure on the absorptive power of charcoal for gases. Cocoa-nut charcoal, according to Hunter's experiments, exceeds all other varieties of wood-charcoal in absorptive power, taking up, at ordinary pressure, 170 volumes of ammonia, and 69 of carbonic acid. Methylic alcohol is more largely absorbed than any other vapour at temperatures from 90° to 127°; but, at 159°, the absorption of ordinary alcohol exceeds it. Cocoa-nut charcoal absorbs 44 times its volume of the vapour of water at 127°. The absorptive power is increased by pressure.

Last year two new processes for improving the manufacture of chlorine attracted the attention of the section, one of these has already proved to be a success, and I am glad to be able to state that Mr. Deacon has recently overcome certain difficulties in his method, and has obtained

a complete absorption of the chlorine. May we hope to see oxygen prepared by a cheap and continuous process from atmospheric air? With baryta the problem can be solved very perfectly, if not economically. Another process is that of Tessié de Mothay, in which the manganate of potassium is decomposed by a current of superheated steam and afterwards revived by being heated in a current of air. A company has lately been formed in New York to apply this process to the production of a brilliant house light. A compound Argand burner is used having a double row of apertures,—the inner row is supplied with oxygen, the outer with coal-gas or other combustible. The applications of pure oxygen, if it could be prepared cheaply, would be very numerous, and few discoveries would more amply reward the inventor. Among other uses it might be applied to the production of ozone free from nitric acid by the action of the electrical discharge, and to the introduction of that singular body in an efficient form into the arts as a bleaching and oxidising agent. Tessié de Mothay has also proposed to prepare hydrogen gas on the large scale by heating hydrate of lime with anthracite.

We learn from the history of metallurgy that the valuable alloy which copper forms with zinc was known and applied long before zinc itself was discovered. Nearly the same remark may be made at present with regard to manganese and its alloys. The metal is difficult to obtain, and has not in the pure state been applied to any useful purpose; but its alloys with copper and other metals have been prepared and some of them are likely to be of great value. The alloy with zinc and copper is used as a substitute for German silver, and possesses some advantages over it. Not less important is the alloy of iron and manganese prepared according to the process of Henderson by reducing in a Siemens's furnace a mixture of carbonate of manganese and oxide of iron. It contains from 20 to 30 per cent of manganese, and will doubtless replace to a large extent the spiegeleisen now used in the manufacture of Bessemer steel.

The classical researches of Roscoe have made us acquainted for the first time with metallic vanadium. Berzelius obtained brilliant scales which he supposed to be the metal by heating an oxychloride in ammonia, but they have proved to be a nitride. Roscoe prepared the metal by reducing its chloride in a current of hydrogen, as a light grey powder, with a metallic lustre under the microscope. It has a remarkable affinity both for nitrogen and silicon. Like phosphorus it is a pentad, and the vanadates correspond in composition to the phosphates, but differ in the order of stability at ordinary temperatures, the soluble tribasic salts being less stable than the tetrabasic compounds.

Sainte-Claire Deville, in continuation of his researches on dissociation, has examined the conditions under which the vapour of water is decomposed by metallic iron. The iron, maintained at a constant temperature, but varying in different experiments from 150° C. to 1600° C., was exposed to the action of the vapour of water of known tension. It was found that for a given temperature the iron continued to oxidise till the tension of the hydrogen formed reached an invariable value.

In these experiments as Deville remarks, the iron behaves as if it emitted a vapour (hydrogen) obeying the laws of hygrometry. An interesting set of experiments has been made by Lowthian Bell on the power possessed by spongy metallic iron of splitting up carbonic oxide into carbon and carbonic acid, the former being deposited in the iron. A minute quantity of oxide of iron is always found in this reaction.

The fine researches of Graham on the colloidal state have received an interesting extension by Reynolds's discovery of a new group of colloid bodies. A solution of mercuric chloride is added to a mixture of acetone and a dilute solution of potassium hydrate till the precipitate which at first appears is re-dissolved, and the clear liquid poured upon a dialyser which floated upon water. The composition of the colloid body thus obtained in the anhydrous state was found to be $[(CH_3)_2CO]_2Hg_3O_3$. The hydrate is regarded by Reynolds as a feeble acid, even more readily decomposed than alkaline silicates. A solution containing only five per cent forms a firm jelly when heated to 50° C. Analogous compounds were formed with the higher members of the fatty ketone series. In the same direction are the researches of Marcet on Blood, which he finds to be a strictly colloid fluid containing a small proportion of diffusible salts.

In organic chemistry the labours of chemists have been of late largely directed to a group of hydrocarbons which were first discovered among the products of the destructive distillation of coal or oil. The central body round which these researches have chiefly turned is benzol, whose discovery will always be associated with the name of Faraday; with this body naphthaline and anthracene form a series, whose members differ by C_4H_2, and their boiling-points by about 140°. The recent researches of Liebermann have proved, as was before suspected, that chrysene is a fourth member of the same series. I may add that ethylene which boils at about −70° corresponds in composition and boiling-point to a lower member of the same series. Kekule propounded some time ago with great clearness the question as to whether the six atoms of hydrogen in benzol are equivalent, or, on the contrary, play dissimilar parts. According to the first hypothesis, there can be only one modification of the mono- and penta- derivatives of benzol; while three modifications of the bi- tri- and tetra- derivatives are possible. On the second hypothesis, two modifications of the mono-derivatives are possible and in general a much larger number of isomeric compounds than on the first hypothesis. Such is the problem which has of late occupied the attention of some of the ablest chemists of Germany, and has led to a large number of new and important investigations. The aromatic hydrocarbons, toluol, xylol, &c., which differ from one another by CH_2 have been shown by Fittig to be methyl derivatives of benzol. According to the first of the two hypotheses to which I have referred only one benzol and one methyl benzol (toluol) are possible, and accordingly no isomeric modifications of these bodies have been discovered. But the three following members of the series ought each to be capable of existing in three distinct isomeric forms. The researches of Fittig had already established the existence of two isomeric compounds having the formula C_8H_{10},—methyl-toluol obtained synthetically from toluol, and isoxylol prepared by the removal of an atom of methyl from the mesytelene of Kane. The same chemist has since obtained the third modification—orthoxylol—by the decomposition of the paraxylylic acid. These three isomeric hydrocarbons may be readily distinguished from one another by the marked difference in the properties of their tri-nitro compounds, and also by their different behaviour with oxidising agents. Other facts have been adduced in support of the equality or homogeneity of position of the hydrogen atoms in benzol. Thus Hübner and Alsberg have prepared aniline, a mono-derivative from different bi-derivatives, and have alway obtained the same body. The latest researches on this subject are those of Richter.

Baeyer has prepared artificially picoline, a base isomeric with aniline, and discovered by Anderson in his very able researches on the pyridine series. Of the two methods described by Baeyer, one is founded on an experiment of Simpson in which a new base was obtained by heating tribromallyl with an alcoholic solution of ammonia. By pushing further the action of the heat, Baeyer succeeded in expelling the whole of the bromine from Simpson's base in the form of hydrobromic acid and in obtaining picoline. The same chemist has also prepared artificially collidine, another base of the pyridine series. To this list of remarkable synthetical discoveries, another of the highest interest has lately been added by Schiff—the preparation of artificial coniine. He obtained it by the action of ammonia on butyric aldehyde (C_4H_8O). The artificial base

has the same composition as coniine prepared from hemlock. It is a liquid of an amber-yellow colour, having the characteristic odour and nearly all the usual reactions of ordinary coniine. Its physiological properties, so far as they have been examined, agree with those of coniine from hemlock, but the artificial base has not yet been obtained in large quantity nor perfectly pure.

Valuable papers on alizarine have been published by Perkin and Schunck. The latter has described a new acid—the anthraflavic—which is formed in the artificial preparation of alizarine. Madder contains another colouring principle, purpurine, which like alizarine yields anthracene when acted on by reducing agents, and has also been prepared artificially. These colouring principles may be distinguished from one another, as Stokes has shown by their absorption-bands, and Perkin has lately confirmed by this optical test the interesting observation of Schunck that finished madder prints contain nothing but pure alizarine in combination with the mordant employed.

Hofmann has achieved another triumph in a department of chemistry which he has made peculiarly his own. In 1857 he showed that alcohol bases, analogous to those derived from ammonia, could be obtained by replacement from phosphuretted hydrogen; but he failed in his attempts to prepare the two lower derivatives. These missing links he has now supplied, and has thus established a complete parallelism between the derivatives of ammonia and of phosphuretted hydrogen. The same able chemist has lately described the aromatic cyanates, of which one only—the phenylic cyanate (CO,C_6H_5,N)—was previously known, having been discovered about twenty years ago by Hofmann himself. He now prepares this compound by the action of phosphoric anhydride on phenylurethane, and by a similar method he has obtained the tolylic, xylylic, and naphthylic cyanates.

Stenhouse had observed many years ago, that when aniline is added to furfurol, the mixture becomes rose-red, and communicates a fugitive red stain to the skin, and also to linen and silk. He has lately resumed the investigation of this subject, and has obtained two new bases, furfuraniline and furfurtoluidine, which like rosaniline form beautifully coloured salts, although the bases themselves are nearly colourless or of a pale brown colour. The furfuraniline hydrochlorate ($C_{17}H_{19}O_2N_2Cl$) is prepared by adding furfurol to an alcoholic solution of aniline hydrochlorate, containing an excess of aniline. We have also from Stenhouse a new contribution to the history of orcin, in continuation of his former masterly researches on that body. He has prepared the trinitro-orcin—

$$(C_7H_5(NO_2)_3O_2),$$

a powerful acid, having many points of resemblance to picric acid. In connection with another research of Stenhouse made many years ago, it is interesting to find his formula for euxanthon, which was also that of Erdmann, confirmed by the recent experiments of Baeyer.

The interesting work of Dewar on the oxidation of picoline must not be passed over without notice. By the action of the permanganate of potassium on that body, he has obtained a new acid, which bears the same relation to pyridine that phthalic acid does to benzol. Thorpe and Young have published a preliminary notice of some results of great promise, which they have obtained by exposing paraffin to a high temperature in closed vessels. By this treatment it is almost completely resolved into liquid hydrocarbons, whose boiling-points range from 18° C. to 300° C.: those boiling under 100° have been examined and consist chiefly of olefines. In connection with this subject it may be interesting to recall the experiments of Pelouze and Cahours on the Pennsylvanian oils, which proved to be a mixture of carbohydrogens belonging to the marsh gas series.

An elaborate exposition of Berthelot's method of transforming an organic compound into a hydrocarbon containing a maximum of hydrogen has appeared in a connected form. The organic body is heated in a sealed tube with a large excess of a strong solution of hydriodic acid to the temperature of 275°. The pressure in these experiments Berthelot estimates at 100 atmospheres, but apparently without having made any direct measurements. He has thus prepared ethyl hydride (C_2H_6) from alcohol, aldehyde, &c.; hexyl hydride (C_6H_{14}) from benzol. Berthelot has submitted both wood charcoal and coal to the reducing action of hydriodic acid, and among other interesting results he claims to have obtained in this way oil of petroleum.

By the action of chloride of zinc upon codeia, Matthiessen and Burnside have obtained apocodeia, which stands to codeia in the same relation as apomorphia to morphia, an atom of water being abstracted in its formation. Apocodeia is more stable than apomorphia, but the action of reagents upon the two bases is very similar. As regards their physiological action, the hydrochlorate of apocodeia is a mild emetic, while that of apomorphia is an emetic of great activity. Other bases have been obtained by Wright by the action of hydrobromic acid on codeia. In two of these bases, bromotetracodeia and chlorotetracodeia, four molecules of codeia are welded together so that they contain no less than 72 atoms of carbon. They have a bitter taste, but little physiological action. The authors of these valuable researches were indebted to Messrs. Macfarlane for the precious material upon which they operated.

We are indebted to Crum Brown and Fraser for an important work on a subject of great practical as well as theoretical interest, the relation between chemical constitution and physiological action. It has long been known that the ferrocyanide of potassium does not act as a poison on the animal system; and Bunsen has shown that the kakodylic acid, an arsenical compound, is also inert. Crum Brown and Fraser find that the methyl compounds of strychnia, brucia, and thebaia, are much less active poisons than the alcaloids themselves, and the character of their physiological action is also different. The hypnotic action of the sulphate of methyl-morphium is less than that of morphia. But a reverse result occurs in the case of atropia, whose methyl and ethyl derivatives are much more poisonous than the salts of atropia itself.

Before proceeding to the subject of fermentation, I may refer to Apjohn's chemico-optical method of separating cane sugar, inverted sugar, and grape sugar from one another when present in the same solution, by observing the rotative power of the syrup before and after inversion, and combining the indications of the saccharometer with the results of an analysis of the same syrup after inversion. Heisch's test for sewage in ordinary water is also deserving of notice. It consists in adding a few grains of pure sugar to the water and exposing it freely to light for some hours, when the liquid will become turbid from the formation of a well-marked fungus, if sewage to the smallest amount be present. Frankland has made the important observation that the development of this fungus depends upon the presence of a phosphate, and that if this condition be secured the fungus will appear even in the purest water.

The nature of fermentation, and, in particular, of the alcoholic fermentation, has been lately discussed by Liebig with consummate ability, and his elaborate memoir will well repay a careful perusal. Dr. Williamson has also given a most instructive account of the subject, particularly with reference to the researches of Pasteur, in his recent Cantor lectures. A brief statement of the present position of the question will, therefore, not be out of place here. It is now 34 years since Cagniard de La Tour and Schwann proved, by independent observations, that yeast globules are organised bodies, capable of reproduction by germination; and also inferred, as highly probable, that the phenomena of fermentation are induced by the development or living action of these globules. These views, after having fallen into abeyance, were revived and extended, a few years ago, by Pasteur, whose

able researches are familiar to every chemist. Pasteur, while acknowledging that he was ignorant of the nature of the chemical act, or of the intimate cause of the splitting up of sugar in the alcoholic fermentation, maintained that all fermentations, properly so called, are correlative with physiological phenomena. According to Liebig, the development and multiplication of the yeast plant or fungus is dependent upon the presence and absorption of nutriment which becomes part of the living organism, while, in the process of fermentation, an external action takes place upon the substance, and causes it to split up into products which cannot be made use of by the plant. The vital process and the chemical action, he asserts, are two phenomena which, in the explanation, must be kept separate from one another. The action of a ferment upon a fermentable body he compares to the action of heat upon organic molecules, both of which cause a movement in the internal arrangement of the atoms. The phenomena of fermentation Liebig refers now, as formerly, to a chemico-physical cause, the action, namely, which a substance in a state of molecular movement exercises upon another, of highly complex constitution, whose elements are held together by a feeble affinity, and are to some extent in a state of tension or strain. Baeyer, who considers that in the alcoholic and lactic fermentations one part of the compound is reduced and another oxidised, adopts the view of Liebig, that the molecules of sugar which undergo fermentation do not serve for the nourishment of the yeast plant, but receive an impulse from it. All are, however, agreed that fermentation is arrested by the death of the plant; and even a tendency to the acetous fermentation in wine may be checked, as Pasteur has shown, by heating the wine to a temperature a little below the boiling-point in the vessel in which it is afterwards to be kept.

I regret that the limits of an address like the present forbid me to pursue further this analysis of chemical work. Had they admitted of abridgment, I should gladly have described the elaborate experiments of Gore on hydrofluoric acid and the fluoride of silver. The important researches of Abel on explosive compounds will be fully explained by himself in a lecture with which he has kindly undertaken to favour the Association. Mr. Tomlinson will also communicate to the section some observations on catharism and nuclei, a difficult subject to which he has of late devoted much attention. And I am also informed that we shall have important papers on recent improvements in chemical manufacture.

No one can be more painfully alive than myself to the serious omissions in the historical review I have now read, more particularly in organic chemistry, where it was wholly impossible to grapple with the large number of valuable works which even a few months produce. I cannot, however, refrain from bearing an humble tribute to the great ability and indomitable perseverance which characterise the labourers in the great field of organic chemistry. It would scarcely be possible to conceive any work more intelligently undertaken or more conscientiously performed than theirs, yet much of it, from its abstruse character, receiving little sympathy or encouragement, except from the band of devoted men who have made this subject the chief pursuit of their lives. They will, however, find their reward in the consciousness that they have not lived in vain, but have been engaged, and successfully engaged, in the noble enterprise of extending, for the benefit of the human family, the boundaries of scientific knowledge. Nor is there any real ground for discouragement. Faraday, Graham, Magnus, and Herschel, who have left their impress on this age, were all distinguished chemical as well as physical discoverers; and the relations of the sciences are becoming every day so intimate that the most special research leads often to results of wide and general interest. No one felt this truth more clearly, or illustrated it better in his writings, than our lamented and distinguished friend, Dr. Miller, whose presence used to cheer our meetings, and whose loss we all most sincerely deplore.

EXPERIMENTS ON FORMATION OF RING VORTICES (WITH SECONDARY PHENOMENA) IN WATER.*

By HENRY DEACON, J.P., F.C.S.

In the course of an experimental research on the motion of fluids, I was very recently working with water very slightly coloured with indigo dissolved in sulphuric acid, projected into spring water, the object being to have both fluids of precisely the same specific gravity. My assistant had prepared the two fluids with a specific gravity bottle in the ordinary laboratory balance, and we were together in a quiet room, with the water quite at rest to commence the research. A phenomenon occurred which I at once said arose from the coloured fluid being the heavier. My assistant referred to his weighings in the laboratory. It occurred to me that if a drop of the coloured water were very gently placed in the perfectly still clear water, the motion of the coloured drop would decide the point; if heavier it would sink. It did sink, but in sinking gave rise to the phenomena now referred to, some of which I hope to succeed in showing you.

To describe what to look for, I refer to the accompanying supplementary plate. Fig. 1 is a ring—a "smoke ring" in miniature. Fig. 2 indicates the commencement of the next change, the formation of nodes, varying much in number and position, influenced by currents in the water, shape of the drop, &c. Fig. 3 shows how, by descending, the nodes begin to develope secondary rings, shown in an advanced state of development in Fig. 4, the centre of each secondary ring being connected with the centre of the one on each side of it by a delicate arch. If coloured solutions are used, and the vessel not too deep and with a flat bottom, this crown-like structure will for a few minutes rest on the bottom, with the arches springing up from circle to circle. Fig. 5 is a rough indication of what frequently happens when the secondary rings and connecting links descend well below the primary rings, and tolerably uniformly. A rather rapid contraction and drawing-up of the tops of the arches takes place; that is, while the lower series of secondary rings continue to descend, the upper part of the structure rapidly descends and contracts. This upward motion lasts but a short time, and then the whole fabric descends altogether. Occasionally, and under circumstances I cannot speak of with certainty, a form is seen of which Fig. 6 is a very feeble illustration. The arches from the secondary rings are here connected by a delicate film; this is contracted into a tube, the upper part of which turns over like a deeply-recurved convolvulus. Working with a very attenuated solution of permanganate of potash, the secondary rings resting on the bottom of the beaker, or wholly suspended in the water, it strikingly resembles a living animal, like a sea anemone. As all this structure is formed from one single drop its extreme tenuity can be easily imagined. The resemblance of these structures to organisms is more than in form. Whilst they are growing they are, so to say, "alive," bright colours and clearly-defined objects. When they cease to grow their "life" ceases too, they become dull, flaccid, nebulous,—they quickly dissolve into the surrounding space,—they *die*. In Fig. 7 I have attempted to show the motion of the "rings" themselves, and the cause to which I ascribe the phenomena indicated in Figs. 5 and 6. The motion of the "ring" is the same as that of the "smoke-rings," reversed, of course, because these "rings" descend instead of ascend. In water, this motion ceases almost entirely, and the whole "ring" descends bodily. In this descent water is displaced, and a current due to this displacement flows upwards through the "ring" centre, as shown by the long arrows. There is, of course, an ascending current outside the ring, but this is spread

* Read before the British Association, Edinburgh Meeting, Section B.

over a larger area, whilst that inside the ring is more concentrated and of greater velocity; it therefore overcomes the outside induced current so far as these phenomena are concerned. Where the secondary "rings" and their connecting arches descend, they obstruct the access of the water to the internal ascending column. A result ensues similar to that of the water-ram. The column continues its motion, its viscosity causes it to elongate, and diminishes in diameter, thus elongating and contracting the adjacent parts of the "ring." The top is re-curved by this column of water beating against the still water above it, in just the same way that the "ring" itself is formed by the drop in motion beating against the water at rest. Fig. 8 feebly represents one of the ordinary phenomena when a faint stream descends, the end is re-curved, and a ring surrounds the re-curved part, just like a delicate fungus upside down. Water holding solid matters in suspension serve well to illustrate these rings and secondary rings, but is, I think, unsuitable for the succeeding forms. I prefer coloured solutions for the remainder of the phenomena. A very brief interval has elapsed since I first saw these rings, and very numerous avocations preclude the idea of my doing much more with them. One thought in connection with them has occurred to me: secondary rings give rise to tertiary rings, and these to a fourth series, and perhaps more.

May not this tendency to form, from merely straight currents, structures at intervals in planes at right angles to the current, throw light on the formation of clouds in strata? A vertical ascending current of vapour develops a structure in a horizontal plane, that is the first stratum of clouds. From this structure vertical columns again arise, and secondary, and, in turn, other structures are formed at various heights, but each in distinct planes. To obtain these rings to perfection, the water must be perfectly still, the drop as nearly the same specific gravity as possible, but the heavier of the two. The dropping-tube, or rod, must deliver a nicely-shaped drop, and this must enter the water quietly and with very little impetus. Some impetus it must have, but too much breaks up the drop, sometimes giving rise to a mere cloud, and sometimes to two or more very small rings, and more or less figures like Fig. 8. With solutions of rather higher specific gravity from dissolved substances the motion of the rings is more violent, but I do not think the phenomena so characteristic. Diffusion comes into play and breaks up the structure.

The secondary phenomena appear to be influenced by the chemical nature of the colouring matter, as illustrated by the different action of the permanganate and indigo solutions, and the secondary rings are always the edge of a thin film of the original drop, never, so far as I have observed, being distinct ring vortices. I should like to see these figures formed from some suitable solution, and illuminated by polarised light or the invisible rays of the spectrum. Somewhat striking experiments could, I think, be devised by having the receiving vessel filled in layers with solutions differing very little from each other in specific gravity, but containing different salts, so that a drop of another kind of solution should, in passing through the different layers, become alternately visible and invisible, or of different colours.

I think these "rings" will serve to illustrate the laws of vortices of motion, as Attwood's machine serves to illustrate some of the laws of bodies in motion. The proportions are preserved in a diminished scale and brought within easy observation. My conviction, based on some very hasty observations, is that phenomena similar to sensitive flames and their congeners can be obtained and studied by the aid of streams of coloured solutions in colourless fluids. That the "rings" are very sensitive to vibrations like those of sound is evidenced by the influence exerted by the diameter and depth of water into which the drop falls. The larger the diameter and the greater the depth, the more complete the series of characteristic transformations. Amongst the possibilities I hope some day to effect with these rings, is their exhibition as solids. Imagine a drop of melted wax, paraffin, sulphur, &c., falling into a suitable solution, and descending into a cold stratum; should we not have a frozen ring?

ON THE ESTIMATION OF SULPHUR BY BARIUM.

By E. F. TESCHEMACHER and J. DENHAM SMITH.

A SOLUBLE salt of barytes, *terra ponderosa*, appears to have been used from the beginning of the art of chemical analysis as the most trustworthy agent for ascertaining the existence, and determining the amount of sulphuric acid present in solutions. The delicacy of the test, and the insolubility of the resulting sulphate, seemed to leave nothing to be desired in the reliance to be placed on the results yielded by barytes when used in analysis for estimating sulphuric acid.

As the methods of oxidation of the sulphides, and the conversion of their sulphur into sulphuric acid, were discovered, the extension of the use of barytes to the estimation of sulphur soon took place; and, until a comparatively recent period, no doubt was entertained that the weight of the sulphate of barytes yielded by any given salt or solution would indicate, unerringly and with exactness, the amount of sulphur present in a sulphide, whether factitious or native. The reliance placed upon the accuracy of a determination of sulphuric acid or sulphur by means of sulphate of barytes precipitated from a dilute acid and boiling solution, allowed to cool, and the precipitate copiously washed with hot water, in the first instance acidified with hydrochloric acid, when dried and ignited—was, within the memory of many, absolute; and the manuals of analysis of the period we refer to do not even hint at the possibility of error. Yet it is well-nigh certain that in every instance of such a determination of sulphur or sulphuric acid, the results are not trustworthy and only approximate to accuracy, and this chiefly because the combining equivalent of barium was then reckoned at some two per cent higher than now, 70 instead of 68·50, so that error in the weight of the barytic sulphate was, in great measure, compensated by the error in the equivalent.

With the advance in the art of chemical analysis, it was found that precipitated sulphate of barytes had a marked tendency to carry down with it variable quantities of other salts contained in the solution, such as those of soda, potash, barytes, magnesia, iron, copper, &c.; and the later treatises on analysis give detailed directions to purify the precipitated sulphate from the adherent salts, directions which, even if efficient, are tedious and troublesome, and, at the best, leave the results still subject to doubts of its accuracy. Hence there has been a tendency manifesting itself to prefer volumetric to gravimetric methods for estimating sulphur; and these have undoubtedly been attended with greater accuracy than formerly, despite the objections inherent in all volumetric methods.

Of late years, since the general adoption of pyrites for alkali-making in lieu of brimstone, accuracy in the estimation of sulphur has become a matter of some commercial importance; and, as in our practice we know but too well how variable are the results certified to as having been obtained by professed analysts from carefully-prepared and similar samples of pyrites, which we have good grounds for regarding as identical samples, we hope that some remarks on the difficulties attending an accurate estimation of sulphur by barium, and the details of a rapid and reliable method when applied to pyrites, long practised by us, may prove acceptable to many interested in the subject, and, we would fain hope, put an end to the gross errors now so frequently brought to our notice in the estimation of sulphur in pyrites, a subject which has been

lately dwelt-upon by the President of the Chemical Society of Newcastle-on-Tyne, and reported in the last volume of the Chemical News, p. 57, and his remarks are so much to the point that we quote them *in extenso* :—

"I beg to draw your attention to this tabulated result of seven different samples of sulphur ore (pyrites), by three different chemists, each having the same sample to operate on.

No.	Sulphur per cent. A.	B.	C.	Difference between A and B.	Difference between A and C.
1.	38·80	38·00	40·20	0·80	1·40
2.	40·90	40·90	42·70	—	1·80
3.	39·60	39·10	41·10	0·50	1·50
4.	39·30	39·50	40·70	0·20	1·40
5.	41·60	41·40	43·50	0·20	1·90
6.	38·20	38·00	40·00	0·20	1·80
7.	39·70	39·20	41·10	0·50	1·40
			Average	0·34	1·60

"You will observe that between A and B, there is comparatively little difference, the maximum amount being 0·80, while between A and C the maximum difference is 1·90; the average difference between A and B is only 0·34, but the average difference between A and C is 1·60.

"I ought to mention that A and B are local chemists, but residing and working in different parts of the district, and acting quite independently of each other, and that C is a metropolitan chemist; also that A and C are professional chemists, B is chemist in the laboratory of the purchasers of the ores."

Probably it would be found on inquiry that different methods of estimating the sulphur in the foregoing experiments have been adopted by the local and the metropolitan chemists above-mentioned; as, whilst the average difference between the professional chemists amounts to 1·60 per cent of sulphur, this rises to almost 2 per cent, if the results of the purchasers' chemist are compared with those of the metropolitan analyst.

In estimating the sulphur in pyrites by the weight of the sulphate of barytes obtained, it must have struck every analyst that the resulting sulphate, after ignition, is usually stained with iron oxide; and also it *may* have been noticed by him, when he has endeavoured to prevent a deep stain by washing the precipitated sulphate with but moderately diluted hot hydrochloric acid previously to collecting the precipitated on a filter, and has kept the filtrate and washings for a day or two, that the sides and bottom of the beaker have been covered with a film, gradually deposited by the previously clear and bright filtrate; but we are unaware that this fact has been commented on, or met with the notice it deserves, proving, as it does, that *sulphate of barytes is noticeably soluble in hot and but moderately diluted hydrochloric acid.* Here, we doubt not, is one source of the differences spoken of in the estimation of sulphur in pyrites by different chemists; nor is this source of error a slight one, especially when we remember that it is the practice of many to operate on but small amounts of pyrites, so that any analytic error is considerably multiplied and augmented when the results are reported *per centum.* True it is that the solubility of the sulphate in hydrochloric acid has already been pointed out, but the importance of this fact has been underrated, and esteemed as but little likely to affect the estimation of sulphur by barium. On the other hand, the adhesion of chloride of barium to the precipitated sulphate is also known, but this does not appear to have excited the same attention of writers on the subject as the analogous case of the nitrate of barytes, which most markedly affects the weight of the barytic sulphate. Thus, 108·60 grs. of crystallised sulphate of iron, equal to 91 grs. of sulphates of barytes, when oxidised in the usual way, but the excess of nitric acid not expelled, yielded 94·20 grs. of sulphate of barytes, being an excess of 3·20 grs. beyond the calculated weight. These sources of error may, however, be somewhat compensated by a partial reduction of the sulphate during ignition, for it must be remembered that the barytic is one of the most readily decomposed of the earthy sulphates, by ignition in contact with deoxidising agents, so that evidence of the presence of barytes on treating the ignited sulphate by water or dilute acid must not be regarded as proving that nitrate or chloride has adhered to the precipitate. Thus, some precipitated and ignited sulphate of barytes, when treated first with water and then with diluted hydrochloric acid, washed and re-ignited, and again treated with water and dilute acid, six consecutive times, yielded each time traces of chlorine and barytes to water only, and a considerable amount of barytes to the dilute acid, proving that sulphate of barytes is sensibly reduced when ignited to redness in the usual manner. From the foregoing, it will be seen that pitfalls abound in the estimation of sulphur by barium.

We had long since found that one requisite, and that an essential one, in the correct estimation of sulphur, was to obtain a soluble sulphate of stable composition, the basic element of which should not be adherent to the barytic sulphate; and this was found in crystallised sulphate of iron. Sulphate of potash seemingly offered a better fixed standard, as this salt is anhydrous, and is readily procured in a state of absolute purity, but long experience had shown us that no salt yielded more discordant results with barytes than sulphate of potash. The sulphate of iron we speak of has, of late years, become an article of commerce, and occurs in hard, separate, and small crystals, very uniform in size. This is crushed to the size of hemp-seed, and the dust and smaller fragments sifted out; then washed by shaking with repeated portions of methylated spirit, and rapidly dried on bibulous paper, when a brilliant hard salt of a light beryl-colour, free from interposed water or per-salt is obtained, which is perfectly stable and unvarying in composition. There is a further advantage attached to the use of crystallised sulphate of iron, viz., that a considerable weight of this salt indicates but a small amount of sulphur, 108·60 grs. being equal to 12·50 grs. of sulphur, the amount of sulphur, or thereabouts, we find to be the best and most reliable for working on in ordinary practice with pyrites; and, moreover, when the solution of this salt is oxidised, the result is identical with that produced by the oxidation of pyrites.

A series of experiments was made by dissolving 108·60 grs. of the above described crystallised sulphate of iron in 2000 grs. of water, acidifying the solution with 500 measured grs. of hydrochloric acid, sp. gr. 1·160; and, precipitating this solution by an equally dilute and acidified solution of chloride of barium, the latter always in moderate excess, and both solutions boiling at the time of precipitation, the subjoined weights of sulphate of barytes were obtained :—

No. 1.	91·90 grs. of sulphate of barytes.			
,, 2.	92·90	,,	,,	,,
,, 3.	92·10	,,	,,	,,
,, 4.	91·25	,,	,,	,,
,, 5.	90·80	,,	,,	,,
,, 6.	91·90	,,	,,	,,
,, 7.	91·30	,,	,,	,,
,, 8.	91·50	,,	,,	,,
,, 9.	91·60	,,	,,	,,

The calculated weight, or that which ought to have been obtained, in each instance being 91·02, practically 91 grs. of sulphate of barytes.

(To be continued).

NOTICE TO AMERICAN SUBSCRIBERS.

In answer to numerous inquiries, the Publisher begs to state that Subscribers in the United States can be supplied with the CHEMICAL NEWS from this Office, post free, for the sum of £1 2s. 4d. per annum, payable in advance.

THE CHEMICAL NEWS.

Vol. XXIV. No. 611.

EXPERIMENTS ON CHEMICAL DYNAMICS.*

By J. H. GLADSTONE, F.R.S., and ALFRED TRIBE, F.C.S.

The authors had recently communicated a paper to the Royal Society in which they investigated somewhat minutely what takes place when a plate of one metal, such as copper, is immersed in a solution of a salt of another metal, such as nitrate of silver. They had shown that, while the silver was being deposited on the copper, an actual passage of the nitric element towards the more positive metal occurs, causing the formation of a dense solution of nitrate of copper inside the crystalline deposit, and a consequent downward current, and at the same time an upward current of almost pure water from the tips of the crystals. They had shown, also, that with solutions of different strengths the chemical action in a given period (say ten minutes) is not in direct proportion to the strength; but, *cæteris paribus*, twice the strength gives three times the chemical decomposition. This augmentation had been attributed to an increased conduction of the stronger liquid. In the present paper, the authors exhibited these phenomena in a dissected form, and carried the observations still further.

Instead of the silver crystals being allowed to grow rom the copper into the nitrate of silver solution, two separate plates were taken, one of copper and the other of silver. The copper plate was immersed in nitrate of copper, and the silver plate in nitrate of silver, while the two metals were connected by a wire, and the two liquids were connected by a porous cell. Silver crystals were gradually formed upon the silver plate, while the copper was dissolved; and at the end of some hours it was found that all the silver had been removed from solution, and that the loss of the copper plate was almost exactly what might be calculated from the amount of nitrate of silver originally placed in the other cell. The actual numbers were—theoretical, 0·412; actual, 0·402. The copper nitrate was formed in the cell with the copper plate, the sp. gr. of the liquid having risen from 1·015 to 1·047.

A similar experiment was tried with plates of copper and zinc in sulphate of copper and sulphate of zinc, respectively. The result was as before, metallic copper being deposited on the copper plate, and the sulphate of zinc rising in sp. gr. from 1·123 to 1·139.

In order to determine whether the amount of silver deposited depended, not merely on the amount of the silver in solution, but also on the amount of copper salt that bridged over the intervening space, similar experiments were made in which the nitrate of silver was kept constant, but the nitrate of copper was increased by equivalent multiples. It was found that the silver deposited increased with the increase of the copper salt, being about double when the copper salt was seven times as strong, and that the effect of successive additions gradually diminished. This is in strict accordance with other experiments, showing that, when the copper plate is immersed in a mixture of the nitrates of copper and silver, the amount of silver deposited is increased, and increases with each successive addition of copper salt, though in a diminishing ratio.

That this acceleration is not produced by a copper salt only was proved by repeating the experiment with a variety of other nitrates.

The subjoined table shows the results, and indicates, at the same time, that the increased effect does not depend simply upon the nitric element, which was present in the same quantity in all, but likewise on the nature of the salt.

Size of plate, 3230 sq. m.m.; volume of solution, 72 c.c., containing 2·8 per cent of nitrate of silver; temperature, 18° C.; time, five minutes.

Solution.	Copper dissolved. Grms.	Increase per cent.
Nitrate of silver	0·0703	—
Ditto + 1 eq. of nitrate of magnesium	0·1010	43·6
,, ,, ,, calcium ..	0·1003	42·6
,, ,, ,, sodium ..	0·0957	36·1
,, ,, ,, copper ..	0·0965	37·2
,, ,, ,, potassium	0·1047	48·9
,, ,, ,, strontium	0·1040	47·9
,, ,, ,, cadmium ..	0·1030	46·5
,, ,, ,, barium ..	0·0987	40·3
,, ,, ,, lead	0·0945	34·4

* Read before the British Association, Edinburgh Meeting, Section B.

ON A NEW SOURCE OF ELECTRICITY.

By JAMES St. CLAIR GRAY, M.B., C.M., &c.,
Assistant to the Professor of Medical Jurisprudence, Glasgow University.

In the course of some experiments relative to sulphur and phosphorus, my attention was drawn to their mutual action while in alkaline solutions, and it occurred to me that probably from this there might be derived an electric currrent.

In order to ascertain this, as well as to determine—should there prove to be such—whether it was constant or not, there was prepared a cell containing a solution of caustic potash in which phosphorus and sulphur, both in sticks, were placed. Within half an hour the phosphorus was reduced to an oily mass, perfectly mobile, occupying the lower part of the cell; the sulphur was not at first affected. The temperature at first rose considerably—about 20°—but this soon passed off, and the solution returned to the temperature of the surrounding medium, varying from 56° to 60° F. During the first six days there was a constant development in small quantity of phosphuretted hydrogen in the spontaneously inflammable form, but after that time, although phosphuretted hydrogen still continued to be evolved, it no longer ignited spontaneously, this being probably due to the simultaneous development of sulphuretted hydrogen, which began to be exhaled in appreciable quantity about this time. At first the sulphur was little affected, but at the end of ten days it was found that at the point of junction of the phosphorus therewith there had occurred considerable loss of substance.

In the solution there were produced sulphite and phosphite, hyposulphite and hypophosphite, and slight traces of sulphate and phosphate of potassium.

At the end of three months the conditions were still much the same; the phosphorus was still fluid and mobile, the sulphur more eroded, the same products present in solution, though increased in quantity and somewhat altered in the ratio which the one salt bore to the other: due allowance being made for increase, the proportion of sulphate and phosphate was greater.

Another cell was prepared on the same principle, and both cells were then submitted to Mr. Hill, one of the assistants in Sir William Thomson's laboratory, to determine the amount of electricity developed, if any. The result far exceeded my expectations, for not only was electricity found to be developed, but a very considerable quantity thereof. The electro-motive force, as registered by Sir William Thomson's electrometer, was found to be 162, which, compared with that of a Daniell's battery, 120, shows a difference in favour of the sulphur and phosphorus of 42°. It was, further, also found that in the cell which had been in opera-

tion for three months, the reading of the scale was quite the same, so that from this cell there was derived an electric current of considerable intensity which had the advantage of being constant.

Wishing then to obtain again in its solid state the residuum of phosphorus which lay at the bottom of the cell, I removed the rolls of sulphur and the alkaline solution, replacing it by pure water, and washing till free of alkali. The phosphorus, under water, was kept for ten days perfectly undisturbed, but at the end of that time was as mobile as ever. A stick of solid phosphorus was then placed among the fluid mass without inducing solidification; on the other hand, the solid become liquefied in a short time. It was then cooled down to 34° F., but still remained fluid, so that I have it still by me in the same mobile, oily condition without apparently any change occurring, though, since the removal of the alkali, nearly two months have elapsed. To what this is due I cannot say, though, I believe, it depends on the presence of some compound of sulphur and phosphorus, as both are present; though in what proportion I cannot at present state.

I am at present engaged in further observations on this and other allied subjects, the results of which I shall hereafter make known.

15, Newton Terrace, Glasgow,
July 22, 1871.

ON THE

BEHAVIOUR OF SUPERSATURATED SALINE SOLUTIONS WHEN EXPOSED TO THE OPEN AIR.*

By CHARLES TOMLINSON, F.R.S.

It is known that, when a vessel containing a supersaturated saline solution is opened in a room, it immediately crystallises, provided the temperature be not too high. Mr. Tomlinson shows that supersaturated solutions of Glauber's salt (and also of Epsom salt, and of alum) may be exposed to the open air of the country for many hours, and even be taken out of the flasks in clean metal spoons, without crystallising. From a large number of experiments, conducted under various conditions, the following conclusions are drawn:—

1. That a highly supersaturated solution of sodic sulphate may be exposed to the open air of the country in an uncovered flask, and in cloudy weather, for from twelve to twenty hours, without any formation of the ordinary ten-watered salt.

2. That if the temperature fall to 40° F., and under, the modified seven-atom salt is formed at the bottom of the solution, just as in covered vessels.

3. That if the exposed solution suddenly crystallises into a compact mass of needles, a nucleus may always be found in the form of an insect, a speck of soot, a black point of carbon, &c.

4. That if, during the exposure, rain come on, the solution generally crystallises suddenly, in consequence of an active nucleus being brought down. But if the flask be put out *during* heavy rain, when we may suppose all the solid nuclei to have been brought down, the rain-drops, now quite clean, fall into the solution without any nuclear action.

5. That the young and newly-sprouted leaves of trees, such as the gooseberry and currant bushes, have no nuclear action.

6. That, in clear cloudless weather, when the force of evaporation is strong, the solutions, by exposure, produce fine groups of crystals of the ten-atom salt, just as a saturated solution would do if left to evaporate slowly in an open dish.

7. That if the solution, after being exposed to the open air, be brought into a room, it crystallises immediately under the action of aërial nuclei.

* Read before the British Association, Edinburgh Meeting, Section B.

ON THE ORIGIN OF THE DIAMOND.*

By the Rev. W. B. CLARKE, M.A., F.G.S.

(Continued from p. 42).

Diamonds in India.

We may now turn to another quarter. India was renowned as a diamond country long before Brazil; Tavernier mentions diamonds in 1642.

In 1814, Dr. Heyne published some tracts on India, in which he described the diamond mines of Southern India, showing that a conglomerate caps the Cuddapah Hills; and he adds, wherever diamonds are found they are in alluvia aud recent deposits in which the rounded pebbles are so numerous as to produce the conglomerate character.

In 1832, Mr. Cullinger published in a Calcutta periodical—"Gleanings in Science"—some notes on the geology of the country between Saugor and Mirzapore, in which he mentions the occurrence of diamonds in solid sandstone underlying chlorite slate, and also in a ferruginous agglomerate, of which he gives several localities.

Mr. Newbold in a paper that may be found in the *Athenæum* of June 11, 1843, has described the diamond-bearing gravel of Cuddapah, in Bundelcund, a little south of Golconda.

It holds rounded pebbles of trap, granite, schists derived from beds twenty to forty miles distant, quartz, jasper, silex, sandstone, and limestone of the vicinity. In it are broken or rolled diamonds; and as the diamond beds are occasionally covered by *Regur*, or black cotton soil (which is also not uncommon in Australia), I consider they are of the same age as the older drift of the Cudgegong. But when these materials are cemented at the upper part by *Kunkur*, which is a tufaceous carbonate of lime (very common in some parts of Australia), diamonds are *never* found. In the Nizam's territory, such cemented beds contain bones of the Mastodon.

If the fifth volume of the second series of *Transactions of the Geological Society of London* is a valuable memoir "On the Fossils of the Eastern portion of the great Basaltic district of India," by the late Mr. Malcolmson, which was read in November and December, 1837. In it he alludes to the Cuddepah diamond mines, in the neighbourhood of which is abundance of basalt. He gives also a sketch of the position of the diamond sandstone of Bangnapilly, which is horizontal, vertically jointed, resting on schistose beds underlain by stratified limestone, and surmounted by a diamond-bearing breccia, which is not interstratified, but is a mixture of sandstone and other rocks, rounded and angular, On the opposite side of the valley, according to Colonel Cullen, the sandstone is replaced by a sharp ridge of trap, and on the descent the schist and limestone were found to be capped by a quartzose sandstone. Besides the diamond conglomerate, seams of rock crystal occur, and fine white quartz charged with galena, and with specular, micaceous, and pyritous iron. The slates are occasionally flinty or jaspideous. The base of the whole is the granite of the Carnatic, and this rock is penetrated by many dykes of greenstone. In the diamond sandstone, magnetic iron and corundum are met with. The fossils in the argillaceous limestone are of fresh water origin.

Mr. Malcolmson opposes the idea of Major Franklin, that the diamond rocks belong to the saliferous deposits of England. In this part of Bundelcund, greenstone follows the strike of the so-called grauwacke in the bed of the Nerbudda River, and basalt forms the overlying strata, another analogy with the Cudgegong diamond district.

Mr. Broderip considered the rocks to be jurassic, and scarcely distinguishable from the white lias of Bath.

As to the saliferous beds, Mr. Malcolmson says, there is not a rock formation in India from granite to recent alluvium in which salt does not exist; and he further states, that the sandstone, covering 800 miles of latitude

* From the Anniversary Address delivered to the Royal Society of New South Wales.

and 400 of longitude, is everywhere above the limestone which Captain Franklin calls *lias*.

In 1853, Mr. Carter, in his "Summary of the Geology of India" (*Bombay Asiat. Soc.*, 1854), also adopts the view that these Bundelcund diamond rocks are jurassic.

D'Archiac (*Progrès*, vol. vii., p. 644) repeats Carter's statements, and puts the diamond-bearing conglomerate *with a note of interrogation* above the Punnah sandstone, and much above the carbonaceous shales of Kuttra.

I would here wish to remark that these beds must be distinguished from those which hold *glossopteris*, and which paralleled with the African Karoo beds, Mr. Tate (*Q. J.*, xxiii.) in 1867, considered triassic, whilst Dr. Oldham, the experienced and able Superintendent of the Geological Survey of India, agrees with me in assigning them to a palæozoic epoch. But inasmuch as coal may exist in the jurassic or triassic, as well as upper palæozoic formations, the proximity of a coal-bearing formation to the diamond rock leaves the question as to the origin of diamond in such a formation just where it was.

Since the establishment of the Indian Survey, under its present enlightened Superintendent, the Messrs. Blandford and Mr. Theobald have explored large tracts of India, and have given their opinion, in which Dr. Oldham concurs, that the Nagpur, Damoodah, and Talcheer, as well as other Bengal coal-fields, cannot be younger than permian. (*Mem. Ind. Surv.*, vol. i., p. 82). These beds in the Damoodah group hold many species identical with those of our New South Wales coal districts, including the outlying patches on the Cudgegong.

The Indian surveyors show that the Mahadeva sandstone (or Bangnapilly rock) surmounts the Damoodah beds, believed to be permian, and that the Talcheer group, which underlies them rests on gneiss, hornblendic gneiss, schist, and quartz schist; and in the Mahanuddi River to the southward of the Talcheer coal-fields, which runs through the basic formations, a small amount of diamonds has been found. Where the Talcheer beds meet the hornblendic rocks by a fault on the Takiria River, and in the Ouli which flows to it from the Mahadeva rocks, gold is occasionally found.

North of this region the great Vindhyan rocks stretch across the country north-north-easterly, being the upper of three groups resting on gneiss and granite. These are described in the second volume of the "Memoirs of the Survey," by Professor H. B. Medlicott; and both he and Dr. Oldham give good reasons for placing the Vindhyan series in connection with the Damoodah, or coal measures, of the Talcheer field, and therefore they are far removed from the Bangnapilly beds belonging to the Mahadeva group to the southward.

Mr. Medlicott shows that the diamond beds are not all of one age, and instances the mines at Punnah, 600 or 700 miles north of Cuddapah, which he places close to the junction of the lower and middle groups of the Vindhyan series, at the northern edge of the Rewah tableland, in the shales, to which latter group they belong. This at once places them far below any possible jurassic or even triassic strata.

The Punnah diamond diggings occupy not more than 20 acres. The diamonds are found in a conglomerate belonging to relics of old spurs and outliers of the tableland. Fine grits among red and green shales, and a few beds of sandstone, constitute the strata.

At Kumerea (another field), the diamond bed is in an incoherent ferruginous sandy earth, of variable thickness and undecided position. To the east it is modified, and near Bridjepur it consists of two feet of conglomeratic sandstone, resting on strong beds of sandstone, and is worked at the surface. The "kukra," or diamond bed, is sometimes an incoherent ferruginous and sandy earth, variable in thickness and position as are the beds with which it is associated. It appeared to Mr. Medlicott to be somewhat of a puzzle where to place the conglomerate among the regular beds, and he considers the ferruginous element to be subsequent to the deposition. The beds thin out and thicken remarkably. The natives seem to have ascertained the limits of the diamond area, owing probably to the beds dying out. The base of the hills has not been tried.

As to the origin of the diamond, he does not think the stratum in which it is found is its native bed. He saw no diamonds *in situ*, but, from what he learned of the labourers, "*the diamonds came as pebbles with the rest.*" Quartz pebbles of any kind are rare. The most prominent pebbles are subangular red and white shale, and of what Franklin calls "green quartz," which is elsewhere described by Mr. Medlicott as "glazed or semi-vitrified sandstone." Pieces of the calcareo-siliceous bottom rock of the size of boulders occur also. One of the workmen confirmed his opinion, that the occurrence of these pebbles indicated the presence of the gem, and that "*they themselves contained diamonds, and were broken up*" as ore or, rather, as gangue.

In a section just north of the mines, twenty feet of regular beds of cherty and compact limestone rest on 50 feet of alternating sandstone and shale, based on rich sienite; the cherty and jaspery condition of some of the more vitrified beds is shown by another section to be due to a "modifying influence." It is supposed that these beds are the sources of the boulders in the diamond conglomerate. Besides these diggings, the great majority are said to be alluvial.

On the Rewa escarpment, in the Vindhyan region, they are at the heads of valleys descending from the plateau. where kunkery and lateritic clays pass into a mixture of clay, gravel, and boulders, increasing to great angular blocks of sandstone, between which the diamonds are found. Diggings occur also on the slopes. In one place men were seen removing 12 feet of dark brown clayey sand to get at the boulder bed, the base of which is richest.

"The limited distribution of the transported diamonds was more puzzling" to Mr. Medlicott than that of the rock. He thinks there are indications beyond the area that is worked.

The conclusion is, that the open valleys of Rewah are not altogether due to atmospheric and river action; the whole must have been under water when these diamonds were washed into their position. "If," says the author, "the diamond is but a pebble in the conglomerate," then, on the other hand, there is every chance of further discoveries, "since quartz grains of similar size with the diamonds are abundant, and there are other sufficient proofs of the recent submergence of the country."

In the above references there is not as clear a relation as was given in connection with Brazil; but the geology of the region is not in some respects so settled as to determine exactly where, in relation to other countries, the Vindhyan rocks of India belong. Enough, however, has been produced to show that the Mahadeva beds are younger than the Damoodah, which clearly correspond with our own upper coal-measures, and that the Vindhyan beds were faulted and elevated and denuded before the deposition of the Talcheer beds that are still lower than the Damoodah.

Under such circumstances it follows that there is probably no very close connection between diamond beds in India at distant localities, and very little to justify the supposition that all, if any, of the Indian diamond deposits can be exactly synchronous with older pliocene.

I have not yet mentioned two very important and interesting memoirs, by Messrs. Hislop and Hunter, published in the 10th and 11th volumes of the *Quarterly Journal of the Geological Society*, on the geology of the Nagpur territory. Differing in opinion from them as to the age to which they assign what they term the great jurassic formation, which extends over enormous areas, and comprises the coal-fields of Central India and Bengal, I would still accept their statements with the greatest respect. They regard the base of the Peninsula as formed of gneiss, granite, sienite, pegmatite, mica

schist, and quartz; but these are not all of anterior date to the sedimentary formations.

Over these occur the coal-bearing rocks, the upper part of which are the sandstones, partly transmuted, which have been already alluded to, and which other authorities regard as the source of the diamond.

Over these beds comes the lower trap rock, which is compact beneath and vesicular at the top, with cresting patches of nodular trap. These traps enclose in places a thin sedimentary formation of tertiary age, which has an uninterrupted range of 1050 miles in one direction, and of 660 miles in the other. Its age has relations with the eocene of Europe. Notwithstanding the order presented in various parts of this large region, the authors consider the various trap rocks as all younger than these beds, the lower having in fact been the younger. The trap, they hold to have flowed into and over and to have altered the lowest of these tertiary beds, which were deposited in a series of great lakes of no great depth.

Above the trap another series of beds occurs, the lowest of which is *laterite*, a well-known term to those who are conversant with Eastern Asiatic geology. In this, the authors state, occur the diamond mines east of Nagpur. They dispute the assertion that the diamonds belong to the transmuted sandstones below the trap; and say that at Weiragad (about 80 miles S.E. of Nagpur) there is no sandstone, but quartzose metamorphic rocks only. At that place the diamonds occur in a lateritic conglomerate, which overlies the sandstone in other places, and in which ferruginous cements occur formed from the detritus and boulders of adjoining formations; and this they hold to be the diamond conglomerate. It is therefore assumed to be younger than the overlying trap formation. Above comes in a series of deposits, the lowest of which is brown, the middle red, with existing fluviatile shells, land shells, and bones of mammalia (which Professor Owen has since determined to be those of buffalo and antelope); tusks of a large animal were also found in the brown clay. The uppermost deposit of all is the Regur or black cotton soil, in which kunkur is mixed. Bones of oxen and sheep are found in it.

Messrs. Hislop and Hunter consider these *black and red* clay beds to belong to the *post-pliocene* formations; the *brown clay* to the newer pliocene.

Assuming these Nagpur deposits to be correctly placed, diamonds of India are still, according to evidence collected from other authorities and already considered, traced to a conglomerate which may be more recent than our basalts on the Cudgegong, but may not be more recent than those at Ballarat; but which seems to have derived its pebbles and boulders from palæozoic and metamorphic and ordinary igneous rocks; *laterite* itself covering rocks alike of every older epoch. Occurring as this detrital *covering* does all over India, and having the same relative position to all kinds of rocks, and at all heights up to that of at least 8000 feet above the sea, the idea of diamond belonging to it as its actual source is not sustainable.

In a subsequent paper (*Q. J. G. S.*, vol. xvi.) the Rev. S. Hislop, one of the authors, considers the intertrappean tertiary bed as lower eocene, producing good fossiliferous evidence for this opinion; and shows that the Mahadeva or Bangnapilly sandstone is about the same age, in which Dr. Oldham seems to coincide. ("Memoirs of India," vol. i., p. 171). Hislop's views have not been thoroughly received by other geologists; and doubts have been expressed as to whether the trap or basaltic formation of India is not all of one age.

If compared with the Cudgegong diamond deposits, the older of which, and from which the younger is derived, underlies the trap (basalt), it will be seen there is a difficulty to be reconciled with respect to each; and if the diamond conglomerate of India be lower eocene, that difficulty is complicated by assuming that the Cudgegong deposit is pliocene.

On reviewing the whole evidence I am inclined to believe that unless they are much younger than the pliocene or pleistocene epochs, in fact of recent origin, they must be considered as drifted from rocks older than the carboniferous. As they everywhere exist in limited areas, it would also be a fair inference that as there is no want of carbon, and similar agencies must operate over enormous regions, the limited range of diamond is a strong argument against its recent production. If the facts advanced by several of the authorities whom I have quoted are received, then diamond must have undergone processes similar to those that have resulted in the formation of gems, of which there is no dispute as to probable age.

It is remarkable how silent observers in general in India are as to the multiplicity of such gems and other extraneous minerals in the Indian diamond regions. Yet Mr. Carter names quartz, jasper, Lydian stone, epidote, micaceous iron, garnets, and corundum, derived from rocks of different ages.

There is another interesting locality near Gungpur, on the northern frontier of Orissa, on a river running to the Bay of Bengal, north of Kuttak; but I have no accurate knowledge of its history.

To these remarks on Indian diamond beds I have only to add, that in 1867, I had the honour of a visit from an officer of the Bengal army, whose official position gave him great opportunities of acquaintance with the country, and who came to this colony on a tour of inspection, to examine our railways and coal-beds, and from him I learned that the Vindyhyan conglomerate is chiefly made up of jasper, chalcedony, specular iron, and a green rock, which latter lies *en masse* on granite; that the diamonds are of all colours—rose, yellow, brown, black, and *pale green*—which last being the favourite, or national colour of the followers of Mahomet, causes the green diamond to find a ready sale, whilst the others are neglected. In size they are that of a hazel nut, or larger. But, he added, that in the diamond districts the people are wretched; they think and talk of little but diamonds, which they often swallow if not watched.

(To be continued.)

ON THE ESTIMATION OF SULPHUR BY BARIUM.

By E. F. TESCHEMACHER and J. DENHAM SMITH.

(Concluded from p. 62).

In each of the preceding experiments the *modus operandi* was the same; the precipitation being effected when both solutions were boiling, a dense arenaceous precipitate fell, which was most easily and quickly washed. Boiling water only was used for the first washings, so as to induce the solution of any adherent chloride of barium, then diluted and hot hydrochloric acid to remove any other possibly adherent salt, finally, boiling water only; the precipitate then was collected on a filter, and washed until the filtrate was not affected by a solution of silver. The precipitate was dried and then ignited on porcelain, first of all gently, and then to redness over a Bunsen burner, the filter-paper being burnt separately, and the weights added together in the usual mode. In every instance, the ignited sulphate was a pure white and soft powder, yielding both chlorine and barytes to water, and still more barytes when treated with diluted nitric acid.

In one instance only throughout the above experiments does the weight of the sulphate obtained fall below the calculated amount; in all the others it is above it, varying from about ¼ to more than 2 per cent in excess, and this when the perfect freedom of the ignited sulphate from the iron base is made evident by its whiteness. So it is clear, despite the especial pains taken to free the precipitate from any adherent salt, that, in eight out of the nine experiments, barium, in some form, has combined with the precipitated sulphate, and thus brought about an increase of weight, when, but for this, from the solubility of the

sulphate in hydrochloric acid, there ought to have been a deficiency.

Although, from experiments which preceded those just described, but which it will be more convenient to consider hereafter, as well as from long practice, we could safely rely on crystallised sulphate of iron as being of an uniform, constant, and definite composition, we thought it well to substitute another sulphate for it, so as to ascertain whether we should be equally at sea with it as with the ferrous sulphate. Accordingly, we fixed on crystallised sulphate of magnesia, which may readily be obtained pure and containing its exact amount of water of crystallisation, several determinations yielding 51·20 per cent of water, which is the calculated quantity. Of this salt, 96·10 grs. is equal to 12·50 grs. of sulphur, or 91 grs. of sulphate of barytes, and proceeding as above described, only replacing the iron by the magnesium salt, we obtained from 96·10 grs. of sulphate of magnesia—

No. 1.	93·00	grs. of sulphate of barytes.			
,, 2.	92·15	,,	,,	,,	
,, 3.	92·60	,,	,,	,,	

and in each case the ignited sulphate yielded chlorine, magnesia, and barytes to water and to acid. It was obviously useless to multiply these experiments, as, although the range of difference is not so great as with the iron salt, yet the weight of sulphate is always in excess, and this sufficiently marked as to confirm us in distrusting the estimation of sulphur by barium.

Our next step in this investigation was to determine the weight of sulphate of barytes yielded by 108·60 grs. of crystallised sulphate of iron after oxidation, as in the estimation of sulphur in pyrites, in other respects following the process already described.

No. 1.	89·70	grs. of sulphate of barytes.			
,, 2.	87·05	,,	,,	,,	
,, 3.	90·10	,,	,,	,,	
,, 4.	89·70	,,	,,	,,	
,, 5.	89·40	,,	,,	,,	
,, 6.	88·90	,,	,,	,,	
,, 7.	90·80	,,	,,	,,	
,, 8.	91·00	,,	,,	,,	
,, 9.	90·00	,,	,,	,,	

Here the reverse of the preceding experiments obtains; in no case is there an excess of weight of the precipitate—in one instance only does it amount to the calculated weight which, in the other eight examinations, is never attained; indeed, this loss is so constant, yet so variable in amount, as to prove that the gravimetric method of estimating the sulphur in pyrites must be abandoned. This loss is the more worthy of remark from the discolouration, in every instance, of the precipitate by oxide of iron, the colour varying from buff to a deep salmon tint; and, also, which seems to be invariable, the presence of chlorine and barytes soluble in water and acid in all the precipitates, so that the actual loss of sulphate is, in every case, even greater than the apparent loss.

This would have been more evident had we not thrown away the filtrates and washings of the first six of the preceding experiments before we bethought ourselves that it was desirable to ascertain whether any sulphate of barytes was held in solution; however, on mixing the filtrates and washings of the three last, and evaporating, we obtained 4·20 grs. of sulphate of barytes, which, added to the precipitates, and averaged, shows the adherent salt to have amounted to 1 gr. in each instance, and to a loss of 1·40 grs. of sulphate of barytes in each experiment. He must especially dwell on this customary deficiency of sulphate of barytes when precipitated from an acidified solution of a soluble sulphate as casting the gravest doubts on the trustworthiness of all analytic results thus obtained, and even leading to but widening error, when the resultant sulphate has been purified from its adherent salts by subsequent treatment with dilute acids.

As our aim in these remarks is, not only to prove the futility of relying on the ordinary methods of estimating sulphur by barytes, but especially their worthlessness as applied to pyrites, we followed the foregoing experiments with three more in duplicate, on a sample of pyrites which we have already ascertained contained 49 per cent of sulphur. 25 grs. of this pyrites, which ought to yield 89·20 grs. of sulphate of barytes, oxidised in the usual manner, but the solution not evaporated to dryness, and, therefore, containing some nitric acid, yielded 90·10 grs. of sulphate of barytes, when the filtered solution and washings were precipitated, by 120 grs. of crystallised chloride of barium, from the boiling solution, this left to cool, and the resulting sulphate washed with diluted and hot hydrochloric acid, and then with hot water till free from chlorine. This 90·10 grs. of sulphate of barytes indicates 49·50 per cent of sulphur. The filtrate and washings of this precipitate yielded 1·10 grs. of sulphate of barytes when evaporated, which, added to the weight of the precipitate, indicates just over 50 per cent of sulphur in this sample of pyrites, or an error in excess of 1 per cent of sulphur. Of the 90·10 grs. of this ignited precipitate, 80 grs., when boiled with diluted hydrochloric acid, washed, collected, and ignited, yielded 78·40 = 88·30 grs. on the whole amount, indicating 48·50 per cent of sulphur. This experiment exactly repeated, yielded 90·50 grs. of sulphate = 49·70 per cent sulphur. Filtrate and washings gave 1·05 grs., which, added to the above, indicates 50¼ per cent of sulphur. Of the ignited precipitate, 80 grs. when purified left 78·20 grs. = 88 grs. on the whole amount, or rather less than 48½ per cent of sulphur.

Another 25 grs. of pyrites were oxidised, and the solution evaporated to expel nitric acid, then re-dissolved in about 200 grs. of hydrochloric acid, and solution and washings treated as in the foregoing experiments. The ignited sulphate weighed 88·80 grs. = 48·78 per cent of sulphur. The filtrate &c., in this instance left 0·70 gr. of sulphate; and 80 grs. of the ignited precipitate, treated as above with dilute acid, left 78·50 = 87·15 grs. on the whole amount, or 47·87 per cent of sulphur. This experiment also exactly repeated gave 87·30 grs. sulphate = 47·88 sulphur. 80 grs. ignited sulphate when purified left 78 = 85·10 grs. sulphate on the whole, or 46·75 per cent of sulphur. Flitrate and washings left 1·50 grs. sulphate of barytes.

Again, 25 grs. of this pyrites, oxidised, evaporated, and re-dissolved in 700 grs. of hydrochloric acid, and then proceeding as above, only washing the precipitate with but slightly diluted acid in the first instance, yielded 88·80 grs. of ignited sulphate = 48·78 per cent of sulphur: and 80 grs. when purified left 77·90 or 86·50 grs. on the whole amount = 47·50 per cent of sulphur. Filtrate, &c., left 1·60 grs. of sulphate of barytes. This experiment also when exactly repeated gave 89·35 grs. of ignited sulphate = 49·10 per cent sulphur. This, purified, yielded 87·35 grs. on the whole amount, or 48 per cent of sulphur, filtrate and washings being equal to 1·60 grs. of sulphate.

Let us tabulate the final results in sulphur of these experiments—column A indicating the percentage of sulphur calculated from the original precipitate. Column B, this, *plus* the deposit yielded by the filtrate and washings, and C the percentage of sulphur on the assumed purified precipitates.

A.	B.	C.	
49·50	50·00	48·50	per cent of sulphur.
49·70	50·30	48·45	
48·78	49·16	47·87	,, ,,
47·88	48·78	46·75	
48·78	49·66	47·50	,, ,,
49·10	50·00	48·00	

Columns A and B are often near to the truth, or 49 per cent of sulphur; the error from the solubility of the sulphate being nearly or more than compensated by adherent impurity; but when the sulphate is subjected to subsequent treatment as in column C, the wide departure

of the results from the truth, and consequent invariable deficiency and error by loss of sulphur, is manifest. Indeed, as we have shown before, this purifying process is unending, all these purified precipitates again yielding barytes on treatment with diluted acids.

We think those readers who have followed us thus far will admit that we have proved the estimation of sulphur and sulphuric acid by the weight of the sulphate of barytes obtained is, and can be, correct only by accident, and when the adherent impurity happens exactly to counterbalance the sulphate dissolved. That sulphate of barytes, when precipitated from a solution by an excess of a soluble barytic salt, invariably takes down with it some of the precipitant, and often salts of other bases which may be present in the solution, and thus vitiates the results. That sulphate of barytes, when ignited over a gas-flame, is always reduced to a noticeable extent. That if it be attempted to purify such sulphate from the adherent salts, that the results are always and still further erroneously affected, and that sulphate of barytes is notably soluble in water acidified by hydrochloric acid, and this to an extent sufficient to falsify all results.

Although the foregoing series of experiments are recent, the facts they point to have long been known to us, and have gradually led to a method of estimating sulphur by barium, more especially the sulphur in pyrites, which experience and continuous use have proved to us to be exact, reliable, and to yield constant results. This method we shall now, in concluding these remarks, endeavour to describe in detail, requesting the patient attention and consideration of our readers for the difficulty we feel in conveying a lucid description of a process which necessarily involves some practice and judgment on the part of the operator to ensure both rapidity in working and correctness of results, although these are assured when once the practical details of the method are mastered.

This method is based on five conditions, viz.—

The use of a standard solution of chloride of barium, *by weight.*
The complete oxidation of the sulphur, and subsequent expulsion of all the nitric acid.
The avoidance of a large excess of hydrochloric acid in the solution.
The avoidance of large quantities of solutions.
The use of considerable weights of pyrites in testing, thus avoiding the extreme of multiplication of any analytical error in the percentage return.

The preparation of the standard solution of chloride of barium, now that this salt is met with in commerce so pure and definite in composition, offers no difficulty and requires no details from us, excepting that we find it convenient in practice and for the sake of the ready calculation of results that 1000 *grs. by weight* of this solution shall be equal to and represent 25 *grs. of sulphur.* It is advisable to use water just acidified with hydrochloric acid in making this solution, to prevent the deposition of carbonate of barytes, which often occurs when the standard solution is kept.

To prove the correctness of this standard solution it is not enough to precipitate known weights, collect, and weigh the resulting sulphate, as these results slightly vary, but it is advisable thus to check the solution as a confirmatory measure by repeated tests, adding, say, 1000 weighed grs. of the standard solution, heated nearly to boiling, to a boiling solution of diluted sulphuric acid containing an excess of acid, when the sulphate of barytes obtained yields traces only of chlorine to water after ignition; but if this order be reversed, and the diluted sulphuric acid is added to the solution of chloride of barium, so that this latter is in excess, until complete precipitation is effected, then the sulphate of barytes will be found to yield abundant evidences of chloride of barium when treated with water after ignition. In any way of testing this standard solution the results will, however, closely approximate to the truth, since in seven tests of the standard solution 1000 grs. yielded 181·40 grs. as the lowest, and 182·30 grs. as the highest weight of ignited sulphate, whilst 181·95 grs. is the average of these seven tests, the calculated weight being 182 grains. This average exactness is in great measure due to the insolubility of sulphate of barytes, in a solution wherein free sulphuric acid is present. Although the error of this test, either way, is but slight, still it is error; so that it is advisable to rely on the crystallised sulphate of iron already described as the ultimate and final test of the accuracy of the standard solution of chloride of barium. Thus, 108·60 grains of this salt = 12·50 grs. of sulphur, is dissolved in about 1000 grs. of water slightly acidified with hydrochloric acid, and heated nearly to boiling; to this is added standard solution of chloride of barium somewhat below the estimated weight, say, 490 to 495 grs., also heated, stirring all the time, and then boiling rapidly. A small portion of the solution is then filtered and the standard solution added, drop by drop, to the filtrate, which must be returned to the test liquor and boiled at each testing until a filtrate is obtained, which, after standing, just clouds both with dilute sulphuric acid and the standard barium solution. In practice it will be found that a standard solution is readily obtained, 500 grs. of which treated as above with 108·60 grs. of crystallised sulphate of iron will yield a filtrate manifesting slight cloudiness both with barytes and sulphuric acid, and which with a deficiency of 2 grs. in the test of the standard solution will yield a marked precipitate on the addition of the 2 grs. to the filtrate, and an equally well-defined reaction with dilute sulphuric acid when 2 grs. in excess of the standard solution of barium has been used. The operator will naturally make sufficient standard solution for some six or twelve months' consumption; but this should not be tested and rectified until it has been made for some forty-eight hours, and then no pains must be spared to ensure its accuracy and exact adjustment. Thus, in addition to the weight of sulphate spoken of above, the average of which was 181·95 grs., the estimated weight being 182 grs., we find the required weight of our standard solution of chloride of barium, when controlled and verified by the already-named weights of crystallised sulphates of iron and of magnesia, equivalent to 12·50 grs. of sulphur, in eleven consecutive tests to be 501, 501, 500, 501, 500, 499, 499, 500, 500, and 500 grs. and with such testing we are satisfied of the reliability of the standard solution, and rest content; merely taking the precaution to re-test from time to time, as when opening a fresh Winchester quart, so as to prevent mistakes of any kind creeping in.

We may be forgiven for insisting at such lengths on ensuring the rigid accuracy of the standard solution of barium, as this is essential to correctness of results; and we now turn to the Estimation of Sulphur in Pyrites. When the sample to be tested occurs in lumps, the whole must be broken down and passed through a sieve of about 120 meshes to the square inch, then thoroughly mixed, turned out on paper, and spread out to an uniform but shallow depth, portions being now taken from various parts with a scoop or laboratory knife, returned to a hard porcelain mortar, and ground still finer. From this another portion is taken in a similar manner and again ground in the usual way. Of this from 100 to 200 grs. are again taken, and ground as finely as possible, and then dried on a water-bath at 212° F. It is essential, and this most especially with the poorer crystalline ores, that this test-sample be reduced to an impalpable powder. Of this test-sample, carefully but rapidly dried, let two portions of 25 and 30 grs. each be weighed and placed in separate flasks with long necks, and of from 16 to 20 ozs. capacity; the flasks being previously damped inside with a few drops of distilled water so as just to moisten the pyrites, and then loosely closed by placing small funnels in their mouths. A mixture of some 50 grs. of hydrochloric acid and 150 of nitric acid, sp. gr. 1·40, by measure, is then to be poured into each flask, but not directly upon the ore, and immediately a quick rotary motion given to the flask, so as to rapidly mix the ore and

acid, which may and ought to be effected and the flask placed on a ring in an oblique position, before action takes place. Action rapidly and energetically ensues, and so soon as it ceases, add 200 grs. of additional hydrochloric acid, place the flask on sand or hot plate for evaporation, which is to be carried *just to* dryness, a point which demands care and watchfulness to hit; 100 grs. more hydrochloric acid is then added to the flask to re-dissolve the contents. Now is the time to detect whether the oxidation of the sulphur is complete or no, as the merest trace of free sulphur may be recognised in the flask by the eye; and, if so, then reject the experiment and begin *de novo* on fresh portions of the test-sample still more thoroughly ground.

A small flask holding some 1000 grms. of standard solution of chloride of barium, with dropping tube, is now counterpoised, and so much of the solution transferred to a porcelain basin as practice shows may be looked for as nearly equivalent to the strength of the pyrites in sulphur.

The requisite quantity of standard solution is a point which must be left to the experience and judgment of the operator; thus, with the best Spanish ores we start with 480 to 485 grs. of standard solution to the 25 of pyrites; with other amorphous ore, 450 grs. is an average amount; whilst with crystalline pyrites 350 to 410 grs. of standard solution is sufficient to start with. Whatever the amount may be, it is to be heated nearly to boiling and poured into the test-solution of the pyrites, having previously washed the neck of the flask and funnel with hot water to carry down any adherent splashes; then the whole returned to the basin from the flask, which must be repeatedly washed with small quantities of water and added to the solution in the basin, taking care that the whole of the solutions and washings shall not exceed in bulk 1500 measured grs. of water. Now boil rapidly, and having a small damped filter ready, filter a little of the mixed solution, and add a portion of the filtrate to about 3 or 4 grs. of standard barium solution placed, from the counterpoised flask containing it, in a test-glass. Should a further precipitate be produced, this tested solution is to be returned to the basin with the rest of the filtrate, and so much more standard solution of barium added as in the judgment of the operator is required, this is again boiled and filtered, using the same filter, and tested as before, repeating this operation until a precipitate ceases to appear with the standard barium solution, when the weight of the solution employed is to be taken and noted. When this point is arrived at, a portion, some 3 or 4 grs., of a standard dilute sulphuric acid, which it is convenient to have equivalent to the standard solution of barium, weight for weight, is to be placed in another test-glass, and a little of the filtrate poured upon it. Should this not yield a precipitate, or should both barytes and sulphuric acid show a cloudiness only on standing for a few minutes, the operation may be pronounced complete, and the test confirmed by proceeding with the second test-solution of the pyrites as above, but adding at once the exact and ascertained weight of the standard barium solution. Should this, also, on testing, confirm the first test, and the filtrate yield evidence neither of barytes nor sulphuric acid, we regard the estimation as complete; the amount of sulphur being easily calculated from, and confirmed by, the weights of standard solution of chloride of barium employed, which should agree within 1-500th, or the operator have recourse to a third test or more, until he is satisfied of his correctness.

When too much chloride of barium solution has been added in the first instance, and consequently a precipitate obtained with standard sulphuric acid, the filtrate is returned to the basin, and boiled with gradual additions of the standard sulphuric acid until the point is attained when neither barytes nor sulphuric acid causes a precipitate, so that the chloride of barium in excess may be deducted from the weight used in the first instance; but it is well to test the pyrites under examination a third time, and to employ the result of this first test as a guide only to the actual test and re-test on which the operator intends to rely when he has overshot the mark and added an excess of standard barium solution in the first instance. We must be allowed to recommend that in all cases when the operation approaches completion, the filtrate, after the addition of barium solution or sulphuric acid, should be allowed an interval of two minutes before testing it the reverse way.

Estimated by the method we have thus endeavoured to describe, the amount of sulphur in pyrites may be determined with accuracy and certainty to a 1000th part or 1-10th per cent; and the sulphuric acid present in any solution may thus be estimated with ease, taking care to avoid too great dilution of the sulphate.

It may be as well to add, that 108·60 grs. of sulphate of iron = 12·50 sulphur, oxidised as in the above-described method, required, in five consecutive experiments, 500 and 501 grs. by weight of the standard barium solution, the filtrate either remaining transparent or slightly clouding with both barium and sulphuric acid; thus proving that no loss of sulphur is sustained by oxidation. It is seldom the difference between the original and confirmatory test of a sample of pyrites exceeds 0·10 per cent, whilst they usually agree. Also, that the crystalline pyrites, of which the Norwegian ore is a type, is apt to deposit free sulphur during oxidation, unless most carefully ground; so that, with such ore, this point must be more carefully looked to than when amorphous samples, like most Spanish ores, are valued.

We have now only to state that, whilst the mode we have endeavoured thus to bring into notice is far more rapid than the gravimetric method of estimating sulphur, the results are so constant and reliable that, should it meet with general adoption and use by those interested in the subject, we feel assured the differences in estimating the value of pyrites, and consequent disputes which have caused so much annoyance to ourselves and others, will cease to exist.

Note.—Dr. Noad has obligingly called our attention to his comments upon some observations of Mr. Calvert, "On the Solubility of Sulphate of Baryta in Acid Liquors;" wherein that author says, "The insolubility of this salt is affected even by the weakest nitric or hydrochloric acids, and that in future the practice of rendering liquors acid with either of these acids must be discontinued when sulphates are to be determined." Dr. Noad, in this paper, which may be found in the *Quarterly Journal of the Chemical Society*, vol. ix., p. 15, most strongly insists on the fact, that sulphuric acid may exist in the nitric acid of commerce without the production of a precipitate on the addition of a soluble salt of barytes; thus furnishing another probable source of error in estimating the amount of sulphur present in pyrites.

As we read the remarks of Dr. Noad, we find our observations on the solubility of sulphate of barytes in solutions acidified by hydrochloric acid fully confirmed by his experiments; and that "the solubility of sulphate of baryta in a large bulk of dilute hydrochloric acid" has been conclusively proved by himself and confirmed by us, although we must beg leave to differ from him in his conclusion, "that in a practical point of view it is of no importance," as, so far as our experience goes, whether the hydrochloric acid used be strong or dilute, sulphate of barytes is always dissolved in the acid solution; and that a considerable excess of the soluble barytic salt only tends in some measure to counterbalance the loss sustained by solution of the sulphate, by its adhesion to the precipitated sulphate of barytes, forming therewith a compound insoluble both in water and dilute acids. And, consequently, we re-affirm, "that we have proved the estimation of sulphur and sulphuric acid by the weight of the sulphate of barytes obtained is, and can be, correct only by accident, and when the adherent impurity happens exactly to counterbalance the sulphate dissolved."

NOTICES OF BOOKS.

The Retrospect of Medicine: Being a Half-Yearly Journal containing a Retrospective View of Every Discovery and Practical Improvement in the Medical Sciences. Edited by W. Braithwaite, M.D., and James Braithwaite, M.D. Lond. Vol. lxiii., January—June, 1871. London: Simpkin, Marshall, and Co. Edinburgh: Oliver and Boyd. Dublin: Hodges, Foster, and Co.

The advent of these well-known volumes edited by Drs. Braithwaite must be welcome to the hard-worked medical man who has little time to read up in cases not immediately presented to him. The volume for the past half-year fully continues the high character of those already issued.

Among the many valuable papers that "On a Rapid and Accurate Method of Milk Analysis; with a special reference to the Examination of Woman's Milk," by Dr. Muter, the Director of the South London School of Chemistry and Pharmacy, is by no means the least interesting. He says:—"After many trials in various directions, it was determined to base the analysis on the real dietetic value of the milk, as represented by a determination of its solid residue and the estimation of its nitrogenous and carbonaceous constituents. Experience derived from the use of Dr. Frankland's elegant system of water analysis by combustion *in vacuo* led ultimately to the application of a similar principle to milk. The process, when used for cow's milk, requires several modifications, in view of possible admixture with certain extraneous matters. The process is conducted as follows:—A small paper filter is prepared which will contain 10 grms. of oxide of copper. It is filled with the oxide and placed in a small funnel. The whole is then exposed for an hour in an air-bath, so constructed as to draw a continuous current of air at 105° C. through and around the funnel. The funnel and its contents are then cooled in the desiccator, and weighed with great care, and the weight having been noted, *five drops* of the milk are cautiously let fall on the centre of the oxide, taking care that no milk spreads to the filter paper. The whole arrangement is then weighed, and the quantity of milk used found by difference. The funnel and contents are then replaced in the air-bath, and exposed to a temperature gradually increasing from 50° to 105° during several hours. When the milk has been thus dried it is again weighed at intervals until it ceases to lose weight. This loss of course shows the percentage of water, and, consequently, of the total solids. The contents of the filter are now transformed to a warm glass mortar, mixed with more oxide of copper and introduced into a combustion-tube. The tube is charged in the usual way, but the front part is filled through 3½ inches of its length with a roll of copper gauze previously ignited in hydrogen. The end of the combustion-tube is then drawn out before the blowpipe, and connected by an india-rubber and glycerine joint to the Sprengel air-pump. Heat is now applied to the front part of the tube, and, the air having been fully exhausted, the combustion is proceeded with, and the residual gases received into a tube over mercury. At the close of the combustion the gases are entirely transferred from the combustion to the receiving tube by the aid of the pump, and it now only remains to measure them in a manometric apparatus. The gases are first measured as a whole, and then separately absorbed by the usual reagents and measured after each absorption. We thus obtain the total volumes of carbon dioxide and nitrogen evolved by the milk-residue, and by a simple set of calculations we are enabled to deduce the actual weight of carbon and nitrogen contained in it, and consequently its exact value in nutriment. In one continued series of operations we therefore ascertain (1) the total solids, and (2) the amount of their flesh-forming and heat-producing constituents. When thus complete, the analysis would be expressed as follows:—

Amount of milk taken, 0·24 grms.
Total solids, 0·0264 = 11 per cent.

Organic nitrogen	0·0014 = 0·5833	per cent.
,, carbon	0·0167 = 6·5420	,,

Therefore—

Water	89·00
Flesh-formers (casein)	3·71
Heat-producers (fat and sugar)..	7·29
	100·00

This is a good specimen of well-balanced healthy milk."

The clinical value of such a plan of analysis it would be difficult to over-estimate, especially as the quantity of milk required is so small as to be easily procurable at any time.

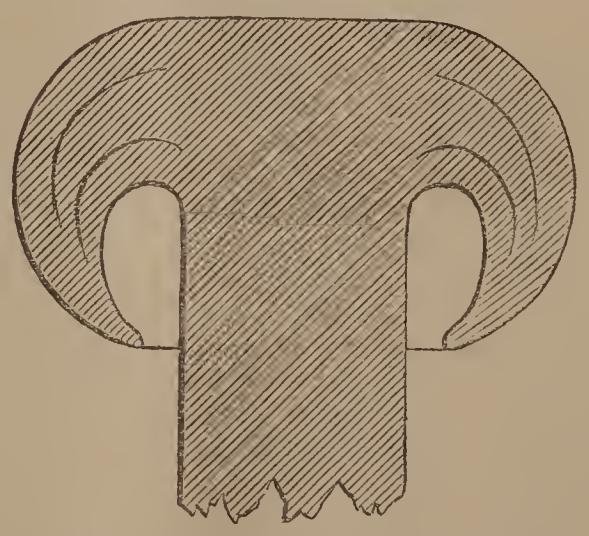
There is another very interesting extract on a Method of Embalming the Dead. Embalming seems in many cases desirable, not only as a sanitary precaution in large towns, where, as in Edinburgh and Glasgow, the dead are placed in family vaults situated in the very heart of the city, but as being of service to the anatomist, and enabling those whose relatives have died away from home to procure the body in a state presenting hardly any post-mortem change. Dr. Vivodtsef's process is simple, short, and easy of accomplishment, consisting merely in the injection of a mixture of carbolic acid and alcohol into the arteries by means of Dr. Richardson's apparatus for local anæsthesia, the quantity of the mixed fluid equalling about one-half the weight of the body. But these papers are not of exceptional interest, and very lengthy extracts would have to be made to do justice to the editors' happy compilation.

CORRESPONDENCE.

RING VORTICES.

To the Editor of the Chemical News.

Sir,—In the *Philosophical Magazine* for 1864 will be found two papers by Mr. Charles Tomlinson, on figures of this kind, which he calls "submergence cohesion figures." His experiments are exceedingly numerous and interesting, well worth study, and relate mainly to oils. He gives his



Section of Head of Smith's Cold Chisel, showing how rings of metal may be made.

views of the causes of the formation of these rings in these words:—"Take the case of a liquid ring. The forces are (1) *diffusion*, which forms the ring; (2) *gravity*, which causes it to sink. The resistance is *friction*, retarding (1) the descent of the ring, (2) its diffusion."

It will be seen I differ from Mr. Tomlinson as to the causes, and especially as to the correlation, of these phenomena. I think the "ring" is due to the ordinary motion following from the impact of two bodies, just as the smith's chisel head is "burred" out and recurved by

blows, showing the commencement of a cold metal "ring." The *descent* is due mainly to the initial velocity of the drop, and although diffusion may modify, and so, in one sense, may be said to create these phenomena, yet it really is the cause of their destruction. Finally, I think the ordinary laws of motion applied to streams of fluids impacting on other matter is sufficient to account for nearly all the phenomena. Least of all, I think, is the effect of cohesion on such "rings" as I am considering, viz., those formed in similar fluids by one small portion moving at greater velocity than another, *i.e.*, by impact. This is clearly shown also, I think, by the influence exerted on these phenomena by the area of the receiving vessel.—I am, &c.,

Henry Deacon.

Edinburgh, August 5, 1871.

MISCELLANEOUS.

British Association for the Advancement of Science.—The following is a complete list of the papers which were brought before Section B (Chemical Science) at the Edinburgh Meeting, under the presidency of Dr. Andrews, F.R.S., &c. They will be published, in full or in abstract, according to their importance, in the Chemical News:—

The President's Address.

J. Dewar.—*Preliminary Report on Thermal Equivalents of the Oxides of Chlorine.*

J. H. Gladstone and Alfred Tribe.—*Some Experiments on Chemical Dynamics.*

Charles Tomlinson.—*On the Behaviour of Supersaturated Solutions when Exposed to the Open Air.*

Thomas Ainsworth.—*Facts developed by the Working of of Hæmatite Ores in the Ulverstone and Whitehaven Districts from 1844 to 1871.*

C. Gilbert Wheeler.—*Recent Progress in Chemistry in the United States.*

Henry Deacon, J.P.—*Deacon's Chlorine Process as applied to the Manufacture of Bleaching Powder on the larger scale.*

T. L. Phipson, Ph.D.—*On Regianic Acid.*

Dr. Crace Calvert.—*On the Estimation of Sulphur in Coal and Coke.*

E. C. C. Stanford.—*On the Retention of Organic Nitrogen by Charcoal.*

J. Smyth.—*Improvements in Chlorimetry.*

W. Delffs.—*On Sorbit.*

Emerson Reynolds.—*On the Action of Aldehyde on Sulpho- and Oxygen-Ureas.*

Emerson Reynolds.—*On the Analysis of a Singular Deposit from Well-Water.*

W. Chandler Roberts.—*The Molecular Arrangement of the Alloy employed for the British Silver Coinage.*

T. Moffat.—*On Ozonimetry.*

Dr. Andrews.—*On the Dichroism of the Vapour of Iodine.*

Dr. Andrews.—*On the Action of Heat on Bromine.*

Dr. O. Richter.—*On the Chemical Constitution of Glycolic Alcohol and its Heterologues, as viewed in the new light of the "Typo-Nucleus" Theory.*

Report of the Committee on the Utilisation of Sewage.

Dr. Bischof.—*On the Examination of Water for Sanitary Purposes.*

Mr. Weldon.—*On a Proposed Method of Recovering the Sulphur Employed in the Manufacture of Soda.*

Abbé Moigno.—*On the Photographic Post.*

Dr. Thorpe.—Contribution to the History of the Phosphorus Chlorides.

Mr. Pattison Muir.—*On an Antimony Ore from New Zealand.*

Mr. John Dalzell.—*On Sulphur Dichloride.*

Dr. Wright.—*On the Oxidation Products of the Essential Oil of Orange-Peel.*

Dr. Wright.—*On some New Derivatives from Codeia.*

Dr. Delffs.—*On a Modified Method of Testing for Morphine.*

Mr. Tichborne.—*On the Dissociation of Molecules by Heat*

Mr. J. Y. Buchanan.—*On the Rate of Action of Caustic Soda on a Watery Solution of Chloracetic Acid.*

Mr. Hope.—*Experiments on Britton's Farm.*

Dr. Corfield.—*Comparison of Results during Winter of Croydon, Norwood, and Britton's Farm Experiments.*

Dr. Corfield.—*Report on Analysis in connection with above.*

Dr. Corfield.—*Upward Filtration of Sewage at Ely.*

Dr. Corfield.—*Phosphate Process.*

Drs. Corfield and Gilbert.—*Dry-Earth System at Lancaster.*

Report of the Committee appointed for the purpose of Superintending the Publication of Abstracts of Chemical Papers.

Prof. Apjohn.—*Some Remarks upon the Proximate Analysis of Saccharine Matters.*

Dr. Gladstone.—*On Crystals of Silver.*

Mr. Braham.—*On the Crystallisation of Metals by Electricity.*

Mr. J. S. Holden.—*On the Aluminous Iron Ores of County Antrim: their History and Composition.*

Prof. Maskelyne.—*On Dufrenite and a New Mineral from Cornwall.*

Prof. Maskelyne.—*On Localities of Dioptase.*

Dr. Goodman.—*Note on Fibrin.*

Rev. H. Highton.—*On a Method of Preserving Food by Muriatic Acid.*

Mr. Wanklyn.—*On the Constitution of Salts.*

Mr. Harkness.—*Preliminary Notice on a New Method of Testing Samples of Wood-Naphtha.*

Officers and Committee.

President.—Prof. T. Andrews, F.R.S. L. and E.

Vice-Presidents.—Prof. Abel, F.R.S.; Prof. Apjohn, F.R.S.; Prof. Crum Brown, F.R.S.E.; Dr. Ronalds, F.R.S.E.; Prof. H. E. Roscoe, F.R.S.; Dr. J. Stenhouse, F.R.S.; Prof. A. W. Williamson, F.R.S.; James Young, F.R.S.E.

Secretaries.—J. Y. Buchanan, F.R.S.E.; W. N. Hartley; T. E. Thorpe, F.R.S.E.

Committee—J. Attfield; Dr. Baumhauer; G. Bischoff; J. C. Brown; Crace Calvert, F.R.S.; M. Carteighe; R. C. Clapham; W. Crookes, F.R.S.; H. Deacon; R. E. Delffs; James Dewar, F.R.S.E.; Dr. Baker Edwards; A. E. Fletcher; R. Gerstl; J. H. Gilbert, F.R.S.; J. H. Gladstone, F.R.S.; W. Harkness; W. E. Heathfield, F.R.S.E.; J. Hunter; Dr. Jennings; J. Kraft; Dr. Longstaff; Stevenson Macadam, F.R.S.E.; Abbé Moigno; Prof. Maskelyne; R. C. Moffat; E. C. Nicholson, F.R.S.; B. H. Paul; W. H. Perkin, F.R.S.; J. A. Phillips; Lyon Playfair, C.B., M.P.; Astley Price; J. E. Reynolds; T. H. Rowney; Angus Smith, F.R.S.; J. Smyth, jun.; E. C. C. Stanford; W. W. Stoddart; J. M. Thomson; C. R. C. Tichborne; C. Tomlinson, F.R.S.; A. Tribe; W. Weldon; Prof. Stephen Williams; W. Williams; C. R. A. Wright, D.Sc.

University of London.—The following are lists of the candidates who have passed the recent First B.Sc. Examination.—*Pass Examination.* (First Division).—Robert William Atkinson, University College, and Royal School of Mines; Frederick Douglas Brown, Royal College of Chemistry and private study; Thomas Carnelley, Owen's College; Robert Moses Lewis, B.A., Downing College, Cambridge; Hugh William McCann, Liverpool Institute; John Henry Poynting, Owen's College; James Richmond, Manchester Grammar School; Thomas Hutchinson Waller, B.A., private study. (Second Division).—Charles Callaway, M.A., Cheshunt College; Baron Armand De Watteville, M.A., University College; Charles William Huson, Queen's College, Liverpool; Alexander Irving, B.A., private study; Leander Starr Jameson, University College; Charles Coleman Jewell, University College; George Lewis, B.A., King's College and private study; Martin Stewart, Queen's College, Birmingham; John Foster Trafford, University College.

Quekett Microscopical Club.—The sixth annual meeting of this club was held on Friday evening, July 28th, at University College. By the annual report of the Committee read, it appears that the number of members now amounts to 550. The President, Dr. L. S. Beale, gave the annual presidential address. At the election of officers which followed, Dr. L. S. Beale was elected President for the year 1871-72; for Vice-Presidents, Dr. Robert Braithwaite, F.R.M.S., F.L.S., Mr. Arthur E. Durham, F.R.C.S., Mr. Charles J. Leaf, F.R.M.S., Mr. Henry Lee, F.Z.S.; for four Members of Committee, Messrs. W. H. Golding, T. Greenish, E. Marks, and F. Oxley; for Treasurer, Mr. Robert Hardwicke, F.L.S.; Hon. Secretary for Foreign Correspondence, Mr. M. C. Cooke, M.A.; Hon. Secretary, Mr. T. Charters White, M.R.C.S. The meeting then terminated in the usual *conversazione*.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 12, 1871.

This number contains the following original papers and memoirs:—

Disulphobenzoic Acid and a New Dioxybenzoic Acid.—L. Barth and C. Senhofer.—Benzoic acid, having been placed along with anhydrous phosphoric acid and strong sulphuric acid, into a sealed tube, and heated to 250°, has yielded disulphobenzoic acid—

$$C_6H_3\left\{\begin{matrix}COOH\\SHO_3\\SHO_3\end{matrix}\right\}+H_2O.$$

This body is very hygroscopic, and retains some water even at 130°. The salts of this acid are crystalline substances. When the potassa salt is fused with excess of caustic potassa, and the fused mass treated, after cooling and acidulating, with ether, the latter takes up a new acid, to which the authors give the name of dioxybenzoic acid. This substance crystallises in prismatic shape, and is characterised by not yielding (as protocatechutic acid, which is isomeric with this new acid, does) a green colouration with chloride of iron, and not being precipitated by acetate of lead. The dioxybenzoic acid fuses at 220°, but is partially decomposed at that temperature; its formula, in the air-dry state, is—

$$C_6H_3\left\{\begin{matrix}COOH\\OH\\OH\end{matrix}\right\}+1\tfrac{1}{2}H_2O.$$

At 105°, this acid loses its water of crystallisation; heated with strong sulphuric acid, it is converted into a red-coloured fluid, which, by the addition of water, yields a green-coloured precipitate. The salts of this dioxybenzoic acid are crystalline substances. On being submitted to dry distillation, this acid does not yield any of the well-known bihydroxyl-benzols. The authors are engaged with further experiments on the nature of the substances formed by the operation alluded to, and also with researches on the nature of the substance produced by the action of sulphuric acid.

Preparation of Protocatechutic Acid from Oxybenzoic Acid, and on the Constitution of the first-named Acid.—L. Barth.—The gist of the contents of this paper is the communication of some experiments made by the author to prove that, notwithstanding the observations of Fittig and others, he duly obtained, from oxybenzoic acid, protocatechutic acid, not due to the presence of any para-oxybenzoic acid among the oxybenzoic acid operated upon. When the position (Stellung) of para-oxybenzoic acid is assumed to be 1—4, and that of oxybenzoic acid 1—3, the position of protocatechutic acid should be 1—3—4.

Bimethyl- and Biethyl-Protocatechutic Acid.—R. Koelle.—Bimethyl-protocatechutic acid is prepared by putting into a tube (to be afterwards sealed) 1 grm. of protocatechutic acid, 4 grms. of iodide of methyl, and 1 grm. of pure caustic potassa dissolved in methyl-alcohol (not methylated spirits of wine). This mixture is heated in the sealed tube for some hours to 140°. The contents of the tube are first filtered, the filtrate next evaporated upon the water-bath, and the oily residue boiled for some time with dilute caustic soda solution. The liquid is next treated with dilute sulphuric acid, so as to acidify the fluid, from which then a flocculent substance—viz., the bimethyl-protocatechutic—is separated. This body, having been purified by means of ether, exhibits a crystalline needle-shaped structure; formula—

$$C_6H_3\left\{\begin{matrix}COOH\\O(CH_3)\\O(CH_3)\end{matrix}\right.$$

point of fusion, 170°—171. By distillation with lime, this substance which exhibits the very characteristic reaction with iron in the same manner as protocatechutic, yields an oily fluid boiling between 210° and 220°, and exhibiting a vanilla-like smell; the formula of this oil is—

$$C_6H_4\left\{\begin{matrix}OCH_3\\OCH_3\end{matrix}\right.$$

Biethyl-protocatechutic acid is a solid substance, exhibiting a crystalline needle-shaped form, contains no water of crystallisation, and fuses at 149°; formula—

$$C_6H_3\left\{\begin{matrix}COOH\\OC_2H_5\\OC_2H_5\end{matrix}\right.$$

This acid yields also, when distilled with lime, a fluid similar to that just alluded to, and the potassa, baryta, and silver salts of both the acids hereinbefore mentioned are crystalline substances.

Contribution to the Theory of Dissociation.—A. Horstmann.—An algebraico-physical essay.

Contribution to our knowledge on the Combination Value (Verbindungswerthe) of the Elements.—C. W. Blomstrand.—Notwithstanding the high scientific value of this essay, it is, in consequence of its length and the large number of formulæ required for the proper understanding of this subject, not well suited for abstraction.

Synthesis of Oxaluric Acid.—L. Henry.—The author states that, by causing ethyl-oxy-oxalyl-chloride—

$$C_2O_2\begin{matrix}Cl\\C_2H_5O\end{matrix}$$

to act upon urea, oxaluric acid is produced according to the following formula:—

$$C_2O_2\left.\begin{matrix}Cl\\C_2H_5O\end{matrix}\right\}+CO\left.\begin{matrix}H_2N\\H_2N\end{matrix}\right\}=$$

$$=\left\{\begin{matrix}CO\text{---}H_2N\\C_2O_2C_2H_5O\end{matrix}\right.\Big\rangle HN+HCl.$$

The result of this reaction is the production of oxalurate of ethyl—

$$\begin{matrix}CO\text{---}H_2N\\C_2O_2\text{---}C_2H_5O\end{matrix}\Big\rangle HN,$$

which is soluble in boiling water, separates therefrom on cooling in crystalline state. This substance is difficultly soluble in alcohol, insoluble in ether, barely soluble in cold, but better in boiling water, and very readily dissolved by acids, alkalies, and ammonia. Heated to between 160° and 170°, this body fuses and becomes decomposed, yielding oxamethan, which volatilises and leaves cyanuric acid. Oxalurate of ethyl is decomposed by boiling along with water, oxaluric acid being probably thereby formed, because, when the oxalurate of ethyl is re-crystallised from boiling water, it leaves a mother-liquor which exhibits an acid reaction.

Experiments made with the view to ascertain the Time Required for the Volatilisation and Re-Condensation of Solid Bodies.—A. Naumann.—The bodies experimented with *in vacuo* were sesquichloride of carbon, C_2Cl_6, which fuses under atmospheric pressure at 160°, and boils at 182°; and naphthaline, $C_{10}H_8$, which, under the same condition, fuses at 79·2° and boils at 218°. The main result arrived at is, that the time required for the volatilisation and re-condensation of the substances operated upon is very short, and hardly longer than the time required to obtain the temperature corresponding to a certain pressure indicated by the height of a column of mercury in millimetres.

Specific Volume of Allyl-Alcohol.—H. L. Buff.—The author first discusses the value of some experiments made by Tollens on the specific gravity of allyl-alcohol, and also bearing upon the labours of Kopp respecting the calculation of the specific volume of fluid compounds. The author next refers to the difficulty of obtaining absolutely anhydrous allyl-alcohol, and lastly communicates that the specific volume of an allyl-alcohol boiling between 96·5 and 96·8 is 74·6.

Preliminary Communication on Bioxybenzoic Acid.—M. Ascher.—Although in the heading this paper is alluded to as a preliminary notice only, the subject is treated of at great length and with a large number of quotations of formulæ. It appears that the author has prepared, by a very circuitous and complex plan, a peculiar dioxybenzoic acid, in small quantity only. The barium salt of this acid has the formula $(C_7H_5O_4)_2Ba$. The acid is designated as the 2,4 bioxybenzoic acid, but it is entirely different from protocatechutic acid, which, according to the author, should be styled 1,3,4.

Constitution of Chrysanissic Acid.—H. Salkowski.—The contents of this paper contain the description of the mode of preparation and properties and formulæ of a series of salts of a dinitro-oxybenzoic acid, which is formed by the action of nitrous acid upon chrysanissic acid. Among the bodies spoken of at length are the mono-ethyl-ether, $C_6H_2(NO_2)_2OHCOO(C_2H_5)$, a diethyl-ether which, by the action of ammonia, is converted into chrysanissic acid, which latter, and also the chrysanissic acid ether, are, by boiling with alkalies, converted into dinitro-oxybenzoic acid, which latter is related to the various isomeric oxybenzoic acids in the same manner as picric acid is to phenol.

Contribution to our Knowledge on the Colouring Matter of Cochineal.—C. Liebermann and W. A. van Dorp.

Phenol Pigments.—A. Baeyer.—This essay and the preceding paper are reserved for full translation.

Manufacture of Ethylen Bases on the Large Scale.—Dr. A. W. Hofmann.—The eminent *savant* first calls attention in this paper to the opportunity afforded, by the preparation of chloral on the large scale, as carried on in and near Berlin by several firms of manufacturing chemists, of obtaining, in large quantity, some of the by-products of this operation. The author describes, next, the preparation, on the large scale, of chlorhydrate of ethylen-diamine—

$$C_2H_{10}N_2Cl_2=(C_2H_4)H_4N_2,2HCl,$$

of which salt about $1\frac{1}{2}$ kilos. were obtained in the shape of large-sized needle-shaped crystals 10 to 15 centimetres in length. It is the intention of the author to return to this subject, and publish a full account of his researches on the bodies which are formed by the action of ammonia upon the chlorides and bromides of ethylen.

Preliminary Communication.—O. Wallach.—This paper treats on the action of chloral upon aniline and toluidine; but as yet the author's researches are not complete, and the only reason why this short paper is published is that for some time to come this work cannot be completed.

Observations on the Allyl Group.—A. Oppenheim.—This memoir is divided into the following chapters:—Action of chlorine upon trichlorallyl; iodallyl-mercury and preparation of diallyl.

Researches on the Platinum Bases.—P. T. Cleve.—This very lengthy essay, however valuable in a scientific point of view, is not well suited for any useful abstraction. It contains the following sections:—On a fourth isomer of the formula $PtAk_2Cl_2$; on the nitrites of the two platinum bases, Pta_2; sulphites of the isomeric bases, Pta_2; product of platosemidiamminchlorid with potassa.

Conversion of the Dichlorhydrine boiling at 174° into that boiling at 182°.—H. Hübner and C. Müller.

On α Sulpho-Toluol.—H. Hübner and N. M. Terry.—These papers, although of great scientific value, require, for the proper elucidation of the subject, a series of formulæ too lengthy and complex to admit of being here conveniently reproduced.

Journal für Praktische Chemie, Nos. 8 and 9 (double number), 1871.

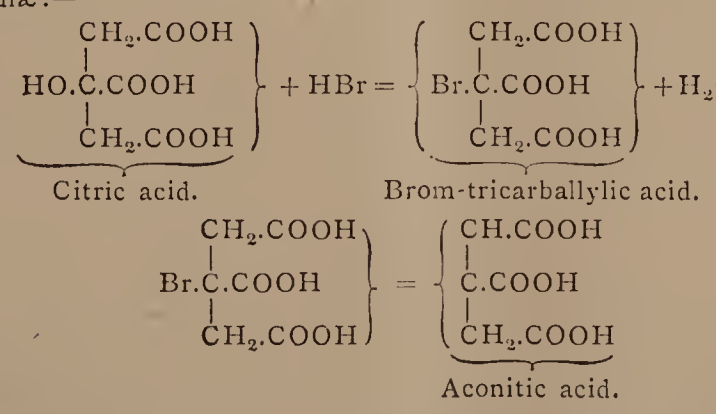
This number contains the following original papers and memoirs:—

Continuation of Monograph on the Periodides of the Alkaloids.—Dr. S. M. Jörgensen.—This portion contains the following sections:—Tetra-ethyl-stibonium-triiodide; triethyl-sulfin-superiodide; tetra-ethyl-ammonium-bismuth-iodide; tetra-ethyl-phosphonium-bismuth-iodide; tetra-ethyl-ammonium-bismuth-bromide; tetra-ethyl-phosphonium-bismuth-bromide; tetra-ethyl-arsonium-bismuth-bromide; tetra-ethyl-stibonium-bismuth-bromide; tetra-ethyl-stibonium-bismuth-iodo-bromide; tetra-ethyl-ammonium-bismuth-chloride; tetra-ethyl-phosphonium-bismuth-chloride; tetra-ethyl-phosphonium-bismuth-iodo-chloride; tetra-ethyl-arsonium-bismuth-chloride; tetra-ethyl-stibonium-bismuth-chloride; tetra-ethyl-stibonium-bismuth-iodo-chloride.

Simple Apparatus to Serve for Washing, as well as simultaneously Absorbing Gas.—Dr. H. Fleck.—Illustrated with a woodcut essentially required for properly understanding the arrangement and mode of working with this contrivance.

Application of a Reflector to Spectrum Analysis.—Dr. H. Fleck.—Illustrated with a woodcut.

Action of Hydrobromic Acid upon Citric Acid.—M. Mercadante.—The author expected to obtain, by causing hydrobromic acid to act upon citric acid, first a bromated acid, $C_6H_7BrO_6$, and from that, by the aid of nascent hydrogen, tricarballylic acid, $C_6H_8O_6$; but, instead of obtaining this result, aconitic acid was formed, which has also been observed to result from the action of hydrochloric acid upon citric acid by Dessaigne. This reaction is due to the elimination of a molecule of water from citric acid, and is elucidated by the following formulæ:—



Normal Valerianic Acid.—A. Lieben and A. Rossi.—This lengthy essay describes the mode of preparation of the acid alluded to from butyl-cyanide, by boiling it with alcoholic potassa solution. The acid in pure state is a fluid; sp. gr. at 0°=0·9577, and at 99·3°=0·9034; boils at 185°; formula, $C_5H_{10}O_2$. The authors describe a series of the salts of this acid, observing that they confirmed, by their researches, the older experiments of Dumas and Stas, anent the acid obtained from the amyl-alcohol of fermentation, that it yields with baryta a syrup-like fluid salt (see *Ann. Chim. Phys.* [2], vol. lxxiii., p. 134).

Continuation of the Researches on the Compounds of Ilmenium and Niobium, and on the Composition of the Niobium Minerals.—R. Hermann.—This exhaustive monograph, to be further continued, is, in spite of its intrinsic scientific value, far too lengthy for any further quotation.

Conversion of Succinic Acid in the corresponding Diatomic Alcohol.—Dr. A. Saytzeff.—This preliminary notice states that the author obtained, by the action of sodium amalgam upon a mixture of chloride, succinyl, and acetic acid in ethereal solution, butyl-glycol, while the thereby simultaneously-produced glycol is probably the homolagon to ethyl-glycol. The full record of these experiments will shortly be made public.

Cobalt Ultramarine, a Contribution to our Knowledge on the Origin of the Colour of Substances.—W. Stein.—The author first refers briefly to his researches on ultramarine (see Chemical News, vol. xxiii., pp. 119, 142, and 204), reminding his readers that a blue colour may result from the intimate mixing of a black and white molecule. Next, this paper contains researches on a sample of cobalt ultramarine, which had been kept for some twenty years in the Museum of the Dresden Polytechnic School. The result of the analysis of that substance led to the following composition, in 100 parts:—Silica, 4·0; alumina, 68·45; cobalt (metal), 20·80; oxygen, 6·75. The composition of the oxide of cobalt present in this ultramarine is $4CoO.Co_2O_3$. The analysis was confirmed by the synthesis of an ultramarine cobalt—viz., by simply igniting the black oxide of cobalt of commerce with alumina.

Ethyl-Diacetic Acid and some of its Derivatives.—A. Geuther.—The first half-page of this paper being only here published, it is reserved for further notice when complete.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, May and June (double number), 1871.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences;—

Cotton Seeds.—Dr. F. Fluckiger.—This lengthy essay contains, in the first place, a succinctly written botanical description of the several kinds of shrubs and trees from which cotton is obtained; next, we meet here with a histological and morphological minute description of the microscopical structure of the cotton seeds, illustrated by coloured lithographs. The latter portion of this essay is devoted to a well-condensed and very complete review of all that has been done in various parts of the world in reference to the scientific, as well as industrial, researches on cotton seeds and the oil it yields. According to the author, the quantity of cotton seed annually gathered amounts to 1,000,000,000 of kilos., which, under the least favourable conditions, would yield 150,000,000 kilos. of oil.

Method of Air Analysis applied to Phuto-Physiological Research.—H. Karsten.—The contents of this paper cannot be rendered intelligible without the reproduction of the woodcuts elucidating the ingenious and complex apparatus here described.

Qualitative and Quantitative Comparison of the Mineral Constituents of a Plant, and of the Constituents of the Soil it has been Cultivated in.—H. Reinsch.—Notwithstanding its intrinsic merits, this lengthy memoir is not well suited for useful abstraction. The author brings forward in this essay, and proves, by experiments made on an extensive scale, some new views concerning the growth and nutrition of plants and their relation to the soil, as well as to the atmosphere.

Poisoning of Bees by means of Yeast.—Dr. R. Mirus.—The main point of interest in this paper is, that a mixture of honey and beer-yeast acts as a poison to bees, in consequence of inducing, when partaken of by these insects, fermentation in the stomach of these animals; the beer-yeast also acts upon bees as a drastic purgative. Neither by microscopical, nor by chemical research, was any other poisonous or deleterious substance found, either in the bodies of the insects or in the mixture above alluded to.

Impurities present in the Reduced Iron, Ferrum Hydrogenio Reductum.—E. Schering.—While this substance has hitherto not been obtained quite free from a more or less large quantity of sulphuret of iron, the author calls attention to the fact—an important one, indeed—that he has met with samples of this medicament which, in addition to the impurity spoken of, also contains oxides and carburets of iron, and even cyanide of potassium, due in all likelihood to the reprehensible practice of preparing the reduced iron from the residues of the preparation of cyanide of potassium from the ferrocyanide of potassium. It is therefore advisable for pharmaceutists to test the ferrum hydrogenio reductum they purchase for the presence of the cyanide alluded to.

La Revue des Scientifique de la France et de l'Etranger, July 8, 1871.

This number does not contain any original papers or memoirs relating to chemistry or allied sciences, but there is an interesting paper on the—

University of Strasburg.—E. Alglave.—Strasburg was once a free city—that is to say, a free and independent republic, just as Hamburg and Bremen are now, and as, during the middle ages, many towns and cities were on the Continent of Europe. As such, Strasburg had a University, which remained in existence until the first Napoleon created what is termed L'Université de France. By the arrangements under which that establishment exists, there was founded at Strasburg a faculty of medicine, of literature, and of sciences, and a school of

pharmacy, and also a faculty of Protestant (Lutheran) theology. This establishment was exceedingly well arranged, and possessed fine collections, libraries, and museums. The Prussian Government intend to establish a very complete university at Strasburg, and, while they have acquired the cession of all the rich *matériel* already in that city, intend to endow Strasburg University with £32,000 a year. The French Government is arranging to re-establish at Nancy (now a frontier town) the University of which Strasburg was the see, while Lyons also is mentioned for a similar purpose. It is a happy feature to learn from this and other scientific periodicals that the French nation is becoming alive to the high importance of general sound education, and of largely-extended scientific instruction.

Revue Universelle des Mines, de la Métallurgie, des Travaux Publics des Sciences et des Arts Appliqués à l'Industrie (double number), for the first four months of 1871.

This number contains the following original papers and essays relating to chemistry and collateral sciences:—

Mercury Mines of Almaden, Spain.—José de Monastério y Corréa.—This esssy, illustrated with a series of engravings, has been written by the author, Inspector General of Mines to the Spanish Government, while sojourning lately at Liège, Belgium, at the request of the editor of this periodical. This valuable memoir, too lengthy for any useful abstraction, contains the following sections:—History of the Almaden mines; situation; geology; veins and seams of ore; mode of working the mines, and extraction of the ore; pumping engines and other machinery required for keeping the workings free from water; ventilation; shifts of workmen; hygienic condition of the workmen.

Note on the Discovery of Four New Seams of Coal at the Collieries of the Grand-Hornu (near Mons, Belgium).—H. Glépin.—Illustrated with maps and engravings.

Influence which the Cession of Alsace and Lorraine to Germany will have on Metallurgical Industry.—Ch. de Cuyper.—From this paper it would seem that, not only in a strategic, but also in an industrial and metallurgical way, Germany has got the mastery to such an extent, that even the United Kingdom will be, at no distant day, very seriously affected by recent events in its metallurgical industry and commercial interests.

Les Mondes, July 13, 1871.

This number contains the following original matter relating to chemistry and collateral sciences:—

Record of the Observations on Meteorites seen in Italy during the Months of March and April of the Current Year.—Rev. Father Denza, S.J.—An important contribution to our knowledge of the phenomena vulgarly known as falling stars, minutely described as observed by Italian astronomers.

Brief Biography of the late Ramon de la Sagra.—Dr. Sacc.—To most of our readers the name of Ramon de la Sagra will be familiar, in more than one sense. The illustrious *savant* was born at Corunna in 1811, and studied, first, medicine, at Bilbao, afterwards exact sciences, at Madrid. He embarked, while yet a young man, in an industrial enterprise, which unfortunately proved a failure, and in consequence of which he left Spain for Cuba, where, for a period of seventeen years, he was director of the botanic gardens near Havana; while engaged in this capacity, the deceased edited his magnificent "Fauna of Cuba" (12 folio volumes, published by J. B. Ballière, Paris). Later in life, De la Sagra returned to Spain; but it appears that, from some cause or other, he has been compelled to leave that country; and he died on the 25th of May last, at Cortaillad, in Switzerland. The deceased was well known, also, for the great interest he took in the improvement of the general education of his countrymen. In politics he was an ardent but moderate liberal.

New Spectroscopic Process.—Rev. A. Secchi, S.J.—The eminent *savant* describes, in this lengthy paper, an optical apparatus, by the aid of which he has been enabled to see, in the field of the spectroscope, the spectrum of the protuberances and the disc of the sun, so that he could readily distinguish the spots and other particulars as easily as if seen with coloured glasses.

Description of a Self-Acting Gas Apparatus not requiring a Gasholder and not Liable to Explosion.—MM. Moussard and Kreiger.—This description is accompanied by a woodcut essentially required for the proper understanding of the working of this apparatus, which is obtainable from F. Rouillé, 8, Boulevard Bonne-Nouvelle, Paris, at a comparatively low price; while, according to the testimony of the Abbé Moigno, who has witnessed the experiments, the light of the gas produced (really a mixture of air with vapours of very volatile hydrocarbons) is very rich and pure, and cheap—exclusive of the duty now imposed in France on the liquids just alluded to—only 15 centimes (about 1½d. per cubic metre) = 35·316 English cubic feet.

NOTES AND QUERIES.

Cement to Resist Nitric Acid.—(Reply to T. Kenyon.)—You are referred to Chemical News, vol. xix., p. 287; vol. xx., p. 23; and vol. xxii., p. 48.

Distillation of Wood.—Will you kindly tell me whether there is a work on the manufactures arising from the destructive distillation of wood, and where it is to be obtained?—J. H. Mayor.

Carbolic Acid.—Will your correspondent, Dr. Ballard, who inserted some time ago a communication in your journal on the above subject, inform me where it can be obtained (for disinfection), without the unpleasant odour usually attaching to it.—Carbolic.

Anthracene.—(Reply to Henry Dorsett.)—In addition to what is published (see Chemical News, vol. xxiii., pp. 143 and 156), you will find a very good account of the best and most practical methods of preparing anthracene in Dr. Elsner's "Chemisch-Technischen Mittheilungen" for 1869-70, pp. 13 and 14; but this paper is too lengthy for quotation here, and does not admit of being condensed. You may inspect this book at the Library of the Commissioners of Patents.

Skein Silk.—We English dyers have to contend very much against foreign dyed silk weighted with gambia to 323 to the pound. The gambia is forced on the silk with crystals of muriate of tin. Now comes our difficulty: after getting on the weight, how to kill the tin, so as to follow with the logwood to make a black,—we resort to boiling-hot soap-lather; the danger is in making the silk tender. Can you or any of your readers give me a more rapid and safer mode of killing the tin, without danger to the silk; you must understand it is in the skein, not manufactured.—C. R. Stevens.

[We think that experimenting is the only means of determining the best mode of killing the tin. The dyeing of silk, especially black, is a delicate matter, and the fibre itself is not such as will stand much *chemicking*, as it is termed.—Ed. *C. N.*]

TO CORRESPONDENTS.

G. F. Ansell.—Received with thanks.

C. E. Craven.—(1). Messrs. Trübner and Co. have just published "A Practical Treatise on the Manufacture of Soaps," by Campbell Morfit, M.D., &c.; it will shortly be reviewed in our pages. (2). The work is in the press.

C. J. Watson.—This correspondent informs us, respecting an extract on "The Phenomena of Vibration" from the *Scientific American* in our issue of July 21st, that the flame examined was a singing flame which required a tube to cause it to sing. The paragraph mentioned the flame of a gas light, in a glass tube to prevent disturbance by air currents.

A Subscriber.—To become a Fellow of the Chemical Society it is necessary that your application be signed by three Fellows who know you personally, and also by two Fellows on general knowledge; fellows are elected by ballot. The Secretary, Burlington House, will supply you with the necessary forms of application, &c.

J. M. Merrick.—We shall be glad to receive the articles.

S. A. Sadler.—Consult the *Transactions of the Royal Agricultural Society*, or article on "Artificial Manures" in Ure's "Dictionary of Arts and Sciences."

A. F. Hargreaves.—We do not know; an advertisement would probably lead to your obtaining the information.

J. Draper.—Address to Messrs. Von Baerl and Co., Worms, Hesse Darmstadt, Germany.

Chemical Technology, or Chemistry in its Applications to the Arts and Manufactures. By Thomas Richardson and Henry Watts. Second Edition, illustrated with numerous Wood Engravings.

Vol. I., Parts 1 and 2, price 36s., with more than 400 Illustrations.

Nature and Properties of Fuel: Secondary Products obtained from Fuel: Production of Light: Secondary Products of the Gas Manufacture.

Vol. I., Part 3, price 33s., with more than 300 Illustrations.

Sulphur and its Compounds: Acidimetry: Chlorine and its Bleaching Compounds: Soda, Potash: Alkalimetry: Grease.

Vol. I., Part 4, price 21s., 300 Illustrations.

Aluminium and Sodium: Stannates, Tungstates, Chromates, and Silicates of Potash and Soda: Phosphorus, Borax: Nitre: Gun-Powder: Gun Cotton.

Vol. I., Part 5, price 36s.

Prussiate of Potash: Oxalic, Tartaric, and Citric Acids, and Appendices containing the latest information and specifications relating to the materials described in Parts 3 and 4.

Bailliere and Co., 20, King William Street, Strand.

PRACTICAL CHEMISTRY.

Laboratory, 60, Gower Street, Bedford Square, W.C.

Mr. Henry Matthews, F.C.S., is prepared to give Instruction in all branches of PRACTICAL CHEMISTRY, particularly in its application to MEDICINE AGRICULTURE, and COMMERCE.

The Laboratory is open daily, except Saturday, from ten to five o'clock; on Saturday, from ten till one o'clock.

Mr. Matthews is also prepared to undertake ANALYSES of every description.

For Particulars and Prospectuses, apply to Mr. Henry Matthews, the Laboratory, 60, Gower Street, Bedford Square, W.C.

Methylated Spirits.—David Smith Kidd, Licensed Maker, Commercial Street, Shoreditch, N.E. Also FINISH, FUSEL OIL, and RECT. NAPHTHA.

THE CHEMICAL NEWS.

Vol. XXIV. No. 612.

THE DICHROISM OF THE VAPOUR OF IODINE.*

By Dr. ANDREWS, F.R.S.

The fine purple colour of the vapour of iodine arises from its transmitting freely the red and blue rays of the spectrum, while it absorbs nearly the whole of the green rays. The transmitted light passes freely through a red copper or a blue cobalt glass. But if the iodine vapour be sufficiently dense, the whole of the red rays are absorbed, and the transmitted rays are of a pure blue colour. They are now freely transmitted as before by the cobalt glass, but will not pass through the red glass. A solution of iodine in sulphide of carbon exhibits a similar dichroism, and according to its density appears either purple or blue when white light is transmitted through it. The alcoholic solution, on the contrary, is of a red colour, and does not exhibit any dichroism.

THE ACTION OF HEAT ON BROMINE.*

By Dr. ANDREWS, F.R.S.

If a fine tube is filled one-half with liquid bromine and one-half with the vapour of bromine, and after being hermetically sealed is gradually heated till the temperature is above the critical point, the whole of the bromine becomes quite opaque, and the tube has the aspect of being filled with a dark red and opaque resin. A measure of the change of power of transmitting light in this case may be obtained by varying the proportion of liquid and vapour in the tube. Even liquid bromine transmits much less light when heated strongly in an hermetically-sealed tube than its ordinary state.

ON SORBIT.†

By PROFESSOR DELFFS.

Twenty years ago M. Pelouze (*Ann. de Chim. et de Phys.* 3 ser., vol. xxxv., p. 222) discovered a crystalline substance in the fruits of *Sorbus aucuparia*, which he called *sorbin*. Since that time very few chemists have paid attention to this matter, and, as far as I know, nobody in my country succeeded in preparing it again. The principal of one of our greatest manufactories of chemical preparations, to whom I addressed myself, told me that he never found the least trace of the said substance, although he had worked up large quantities of the above-mentioned fruits for preparing malic acid, and to the same result came M. Byschl (*Buchner's N. Repert. der Pharm.*, vol. iii., p. 4), who asserts that there is no ready formed sorbin in the ripe berries of *Sorbus aucuparia*. In my two first attempts of getting sorbin I failed also, but in the last year I succeeded, and at the same time I became aware of the reason of my first failures. When I first tried to get sorbin, I thought it profitable to combine the preparation of malic acid with the prescription given by M. Pelouze for getting sorbin, and, therefore, I separated the former by means of acetate of lead, before I followed the same way as M. Pelouze. This is the reason, I think, which has prevented the success of myself as well as of other chemists, in the preparation of sorbin.

As I will not trouble you by repeating a method to be found in all manuals of chemistry, it is sufficient to say, that when I kept strictly to the prescription of M. Pelouze, I got a large quantity of beautiful crystals, a specimen of which is contained in this tube. After I had got these I tried to obtain the malic acid from the residue, but I found that the malic acid had quite disappeared. To this, I must add, that the alcoholic fermentation, which takes place after the juice of the berries of *Sorbus aucuparia* has been left a few days in a tepid place, is easier perceived by the formation of carbonic acid than by the smell of spirit of wine. I think it, therefore, not improbable, that there is a connection between the disappearance of the malic acid and the small produce of spirit of wine on the one side, and the formation of sorbin on the other. Suppose the malic acid—commonly called *bibasic*, and, therefore, apt to form a bimalate of ethyl ($=C_4H_5O+2C_4H_2O_4+HO$)—assimilates two equivalents of water to this compound, you will have then the equation $C_4H_5O+2C_4H_2O_4+3HO=C_{12}H_{12}O_{12}$, the latter formula of which gives the composition of sorbin.

As what belongs to the preparation of sorbin I have only to add, that the dark sticky lye in which the crystals are formed, can very easily be separated by putting both on a brick. After a few days' repose, the brick has absorbed nearly all the lye, and the pale yellow coloured crystals of sorbin, if dissolved in water and left to spontaneous evaporation, become very soon colourless.

The sorbin belongs to the same group as the mannit, quercit, inosit, dulcit, pinit, &c., and, as the last syllable is always characteristic in organic chemistry, its name I think, should be changed into sorbit.

Further experiments are required to prove, if the supposed genesis of sorbin is true or not, but, in any case, I am convinced, that there is no sorbin *ready formed* in the fruits of *Sorbus aucuparia*.

IMPROVEMENTS IN CHLORIMETRY.

By JOHN SMYTH, jun., A.M., M.I.C.E.I., F.M.S.

The author showed that the use of the milky solution of bleaching powder in chlorimetry is unsatisfactory, and hence was glad to discover a method of securing a clear solution containing all the chlorine. by dissolving it in an alkaline solution. This is conveniently done by adding say 10 grms. of bleaching powder to 20 grms. of soda crystals ($NaOC_2+10HO$), filtering out the precipitated carbonate of lime, which is known to be washed when it no longer discharges the colour of dilute sulphate of indigo, and making up the filtrate by water to 1 litre of fluid. It is a clear, colourless liquid, of the sp. gr. of 1·007; but, if made of sp. gr. 1·233, slightly greenish, having a pleasant oily feeling between the fingers, contrasting favourably with the roughness of the decanted solution of the bleaching powder, with which it gives a precipitate. Most satisfactory results are obtained from it by all the chlorimetrical methods, and it has the additional advantage of showing the amount of lime in the sample, by adding a solution of known strength of carbonate of soda until a precipitate is no longer formed. It is manufactured and used in the north of Ireland for bleaching fine linens; and from the ease and accuracy with which its percentage of chlorine was obtained, the author was led to investigate the feasibility of converting bleaching powder into it for chlorimetrical purposes, and obtained the above results.

* Abstract of a Paper read before the British Association, Edinburgh Meeting, Section B.

† Read before the British Association, Edinburgh Meeting, Section B.

* Abstract of a Paper read before the British Association, Edinburgh Meeting, Section B.

ON THE

CORROSION OF COPPER PLATES BY NITRATE OF SILVER.*

By J. H. GLADSTONE, F.R.S., and ALFRED TRIBE, F.C.S.

In some recent experiments in chemical dynamics, the authors had occasion to study the action of nitrate of silver on copper plates in various positions. They observed that, when the plate was vertical, there was rather more corrosion at the bottom than at the top. This is easily accounted for by the upward current, which flows along the surface of the deposited crystals, and which necessitates a movement of the nitrate of silver solution towards the copper plate, especially impinging on the lower part. It was also found that, when the copper plate was varnished on one side, it produced rather more than half the previous decomposition, and was most corroded at the edges of the varnish. By making patterns with the varnish, this edge action became very evident. This was explained by the fact that the long crystals of silver growing out from the copper at the borders can spread their branches into the open space at the side, and so draw their supply from a larger mass of solution than the crystals in the middle can do; and increased crystallisation of silver means increased solution of copper. This was proved by making the varnish a perpendicular wall instead of a thin layer, when the greater corrosion was not obtained. In a plate completely surrounded with liquid, the greatest growth of crystals is also evidently from the angles. It was likewise observed that, if a vertical plate be immersed, the lower part in nitrate of copper, and the upper part in nitrate of silver, there is greater corrosion about the point of junction; this was attributed to the greater conduction of the stronger liquid.

THE ESTIMATION OF SULPHUR IN COAL AND COKE.*

By F. CRACE CALVERT, F.R.S.

Having for many years observed the analyses of the amounts of sulphur existing in coals and coke as published in various works, I have come to the conclusion that the difference observed in the amounts of sulphur found in the same coal by different chemists is not due so much to a difference in accuracy or wide differences of samples as to the various methods adopted to determine the weight of the sulphur. Without entering into the merits of the various processes which have been proposed to effect this object, I only wish in this paper to point out sources of error attending the method which, I believe, to be most usually adopted, which consists in adding to an oxidising *aqua regia* a known weight of very finely powdered coal or coke, leaving it to be digested at a moderate temperature until the whole of the sulphur is supposed to be converted into sulphuric acid, then driving away the great excess of acid, boiling with water, filtering, washing the carbonaceous residue on the filter, and determining the amount of sulphuric acid in the filtrate.

In operating in this manner, there are three serious sources of error. The first is that the sulphate of lime, which many coals contain in considerable proportion, may mislead the analyst, owing to its solubility in water being much increased by the presence of free acid. The figures usually obtained include the sulphur combined with the calcium as well as that existing as pyrites in coal, or sulphuret of iron in coke. It is, however, most important, in a metallurgical point of view, to give the figures separately, for the sulphur combined with the calcium as sulphate of lime will not leave its strong base to deteriorate the quality of the iron, either in the blast furnace or in any of the subsequent processes of manufacture, whilst the pyrites, although losing part of its sulphur as sulphurous acid, mixes as monosulphuret with the iron, and seriously lowers its commercial value.

It appeared to me, therefore, important to devise a method by which the amounts of sulphur, combined with calcium and iron, respectively, could be determined, and the following process I found to be successful. The finely pulverised coal or coke is boiled for about twenty hours with water containing an equal weight of coal or coke taken. By this means the sulphate of lime or sulphuret of calcium is decomposed, whilst the sulphuret of iron remains unattacked. The residue is then filtered and rapidly washed with boiling water. If a coke has been taken, nitric acid in slight excess must be added to the filtrate to convert the sulphuret of sodium into sulphate, and the sulphuric acid determined in the usual manner. The sulphur found in the residue will then represent the amount present in the coal or coke as pyrites or sulphuret of iron.

The value of a coal or coke for use in the iron manufacture may easily be seriously miscalculated if this difference be not taken into consideration, as may be seen from the subjoined table, which gives the figures found in six samples sent to my laboratory for analysis. It will be seen that by the usual process the coals would be condemned as unfit for use in the manufacture of iron, while, in fact, they are well adapted for that purpose.

	Old process.		New process.		In washings.		Difference between processes.
	Sulphur, per cent.	Mean.	Sulphur, per cent.	Mean.	Sulphur, per cent.	Mean.	
1.	1·36 1·40	1·38	0·60 0·58	0·59	0·79 0·78	0·79	0·79
2.	1·59 1·55	1·57	0·63 0·67	0·65	0·97 0·95	0·96	0·92
3.	1·78 1·73	1·75	0·89 0·85	0·87	0·85 0·88	0·87	0·88
4.	1·37 1·38	1·38	0·50 0·53	0·52	0·98 1·00	0·99	0·86
5.	1·41 1·42	1·42	0·54 0·56	0·55	0·91 0·94	0·93	0·87
6.	1·58 1·60	1·59	0·68 0·70	0·69	0·97 0·99	0·98	0·90

The second objection to the method of analysis above given is that if the evaporation of the aqua regia be carried too far a subsulphate of iron is sometimes formed, which no amount of boiling with water will remove from the carbonaceous mass, and the chemist may thus obtain too small a quantity of sulphur in the coal or coke under examination.

The third objection is that in an acid liquor, especially if any nitric acid be present, the amount of sulphur found will always be much below the actual quantity present, owing to the fact that the formation of sulphate of baryta is, in some measure, prevented by the presence of the acid, the proportion, of course, varying with the concentration of the acid. Thus I showed some years since that the non-formation of sulphate of baryta could reach the large proportion of 14 grs. of sulphate of baryta in 1000 grs. of nitric acid, of sp. gr. 1·21, an amount greatly exceeding that produced from the sulphur usually found in 100 grs. of coal or coke.*

As the amount of nitric acid left in the liquor is unknown, the extent to which the formation of sulphate of baryta has been prevented is also unknown, and, consequently, the figures obtained cannot be relied upon.

I cannot impress too much upon young analysts the importance of paying attention to the fact that the formation

* Abstract of a Paper read before the British Association, Edinburgh Meeting, Section A.

* Read before the British Association, Edinburgh Meeting, Section B.

* "On the Solubility of Sulphate of Baryta in Acid Solutions,' *Memoirs of the Manchester Literary and Philosophical Society*, vol. xiv. 1856.

of sulphate of baryta is prevented by, and is in ratio to, the excess of nitric acid existing in the fluid, and the common belief, that leaving the liquor to stand twenty-four hours, overcomes the objection, is only approximately true, as only a part of the sulphuric acid is precipitated, while part remains in solution.

To avoid these two latter objections, I always, after concentrating the acid liquor, add carbonate of soda in excess and heat to near the fusing-point. By this means the iron, silica, and alumina, are rendered insoluble; the mass is then treated with water, washed well, and the filtrate made slightly acid with acetic acid. The sulphate of baryta is thrown down from this liquor immediately and completely.

If the dry oxidising process is followed, that is, the addition of the finely pulverised coal or coke to a fused mixture of carbonate of potash and of chlorate or nitrate of potash, then two of the above objections are removed, viz., the non-formation of sulphate of baryta in an acid liquid or the production of a basic sulphate of sesquioxide of iron, but there still remains the objection of the determination of the sulphuric acid of the sulphate of lime, together with that of the pyrites; and, further, I have never obtained a satisfactory determination of sulphur in an organic product or in coal when I have employed this method. There has always been a loss of sulphur.

PRELIMINARY NOTE ON OXY-CANNABIN.

By T. BOLAS and E. E. H. FRANCIS.

We have ascertained that oxy-cannabin contains nitrogen, which was overlooked in our original examination (*Journ. Chem. Soc.*, xxii., 417). Subjoined are the analytical results obtained with a carefully purified specimen.

III. 0·4663 grm. sub. gave 1·0184 grms. CO_2 and 0·2100 H_2O.
IV. 0·3951 grm. sub. gave 0·8711 grm. CO_2 and 0·1851 H_2O.
V. 0·2007 grm. sub. gave 10·81 c.c. N (cor.).
VI. 0·2188 grms. sub. gave 11·63 c.c. N (cor.).

	Theory.		Found.				
			III.	IV.	V.	VI.	Mean.
C_{20} ..	240	60	59·56	60·13	—	—	59·85
H_{20} ..	20	5	5·00	5·21	—	—	5·10
N_2 ..	28	7	—	—	6·76	6·67	6·72
O_7 ..	112	28	—	—	—	—	—
		100					

This substance is still under investigation.

OBSERVATIONS ON THE COLOUR OF FLUORESCENT SOLUTIONS.

By HENRY MORTON, Ph.D.,
President of the Stevens Institute of Technology.

As the result of a series of experiments to be presently described, I have come to the curious conclusion that all the familiar fluorescent solutions, such as the tincture of turmeric, of agaric, of chlorophyl, and the solution of nitrate of uranium, emit light of the same colour by fluorescence—viz., blue, identical with that developed by acid salts of quinine. This blue, however, in all cases, that of quinine included, being, not of a single tint or refrangibility, but yielding a continuous spectrum in which the more refrangible rays predominate.

My attention was first drawn to the subject by observing that a specimen of mixed asphalt, which is here largely used in the preparation of pavements, yielded a light yellow solution with alcohol which fluoresced blue, and an orange solution with turpentine which fluoresced green. It at once occurred to me that the green colour was simply due to the absorptive action of the coloured solution, and not to the development of green rays.

Examined with the spectroscope, the seemingly green fluorescence showed no increase in the green or yellow part of the spectrum, as compared with the blue fluorescence, but only an absorption of the red and violet ends.

When, however, a piece of fluorescing canary-glass or solid nitrate of uranium was examined, the green light was, as is well known, of course, largely augmented.

I also found that when, by filtration through animal charcoal, the solution in turpentine was reduced in colour, the green tint of the fluorescence disappeared in a corresponding degree.

This alone would, however, have proved nothing, as a green-fluorescing matter might have been absorbed by the charcoal, but in connection with the spectroscopic result it was of interest.

I next took up for examination the tincture of turmeric. This is set down in standard works, such as those of Du Moncel, as fluorescing red.

This solution, when concentrated, has a rich orange-red colour, and the jacket of a Geissler tube being filled with it all the light reaching the eye from the electric discharge within is of a deep orange or red colour. If, however, the solution is simply diluted until its colour is reduced to a rich yellow, the fluorescence appears green. The same result follows from filtration through bone-black, with a marked increase in the amount of fluorescence visible as compared with the red solution.

By continuing the decolouration until the liquid is of a very light tint, its fluorescence is distinctly blue.

The results with the spectroscope, when it was applied in this case, were the same as with the solution of asphalt. Such, also, is the case with tinctures of chlorophyl, which, when fresh and green gives a green light, and when old and brown a grey colour.

Finally, I took up the nitrate of uranium, about which such contradictory statements have been published. This salt, in its solid state, gives a brilliant green fluorescence, whose spectrum is figured by Becquerel, and abounds in green rays; but in solution it gives a very feeble fluorescence, far inferior to that of turmeric, and of no more green tint than would be due to its yellow colour.

So, in fact, says also the spectroscope.

From these results, it would seem that the molecules of fluorescent bodies in solution are not capable of restricting their vibrations to limited rates, but move at rates corresponding with all refrangibilities, having simply an excess of the higher ones; though the same substances in the solid state may act quite differently, as in the case of nitrate of uranium, and possibly the fluorescent material in the asphalt, which may be related to the solid hydrocarbon fluorescing green which Becquerel mentions.—"La Lumiere," vol. i., p. 382.

In this general connection, let me mention that I have observed that, while the acid salts of quinia generally are fluorescent, the chloride is not, and that hydrochloric acid will decompose the acid sulphate, so as to destroy its fluorescence. There are several other points in connection with this and the foregoing subject which I must leave for a subsequent discussion.

ON THE USE OF POROUS CONES IN FILTRATION.

By CHARLES E. MUNROE.

The sulphides of arsenic and antimony being quite easily obtained have long been regarded as furnishing the readiest and best means for the estimation of these two elements. A serious objection has, however, arisen in the fact that they must be determined upon weighed

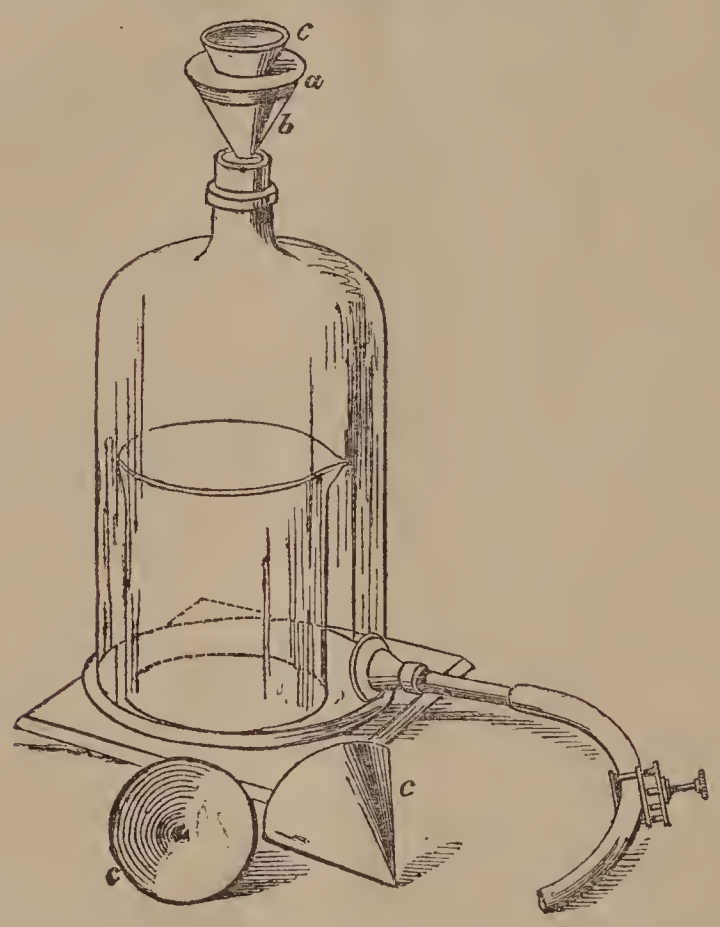
filters, and that paper filters cannot be dried above 100° without danger of loss. Hence, a filter which could be weighed easily and withstand a high temperature became a desideratum.

Taylor* accomplished this with sand filters, and obtained some excellent results. This method, however, requires experienced and careful manipulation, reasons which will probably prevent its being generally used.

Under these circumstances the idea of using a cone made of very porous earthenware, and as a substitute for the paper filter, presented itself to me, and has been carried out in the following manner:—

The cones† are made of very light, porous earthenware, and have an angle of about 60°. They are used in the following way:—

A section of a seamless rubber tube, *a*, is stretched around the mouth of a funnel, *b*, preferably a Bunsen funnel, allowing a portion of the tube to project above the top. This part will immediately arrange itself at right angles to the top of the funnel; into the circle thus formed the



cone, *c*, is put. It is then connected with the Bunsen pump. When the cone is moistened and the pressure applied, the rubber band forms an air-tight joint, and the liquid runs through with great rapidity. Before the cones are applied to quantitative work they must be carefully washed, first with concentrated chlorhydric acid, then with distilled water, dried, and weighed. A small porcelain crucible was always kept at the balance in which to weigh them. With this apparatus the following results have been obtained.

A sample of ordinary crystallised potassio-antimonylic tartrate gave—

	Grms.		Grms.		
(1).	1·1069	gave	0·5570	Sb_2S_3 = 35·94	per cent Sb.
(2).	1·6985	,,	0·8550	,, = 35·96	,, ,,

Mean 35·95.‡

A specimen of the same salt, carefully re-crystallised, gave upon analysis the following data.

	Grms.		Grms.		
(1).	0·7755	gave	0·3955	Sb_2S_3 = 36·40	per cent Sb.
(2).	0·6050	,,	0·3085	,, = 36·42	,, ,,

Mean 36·41.

Mr. W. Lincoln also made an analysis of the same salt by means of the cones, and kindly permits me to use his results.

	Grms.		Grms.		
(1).	0·4683	gave	0·2388	Sb_2S_3 = 36·41	per cent Sb.
(2).	0·8135	,,	0·4144	,, = 36·38	,, ,,

Mean 36·40.

In all of these analyses Sb = 120.

The Sb_2S_3 was precipitated in the manner recommended by Sharples.* It is necessary that the boiling should proceed for some time, a brisk current of sulphydric acid being passed through the liquid. The precipitate is then filtered upon the weighed cone, and the whole dried in an air-bath at 300°. The antimonous sulphide is at this temperature converted into the gray crystalline modification.

No formula has yet been found which agrees with either of the percentages obtained. As the atomic weight of antimony is differently stated from 120 to 122, this is easily explained.

It is unfortunate that the atomic weight of antimony is yet so uncertain, but it is hoped that these results, agreeing so closely among themselves, will be accepted as proving the value of the process.

Arsenious Oxide.—This was the next substance analysed. The sulphide was precipitated in the usual manner, but it was noticed that by having the solution decidedly acid and passing through it a very rapid stream of sulphydric acid, that the sulphide was obtained in a more granular condition.

The precipitate can be dried with impunity at 120°. At 140° the lemon-yellow sulphide commences to change to red, and at 180° is completely converted into the liver-red variety.

With ordinary commercial arsenious oxide, the following results were obtained.

	Grms.		Grms.		Found per cents.	Theory per cents.	
(1).	1·7940	gave	2·2260	As_2S_3 =	75·64	75·76	As.
(2).	0·5770	,,	0·7165	,, =	75·84	,,	,,
(3).	0·8520	,,	1·0579	,, =	75·68	,,	,,

Mean 75·72

Mr. Lincoln obtained as the result of two analyses:—

	Grms.		Grms.		Found per cents.	Theory per cents.	
(1).	0·8926	gave	1·1087	As_2S_3 =	75·76	75·76	As.
(2).	0·8145	,,	1·0128	,, =	75·77	,,	,,

Mean 75·76

These results show that this process renders the estimation of antimony and arsenic one of the simplest and most accurate operations in quantitative analysis.

The cones can be used repeatedly and can replace paper filters in every case. They will, undoubtedly, be found to be of great value in commercial work, for drying crystals and filtering corrosive liquids. As they will stand sudden changes of temperature without breaking, they can be substituted to advantage in many cases for crucibles.

In closing, I desire to return my sincere thanks to my kind teacher, Dr. Gibbs, who has furnished me with the material for these investigations, and has aided me by his counsels and advice.—*American Journal of Science.*

* *American Journal of Science*, II., vol. xliv., p. 215.

† Much credit is due to the firm of A. W. and H. C. Robertson, of Chelsea, Mass., who, by their superior mechanical skill, have aided me much in accomplishing the desired result.

‡ Taylor obtained as the mean of three analyses 36·08.

* *American Journal of Science*, II., vol. i., p. 248.

† From the Anniversary Address delivered to the Royal Society of New South Wales.

ON THE ORIGIN OF THE DIAMOND.†

By the Rev. W. B. CLARKE, M.A., F.G.S.

(Concluded from p. 66).

Diamonds in Russia.

Russia is a country in which diamonds are also found, but sparingly, as near Bissersk and Chrestovodsvingensk in the Ural chain; the detritus in which they occur being made up of angular fragments of chloritic, talcose, and

quartzose rocks. The former of these places was mentioned in 1831 in the "*Gornoï*" *Journal of Petersburg*; and in 1839 Baron von Meyendorf stated to the Geological Society of France that diamonds had been discovered in two different localities, and that they had been found in a microscopic form in native iridium which had been brought to Paris. (*Bull.*, ii., 314).

The first Ural diamond was found at Bissersk in 1829 after Humboldt's visit to Count Polier; three others were found afterwards in that year. In 1830 other three were found. M. Karpoff, a mining officer, shortly after was deputed to carry on the search, and four were discovered, which are described as colourless, diaphonous, smooth, and very bright, with 42 triangular facets. One was broken in two.

Thirty-seven others were taken, the last in July, 1833, from the Adolphskoi Mine, and were used by the Countess Polier in decoration of her church images. One weighed $\frac{3}{4}$ of a carat. Their forms showed from twelve to forty-two curved facets, smooth and sparkling. In 1831, however, a few were found in the gold land of M. Medjer near Ekatherinburg. One was given to the Institute of Mines by his son after the father's death. It was a rhomboidal dodecahedron with rounded edges and translucent, weighing $\frac{5}{8}$ of a carat. (*Bull. Geol. Soc. de France*, vol. iv., p. 100, 1833). The information here given was received from Count de Cancrine, Russian Minister of Finance.

Sir Roderick Murchison, in 1841, saw forty diamonds from the Adolphskoi rivulet; but as the gold found with them did not pay, no further search was made for diamonds. Three other localities have also been named (*Geol. of Russia and the Ural*, 1845, p. 641), in two of which one diamond and in the third two diamonds were found.

Sir Roderick considers that the itacolumite of Brazil occurs in various parts of the Ural, where it was detected by Colonel Helmersen, and adds, what seems to bear upon certain conjectures previously mentioned. He says:—"We may add that as carbonaceous grits of the Devonian and carboniferous periods exist, it is very easy to conceive how these masses, like other sediments to which we have previously alluded, have been transmuted into the quartzose micaceous schists which occur in the chain, and how the diamonds have been derived from them and deposited in the auriferous gravel."

Finally, I may remark that osm-iridium found on the Cudgegong occurs in three places near the Ural, as well as in South America and in Canada, in gold diggings with which diamonds are, as we have seen, generally associated. Moreover, cinnabar found on the Cudgegong is also associated with the diamond detritus of Brazil; and as the mode of its occurrence is precisely that in which it presents itself in the Gilbert gold-field of North Queensland (as I learn from Mr. Daintree), and also in that most wonderful gold-field on the River Thames in New Zealand (as Dr. Hector has stated), as well as in Otago, *i.e.*, *not in lodes* but as a member of *drift deposits*, there is a sort of union between these and other regions in which the diamond is found. Drift or alluvial cinnabar is not less remarkable than drift diamonds; and I believe at present no lode has been detected.

In California cinnabar is said to be brought up by *solfatara* action. (Phillips in *Phil. Mag.*, Dec., 1868, p. 431). It may, therefore, be that the Cudgegong mineral is due to the action of former hot springs. The account given by Mr. A. Phillips respecting the "Chemical Geology of the Gold Fields of California" in the paper cited above, justifies the further inference that silicated waters may also have operated in coating and cementing pebbles and fragments of rocks at Cudgegong as they have done in California. He even shows that quartz veins holding gold and coloured by pyrites, as well as auriferous pyrites itself, have been formed in recent times by the action of aqueous solutions.

Diamonds in Borneo and Africa.

In the *southern* ravines of the Rotos Borneo chain, which is composed of serpentine, diorite, and gabbro, which run north and south, there is a deposit of red clay with fragments of quartz, in which spangles of gold, magnetic iron, platinum, and also *osmium* and *iridium* are met with, the whole reposing on serpentine. In this clay, on the *western* slopes, diamonds are found over fragments of sienite and diorite, and with the ores above named. Black quartz with pyrites and plates of platinum are *there* the indications of diamond, and, according to M. Louis Horner, this quartz belongs to the Serpentine. (See *d'Archiac*, vol. ii., p. 333).

So varied, yet, to some extent, so consistent with each other, are facts connected with the history of the diamond. That its mode of production in all countries may have been the same is very probable; but that origin, it must be said, obtains little illustration from the various geological conditions with which it is associated. Perhaps this very variety, whilst setting dogmatism at defiance, may serve as encouragement to the close observation of practical prospectors.

Of African diamonds we have only heard much of late. Knowing that they are generally found with gold, and that Africa contains numerous auriferous regions, it might have been anticipated that diamonds would have had a greater celebrity in that vast country, forming a quarter of the globe, than they have had in modern time.

But though Heeren has shown that there was a considerable trade among the ancient Carthaginians in diamonds brought from the interior of Africa, the only record I can find in modern times of the existence of diamonds in that part of Africa is of three shown at the Exhibition of the produce of Algiers. They were found in the Goumel River, in the province of Constantine, and were given up in payment to M. Peluzo, the Sardinian consul at Algiers, by an Arab who wished to know their value, saying that they were found in the sand of the Goumel River, with gold. One of these is deposited in the School of Mines at Paris; the second was purchased by M. Brongniart for the Museum of Natural History; and the third by M. de Drée. The Arab had several others. M. Rozet says, however, that he had acquaintance with the jewellers of Algiers, and had never heard of diamonds found in the province. The facts stated are on the authority of Dufrénoy and the Secretary of the Geological Society of France.

In Southern Africa diamonds were reported to have been discovered in 1867. After the announcement of the new find, Mr. Gregory, a well-known London mineralogist, who went to Africa on behalf of the great diamond merchant, Mr. Emanuel, sent to the editor of the *Geological Magazine* (December, 1868) an article denying the statement, and declaring it a "hoax," "imposture," or a "bubble scheme." To this Dr. W. G. Atherstone, F.G.S., a resident of Graham's Town, Cape of Good Hope, replied (May, 1869) refuting the charge, and declaring that twenty-one diamonds were known to have been found either on private or Government land, and thirteen of these were bought by persons of credibility, one of them the Governor of the colony, and another by a lapidary. Dr. Atherstone contradicts Mr. Gregory's account of the geology of the district, the latter asserting that all the rocks are igneous or their derivatives, and the former declaring that the rocks are fossiliferous, of the *Dicynodon* beds (which, by the way, brings them into relation with some of our Australian rocks); and that Mr. Wyley (an accepted geological authority) had, years before this controversy, shown that there was an intimate relationship with the Indian diamond region of Bangnapilly, and that Dr. Shaw had described the African district in the *Graham's Town Journal* of the 20th January, 1869, pointing out also the same resemblance.

In the *Journal of the Society of Arts*, of the 13th February, 1869, is a list of the diamonds by Mr. Chalmers;

who, as well as Mr. Radeloff, a Missionary, asserts that one of them was found near Pniel, by a Griqua.

Mr. Gregory. in answer to this reply, explains some personal remarks of his own, and admits the existence of Dicynodon relics, but *south* of the district alleged by Dr. Atherstone. And thus stood the matter till 1870. It now appears that diamonds have been found in vast quantities and that many magnificent and valuable stones have been disinterred. They are found on the surface of a calcareous conglomerate near the frontier of the Orange River territory, and are said to vary in weight from 6 to 13 carats; some of them reach 150 carats. The diamonds are accompanied by garnet, topaz, and other hard minerals.

It may be as well to state here that diamonds have occasionally been found in our sister colony of Victoria, and have been recorded by my friends, the Rev. Dr. Bleasdale, Mr. Ulrich, and Mr. Brough Smith, the latter of whom, in his recently published valuable official work on the "Gold-fields of Victoria," mentions sixty small diamonds of little value from Beechworth, taken out of, or near to, the usual "wash dirt" of the diggers, varying in weight from one-eighth to two carats and a half.

In 1865, fifteen more diamonds were also procured from the Woolshed diggings.

It is said also, that some small diamonds have been found at the Echunga gold-field S. E. of Adelaide, in South Australia.

At the present time, therefore, New South Wales is the diamond colony of Australia.

MINERALOGICAL NOTES FOR 1870.*

By W. H. WAHL.

New Minerals.—From various available sources of reference it appears that during the year 1870 about eleven new species have been added to the catalogue of minerals, with the usual abundance of new varieties. The following historical list will suffice to give a general idea of the character of the new additions.

Glaukopyrite.—Announced by Professor F. Sandberger, occurs at Guadalcanal in Spain, associated with calcite, tetrahedrite, pyrargyrite, and sulphide of antimony. It is described as occurring in rounded aggregations, which, when magnified, are found to be composed of a series of thin layers. The structure is mainly finely granular. Crystals are not sufficiently developed to be definitely determinable, but Sandberger suspects them to belong to the orthorhombic system. He also believes that he has detected twins and triplets, bearing a general resemblance to those of cerusite. The mineral is described as follows:—Lustre, metallic; colour, light lead-grey, approaching tin-white; streak, greyish-black; hard., 4; specific gravity 7·181.

The chemical examination gave the following as its constitution.

Sulphur	2·36
Arsenic	66·90
Antimony	3·59
Iron	21·38
Cobalt	4·67
Copper	1·14

The species approaches nearly to the geyerite of Breithaupt, but differs in colour, specific gravity, and in containing copper. It would fall in Dana's pyrites division as a member of his marcasite group.

Rabdionite is the name assigned by Von Kobell to a new metallic mineral, belonging to the class of hydrous oxides of which wad and asbolan are representatives. It differs, however, from the latter, which it approaches very nearly in chemical composition, in several important particulars. It is crystallised, occurring in short prisms; it has more water, and is more readily fusible. Its characteristics are described as follows:—Colour, black; matt; streak, dark brown; very soft, so that taken between the fingers it readily rubs away, leaving a stain behind.

Namaqualite.—Church describes under this name a new copper ore, from Namaqualand, South Africa. It is described as occurring in thin, fibrous masses, alternating with silicate of copper. Colour, light blue; lustre, silky; hardness, 2·5; specific gravity, 2·49. It consists mainly of oxide of copper, alumina, and water, with small quantities of magnesia, lime, and silicic acid.

Phosphorchromite—Occurs at Beresowsk upon listwänite, associated with crocoisite and pyromorphite. It occurs in spherical aggregates, the surfaces of which display minute crystal facets. Internally, the spheres are partly crystalline and partly dense in texture. The mineral is described by R. Hermann as follows:—Colour, dark green; streak, lighter; hard., 3; sp. gr., 5·80. The analysis gave:—

Plumbic oxide	68·33
Cupric oxide	7·36
Ferrous oxide	2·80
Chromic acid	10·13
Phosphoric acid	9·94
Water	1·16

Epiboulangerite.—Websky describes a new ore from Altenberg, occurring with mispickel, blende, galena, and pyrites. It occurs in needles of a dark grey colour. Though not suggested by the author, it may prove to be analogous in crystallisation to antimony glance, as it is, in chemical constitution. It differs from Boulangerite, of which it is doubtless a changed product, in containing from 21 to 22 per cent of sulphur.

Amblystegite.—G. Vom Rath gives this name to a new member of the pyroxene group containing alumina. The mineral occurs in the curious sanidin bombs from the remarkable volcanic region of Lake Laach, in the Eifel. The new mineral was long held by Wolf, the well-known historian of Laach minerals, to be an olivin, to which its crystallisation (orthorhombic) bears a close resemblance. The pyramid is, however, much more obtuse (measured over the macrodiagonal edge, it gives 125° 58½″, and the dimensions of the axes are determined to be $a : b : c =$ 0·97 : 1 : 0·57). Its cleavage is described to be inappreciable; hard., nearly 7; sp. gr., 3·4; colour, brown to reddish brown; lustre, adamantine. Chemical composition:—

Silicic acid	49·8
Ferrous oxide	25·6
Magnesia	17·7
Alumina	5·05
Lime	0·15

Uranotil.—Boricky gives this name to a mineral occurring in a drusy quartz which coats the surface of feldspar at Walsendorff, in Bavaria. The character of the occurrence is in fine needles, which Von Zepharovich determines to belong to the orthorhombic system. The needles display frequently a radiated structure. Colour, lemon-yellow; sp. gr., 3·95; streak, lighter. The mineral blackens before blowpipe. Constitution:—

Uranium sesquioxide	66·752
Alumina (ferric oxide)	0·511
Lime	5·273
Silicic acid	13·781
Phosphoric acid	0·448
Water	12·616

Both in crystallographic and chemical character it approaches the uranophan of Websky.

Jacobsite.—A new spinell is described by Damour under this name. It crystallises in octahedra, which are frequently much distorted. Colour, black; lustrous, opaque; hard., cuts glass; sp. gr., 4·75. It contained, according to

* From advance-sheets of the *Journal of the Franklin Institute*. Communicated by the Editor.

analysis, 4·21 per cent of peroxide, and 20·57 per cent of the protoxide of manganese. The peroxide constituent is chiefly iron. Small quantities of magnesia and zinc oxide are also present. It may, therefore, be termed a manganese spinel. It occurs at Jacobsberg, in Sweden, in crystalline limestone, associated with silvery mica and particles of native copper.

Gümbelite.—Named by Von Kobell in honour of the geologist Gümbel; is described as a greenish-white mineral, of a pearly or silky lustre; translucent, soft and flexible, and like asbestos to the touch. Occurs in Oberfranken. It consists essentially of a hydrous silicate of alumina, containing likewise a small proportion of potash and ferric oxide.

Milarite.—A new Swiss zeolite occurring in a granite rock in company with smoky quartz, orthoclase, apatite, chabacite, &c.; is described by Professor Kengott. Its crystallisation is hexagonal, the forms being small but sharp, and combinations of prism and pyramid of both orders (the polar interfacial angle of pyramid = 144° 46′ 5″). The analysis shows it to be a hydrous soda, lime, and alumina silicate. Its name is derived from its occurrence in the Val Milar. Colour, white to green; hard., 55·6.

It will be noticed that Gmelinite, which approaches very nearly in chemical character, presents a further resemblance to the mineral just described in its crystallisation, which is hexagonal (holohedric). The angle of its pyramid is 142° 25′, a variation of but 2° from the measurement which Kengott announces for Milarite.

Hessenberg describes likewise another zeolite from the volcanic region of Santorin. The crystals are short orthorhombic prisms. Before blowpipe it swells considerably and fuses readily to white glass. Prof. Hessenberg describes it as very closely resembling epistilbite. From the similarity, almost identity, of the angle of the prism (the difference scarcely amounts to 1°), it would seem highly probable that the two were the same.

Sandberger describes several new hydrated phosphates, one of which, a phosphate of lime, is analogous to the hydrated phosphate of copper, known as libethenite. The crystals are colourless, belong to the monoclinic system, and possess a prismatic habitus. No name has as yet been proposed for it.

Simonyite is a new sulphate, found in the salt works at Hallstadt, and described by Tschermak. It occurs associated with rock-salt and anhydrite, chiefly in thin layers of a bluish-green colour, presenting here and there a crystalline form, which is announced to be monoclinic. It is a hydrous magnesia-soda sulphate.

Of the numerous varieties which have been announced, the following seem to be the most interesting:—

Lithiophorite.—An ore of manganese, containing lithia. It is amorphous, occurring in thin layers; also pseudomorphic after calcite. It colours the flame intensely red. It is found in the granite of Schneeberg, Schwartzenberg, and Johanngeorgenstadt—generally coating quartz. The granite is much decomposed, and with the spectroscope gives distinct indications of the presence of lithia.

A new Olivine.—Roepper gives the following as the composition of a mineral occurring in crystals of an inch or two in length, at Sterling, N. J. It is found associated with willemite, Franklinite, Jeffersonite, and spinel.

Silicic acid	29·90
Iron protoxide	35·60
Oxide of manganese ..	16·90
Oxide of zinc	10·66
Magnesia	5·81
Insoluble	1·03

The crystals were weathered externally, but within were weathered externally, but within were bright. Colour, dark-green to black; hard., 5·5—6. A zinc deposit was obtained with the blowpipe. The crystallisation and analysis prove it to be an olivine. The proportion of zinc and manganese in its composition make it a most interesting variety.

The same author describes a *manganese dolomite*, from or near the same locality. It is a rosy-red mineral, occurring in a vein of apple-green willemite. It possesses distinct rhombohedral cleavage. Hardness = 4; sp. gr., 3·05. An analysis gave as much as 43·5 per cent of carbonate of manganese, 50 per cent of carbonate of lime; the remainder consisting of carbonate of iron and magnesia. Accordingly Roepper characterises it either as a dolomite in which the magnesia has been replaced almost entirely by manganese, or a diallogite, in which a large proportion of the manganese has been replaced by lime.

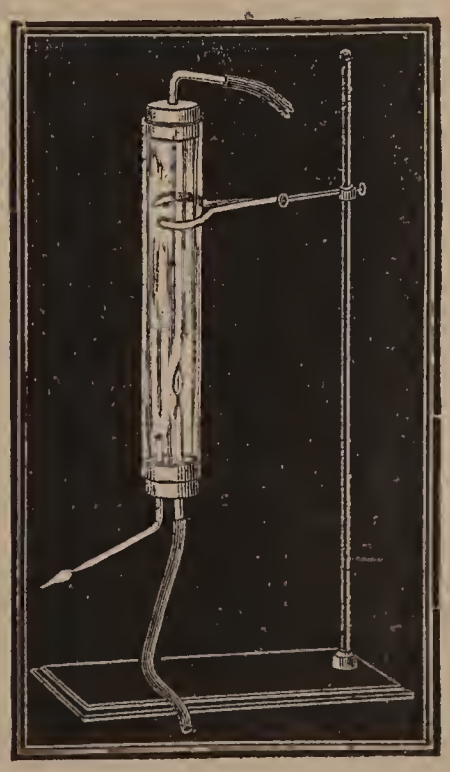
Hallite, a micaceous (or chloritic) mineral from Chester county, Pennsylvania, has been announced by Leeds. It is flexible, of a brownish colour, and occurs in plates of various sizes. It is believed to possess distinguishing optical properties, though no investigation of the subject has yet appeared.

Metacinnabarite.—G. E. Moore has announced the occurrence, in Lake county, California, of an amorphous sulphide of mercury in a siliceous gangue, in company with cinnabar. It frequently covers crystals of pyrites, and is filled with small cavities in which are found crystals of cinnabar. The colour is greyish-black; streak on porcelain, pure black; hard. = 3; sp. gr., 7·7. It gives all the reactions of cinnabar, with which it is identical in composition. The author very properly identifies it as the variety of sulphide obtained in the laboratory as an amorphous black powder, upon precipitating a soluble mercuric salt. He proposes the name given above to designate the variety.

A LECTURE EXPERIMENT.*

A number of devices, some of them simple, others complex, have from time to time been described for showing the reciprocal combustion of the elements of water, and experiments of a similar nature.† Most, if not all of these, however, as will be found upon testing, either do not entirely remove the danger of an explosion from the operator, or they require the exercise of an unusual amount of care and dexterity to be used with success.

The accompanying arrangement, which is of the most simple character, and which we saw for the first time on the lecture table of Professor Himes, we have since repeatedly used to show the burning of oxygen, air, chlorine, &c., in hydrogen, burning gas or hydrocarbon vapours. The experiment can be performed with such ease that is worthy of notice.



The arrangement consists of a cylinder of glass, about a foot or a foot and a half in length (the kind used commonly as chimneys for the argand-burner can be had of proper length). This is furnished above and below with a cork; the one at the upper end has one, that below has two, glass tubes of the form shown in figure. The whole affair is supported from the retort stand. The hydrogen (in the H and O experiment) is admitted through the upper tube, when it has completely displaced the air it is ignited below—the cork having been removed—and the

* From advance-sheets of the *Journal of the Franklin Institute.* Communicated by the Editor.

† *Ber. d. Deutsch. Chem. Gesel.*, iii., pp. 419, 930; *Journal of the Franklin Institute*, lxi., 210.

supply is regulated until only a weak hydrogen flame remains. The oxygen supplied through the straight tube in the lower cork, is now turned on slightly, and the cork fitted into its place. The flame of hydrogen at the opening is extinguished, but the oxygen, in passing up through it, is ignited, and burns now in the centre of the cylinder. The surplus of the hydrogen escapes now from the second tube below, and can be there ignited. This last flame serves the purpose of a good indicator, by which the supply of gases in the cylinder can be regulated, and which, of course, leaves the size of the flame at the will of the operator. Once in operation, the experiment may be left to take care of itself for the remainder of the hour.

ON J. STODDART'S PLAN OF CONCENTRATING SULPHURIC ACID BY MEANS OF HEATING AND BLOWING AIR THROUGH THE ACID.

By F. BODE.

The author, having seen in the first number for June of *Dingler's Polytechnisches Journal* a translation of the short paragraph, written by M. J. Stoddart, and published at page 167, vol. xxiii., of the Chemical News, has sent to us a loose sheet taken from *Dingler's Polytechnisches Journal* (first number for July), with the request that a translation should be made of the following lines containing observations on the plan of M. Stoddart, only briefly set forth *loco citato*.

F. Bode says:—The boiling-point of sulphuric acid at 60° (1·7 sp. gr.) lies between 190° and 200°, but an acid of the strength just indicated is always obtained when it is run off from the pans at a temperature of from 185° to 190°; according to Stoddart, it would only be necessary to raise the temperature 40° less than is otherwise required. Stoddart has not communicated, in his very brief notice, what saving of fuel and of labour his process yields, as compared with the process in ordinary use. When the pans are well and rationally constructed, and the fire-place properly arranged, 1 cwt. of 60° B. acid may be obtained from acid at 50° by the combustion of from 16 to 18 lbs. of coals of average quality; although the author (F. Bode) knows quite well that in many instances, owing to badly-constructed fire-places and pans not well arranged, as much as double this quantity of fuel is required for the production of the same effect. It would require the setting forth of a great many conditions to enable me to say how much fuel is required to heat acid already at a temperature of 150° further to 190°; but it is clear that the less expenditure of fuel, resulting from having only to heat to 150° instead of to 190°, would not bring on any real gain obtainable from the new (Stoddart's) process. Next comes the point that the air to be blown through the hot acid has to be compressed, even though it be only feebly. By passing through the acid, the air will become hot, and thereby acquire the property of taking up more aqueous vapour than it can take up while cold; but the heating of the air necessarily causes the cooling of the acid, and this loss of heat has to be met by the expenditure of a fresh quantity of fuel. The blowing of air through the acid will either require expenditure of fuel or manual labour not required by the usual mode of concentrating the acid. I should, however, observe that the withdrawal of heat by the blowing through of air may, under certain premises, be rendered very small. In order to make the air which is forced into the acid take up as much water as possible, that air should be brought largely into contact with the acid, and should become as warm as possible; but this arrangement necessarily involves a high column of liquid for the air to pass through, consequently the use of a very deep pan. The pans now generally in use for concentrating acid to 60° B. are generally not filled deeper with acid than to a height of 0·35 metre, and, for the blowing of air through the acid, this height appears rather too small; yet the construction of pans of greater depth is not to be recommended, for a great many reasons. In the first place, deep pans containing a high column of acid will require (since the pans are made of lead, which is apt to bend and give way, by becoming hot, under the weight and pressure of the acid), to be supported at the bottom all over. This support, although best made of cast-iron plates, is often simply made of slabs of burnt fire-clay; but these slabs, in the first place, prevent the ready transmission of the heat from the fuel to the pan and the acid therein contained: moreover, these slabs not only absorb and retain heat which is not utilised, but they interfere with the giving off of the heat of the gases of the combustion to the pans, and thereby cause that, if pans are constructed so as to yield, in a given time, a certain quantity of acid of 60° B., either a larger number of pans will be required (under the conditions alluded to), or a pan will have to be made so as to be exposed to a larger surface of fire. These considerations apply to deep pans, and so do the following:—The destruction of the lead of which the pans are made is generally observed to take place chiefly, if not exclusively, at the bottom, unless, indeed, exceptionally, either from defects of the lead or from construction. There is no reasonable ground to suppose that, of two pans of equal size at the bottom, the pan with greater depth and consequently higher column of acid therein, should last longer than a shallow pan, and we must therefore assume the durability of each of these pans to be the same; but it is then clear and evident also that a shallow pan will be, in a given time, more advantageously worn, because the weight of lead contained in the sides of such a pan is less. In order to guard against the spirting of acid, and, consequently, loss, when air is blown through it, the pans will have to be covered, or at least a hood will have to be placed over it; even with the pans now in use, it frequently happens that, as soon as the acid becomes more concentrated, particles of acid are driven off along with the aqueous vapour, as is readily perceived by the action of the latter on the skin. When sulphuric acid is forced up by means of compressed air, and the latter allowed to blow off, after the *monte-acide* has been emptied, it will be observed that, even before all the acid has been discharged, but the stream thereof issuing from the discharge-pipe becomes less bulky and already mixed with air-bubbles, a more or less strong cloud appears at the mouth of the pipe; which cloud is readily perceived, by its action upon the skin of the face and hands, to be sulphuric acid in finely divided state, and some of it follows along with the air while blowing off after not a drop more of acid is discharged from the mouth of the pipe. When air is forced through sulphuric acid contained in covered pans, a similar effect will ensue, and the consequence will be that a large portion of the acid thus carried off in vesicular shape by the air will be lost. Supposing the air blown through the hot acid to be warmed from 0° to 100°, and to become saturated with as much water as air of the last-named temperature will bear, 1 cubic metre of such air will absorb 295 grms. of aqueous vapour, which quantity is therefore withdrawn from the acid. One cubic metre of air at 0° weighs 1·2991 kilos., and the specific heat of air is 0·2669; by the heating of 1 cubic metre of air from 0° to 100° the acid will loose—

$$1{\cdot}2991 \times 100 \times 0{\cdot}2669 = 34{\cdot}67 \text{ units of caloric.}$$

I now leave out of the question whether or not a larger consumption of heat takes place, owing to the fact that the water present in fluid state (in the acid) assumes the gaseous (vapour) form. In order to evaporate 1 kilo. of water we require, according to what has just been stated, $\frac{1000}{295} = 3{\cdot}39$ cubic metres of air to be blown through the acid, and the withdrawal of heat (caloric) amounts, therefore, for every kilo. of water evaporated, to:—

$$34{\cdot}67 \times 3{\cdot}39 = 117{\cdot}53 \text{ units of caloric.}$$

By removing 1 kilo. of water from sulphuric acid at 50° B., we obtain 4·25 kilos. of sulphuric acid at 60° B., and the quantity of heat (caloric) withdrawn amounts for the kilo. of acid at 60° B. to—

$$\frac{117{\cdot}53}{4{\cdot}25} = 27{\cdot}66 \text{ units of caloric.}$$

It cannot be said that these figures bear unfavourably upon the process under discussion, and even when more unfavourable premises are assumed, this does not alter the case. Supposing the heating of the air blown or forced through the hot acid to extend only to 50°, 1 cubic metre is saturated with 63·6 grms. of aqueous vapour, and, in order to obtain an evaporation of 1 kilo. of water, $\frac{1000}{63{\cdot}6} = 15{\cdot}72$ cubic metres have to be applied, which, by becoming heated to 50°, will withdraw from the hot acid:—

$$1{\cdot}2991 \times 50 \times 0{\cdot}2669 \times 15{\cdot}72 = 272{\cdot}52 \text{ units of caloric.}$$

The loss of heat for acid at 60° will, in this case, amount to 64·1 units of caloric. Stoddart intends to apply this same process, also, to obtain acid at 66° B., the only difference being that in this case the acid has to be heated to 260°. The question may be reasonably asked whether or not, at this temperature, and with so strong acid, the leaden pans will not be rapidly destroyed, and the acid so strongly contaminated with lead as thereby to become unfit for many uses.

The author of this paper does not for a moment suppose that Stoddart has not made careful researches before bringing his process into practical use at the Uphall works, but since, from the very short and incomplete notice Stoddart published in the Chemical News, no precise information about the process can be obtained as to its practical bearing, the above observations have been written with a view to obtain what, to those interested in this subject on the Continent, —and, among them, the author of these observations,— will be highly gratifying—a more complete account of Stoddart's process, with every particular relating to it.

NOTICES OF BOOKS.

A Practical Treatise on the Manufacture of Soaps. By Campbell Morfit, M.D., F.C.S., formerly Professor of Applied Chemistry in the University of Maryland. London: Trübner and Co.

Soap-making, until lately, has not advanced equally with other branches of industrial chemistry. There has been much empiricism in the methods of operation, amounting at times to so great a defect that no uniformity could be obtained even in batches of soap from the same maker. This state of things in an art so important in both its scientific and commercial bearings, naturally attracted the attention of some of our foremost chemists, and, as a consequence, are the many exquisite soaps produced during the last few years. One of the first to commence laboratory researches was the author of the work here noticed, who in 1856 introduced his system of oleic soap manufacture, subsequently substituting sal-soda fused in its water of crystallisation or the powdered sal-soda—

$$(NaO,CO_2,10HO)$$

and semi-dehydrated sal-soda ($NaO,CO_2,5HO$) before used, thereby reducing the salt to the necessary state of fine division without mechanical means or labour. In continuing his researches Dr. Morfit now presents to the public a handbook of soap manufacture founded on the four following principles:—

(1). The saponification of the fat acids generally, whether singly or intermixed among themselves, or with rosin, and their conversion into soap by means of alkaline carbonates, either with or without the direct use of water.

(2). The management of the water of constitution of the soap in a manner quasi-chemical, by which it is made, comparatively, a permanent ingredient.

(3). The use of carbonate of soda of different degrees of hydration, as a means of apportioning the water and alkali in the soap.

(4). The instantaneous manufacture of soap, hard and soft, without the use of caustic leys, and upon a definite plan by which the amount and composition of the product may be deduced in advance from the quantity of the materials employed.

In order to bring his work within certain limits, Dr. Morfit has confined himself to thorough instruction in the more practical bearings of the acid derivatives of neutral fats upon the manufacture of soaps, and more exclusively to the employment of crude oleic acid, olein, and fat acids generally, as soap-stock, in place of tallow, palm-oil, and similar neutral fats. This has been done to bring into commercial consideration the utilisation of the by-products of the manufacture of stearic candles, the clarification of oils, &c., these constituting an increasing source of material for which, at present, there is but a limited demand, the price being much below that of tallow. These reasons are worthy the full consideration of the soap-maker, for the market for crude oleic fats in England is never exceedingly active, and, besides, these fats cannot be utilised for illuminating and lubricating purposes, whereas there is a steadily increasing demand for tallow and the more consistent neutral fats. Dr. Morfit treats the subject very fully; the raw materials, the arrangement of the factory, the process, have each a distinct consideration. Dr. Morfit's long practical experience renders the advice detailed with respect to the best factory plant and its cost of high value, while the several apparatus are elucidated by large sectional and perspective diagrams. After the arrangement of the plant there follow numerous formulæ for the various soaps, and an estimate for the actual expense per month for working a soap-factory. Finally, there is a clearly written chapter conveying instructions in the chemical analysis of soap. Dr. Morfit advises the weighing out of 100 grains of the soap to be tested, and the solution of this quantity in alcohol, aided by the heat of a sand-bath. The solution is then to be filtered, and the alcohol of the filtrate evaporated; the filter with the residuum being heated to dryness, the constant weight, less that of the paper, expresses the percentage of foreign matters as well as of free alkali in the soap. The proportion of free alkali is determined by the quantity of normal acid liquor required to redden the blue litmus test paper; while the quantity of combined soda (NaO) is estimated from the evaporated filtrate in the same manner, the acid employed in this test serving to separate the fat element, which floats at the surface of the liquor, and may be collected in wax. As related to the manufacture of soaps, a chapter is appended on the constitution of lubricating compounds for railway and common waggon uses. The matter in all parts of the book is carefully illustrated with woodcuts, the type is large, and the arrangement admirably adapted for easy reference; the utility of the work is beyond question.

Mineral Statistics of Victoria for the year 1870. Presented to both Houses of Parliament by His Excellency's command. By authority: John Ferres, Government Printer, Melbourne.

Reports of the Mining Surveyors and Registrars; quarter ending March 31*st*, 1871. John Ferres, Government Printer, Melbourne.

The publications, of which the titles are above quoted, contain, as may be inferred from these titles, a very large amount of highly useful and practical information on a subject interesting, not only to those who reside in Victoria (formerly a portion of South Wales, known as Port Philip district, but erected into a separate colony by the Act 13 and 14 Vict., cap. 59), but also to the rest of the civilised inhabitants of the globe, on account of the great influence the gold production of this Colony exercises upon trade

industry and everything connected therewith or dependent thereupon. Not only are gold, silver, and diamonds* found in Victoria, but antimony, copper, coals, tin, manganese, lead, slate, and building stones, are referred to in the papers before us. From the laboratory report appended to the first-named paper—we cannot call it a blue-book because it is not dressed in the garb of that colour—and written by Dr. C. Newberry, we abstract the following particulars:—"The only novel or unusual occurrences of gold which have come under my notice during the year have been some specimens from the Empire Company's claim near Landsborough, in which gold occurs associated with native silver and copper, chloride of silver, carbonates of copper and lead, and oxide of iron in a micaceous sandstone, through which pass thin veins of ferruginous quartz; three samples of the metal obtained by the miners from this stone gave the following results in 1000 parts:—

	I.	II.	III.
Gold	197·44	517·442	189·65
Silver	755·57	460·272	768·63
Copper / Lead ..	46·99	22·286	41·72
	1000·00	1000·00	1000·00

The only new compound of gold which has been received was one containing 56 per cent of gold, and 44 per cent of arsenic. The alloy was of a yellowish-grey colour, brittle, breaking with a crystalline fracture. Dr. Newberry suggested that this alloy was not a native product, but accidentally formed in a roasting kiln, but the manager of the mine where the alloy alluded to was found distinctly states that the specimen is native, as he obtained it from the quartz. Several specimens of fossil trees, fruit, leaves, seeds, and other fossil vegetable matter exhibiting organised structure have been found in a locality named Haddon, and some of these are described and illustrated with very well executed lithograms (so it reads in the original), by Dr. F. Von Mueller, Director of the Botanic Gardens, and Government Botanist at Melbourne. The Colonial Government of Victoria may be congratulated upon the excellent manner in which the reports herein alluded to are made up under its care by men evidently well up to their work.

MISCELLANEOUS.

The Bancker Collection.—For many years past there has existed in Philadelphia, and known only to those of its citizens more especially interested in scientific pursuits, a collection of philosophical and chemical apparatus unequalled in this country, and, if the opinion of foreign *savans* be taken, without a rival in the world. It was made and owned by the late well-known Charles N. Bancker, Esq., who devoted all the leisure hours of a life extended far beyond the average lot of man, and constantly applied to the successful prosecution of business, to the cultivation of scientific knowledge. For more than half a century he imported from the workshops of Europe their choicest productions in the way of apparatus; and his interest was not limited to one, but extended to all the sciences embraced within the scope of philosophic inquiry. In this collection will be found cabinets of minerals, with beautifully executed models in glass and wood, to exhibit the immense variety of crystalline forms; charts and maps in relief, with suites of rocks, to illustrate the geology of various countries; telescopes and instruments for observing the stars, with orreries and globes for studying the motions of the heavenly bodies; models of pumps, rams, jets, mills, and all manner of contrivances to demonstrate the properties of fluids when in rest and in motion. The collection also contains magnets, simple and compound, with machines of the most varied description, to illustrate the phenomena of electricity and magnetism. But above all, it is rich in optical and acoustic apparatus. The Abbé Moigno, a distinguished French *savant*, wrote of it some years ago in *Cosmos*, that "this collection of optical instruments is certainly the most extensive and most brilliant that exists in the world. It embraces in itself more riches than all our cabinets of France, and perhaps of Europe, united. And its founder, whose zeal seems to grow with his age, does not cease to gather the freshest novelties. We exaggerate nothing when we estimate the optical treasure of Mr. Bancker at many hundred thousand francs. Besides illustrating the history of optical discovery and research during the present century, it contains numbers of the most valuable and efficient instruments, such as the saccharimeter of Duboscq, the polarising apparatus of Dove, Powel, and Soleil, microscopes by Zentmayer, Smith and Beck, &c., and complete sets of apparatus and objects for repeating the researches of Becquerel and Stokes on phosphorescence and fluorescence. Professor Henry, President of the Smithsonian Institution at Washington says in a recent letter:—'I am free to say, that, with the addition of a very few articles that have been improved or invented within the last few years, it would be the most complete series of instruments that I know of for the illustration of the phenomena and history of physics. To break up the collection and dispose of it piecemeal, would be a matter of much regret, since the value of the instruments is enhanced by the fact of their being part of a series well adapted to the illustration of the order of the development of science.'" Fortunately for the interest of science, the wish of Professor Henry has been, to a great extent, realised. The entire collection of optical and acoustic apparatus has been purchased by Professor Morton on behalf of the Stevens Institute of Technology, at Hoboken, and is now thrown open to all the students who may wish to prosecute researches within the walls of that great institution.—*Journal of the Franklin Institute.*

* As yet only 75 in all have been found in this country, and among this number few of great value, while a systematic search for these stones proved in 1870 a complete failure.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, July 10, 1871.

This number contains the following papers relating to physico-chemical and collateral sciences:—

Action of Electricity upon the Coloured Tissues of Plants.—M. Becquerel.—This very lengthy essay contains the record of a series of experiments made by the eminent author in order to illustrate the action of electricity upon the living organism of plants.

Freezing of Water.—M. Boussingault.—After briefly referring to the experiments of the Florentine Academicians, and of Huyghens (1667), on the force exerted by the freezing of water in closed metallic vessels, the author relates a series of experiments made by him last winter in order to ascertain whether water, when put into a strong vessel (a steel cylinder of great strength, and so arranged that the dilatation, or expansion, of the water, when cooled below +4·1°, could be prevented), would or would not remain liquid, even when exposed to a cold very considerably below its point of congelation, in consequence of the expansion due to the cooling down from below +4·1° being prevented by the strength of the vessel containing the water and stopper (steel plug) fitted thereto. The result of this investigation was found to be that water remains liquid under the conditions alluded to, even at a temperature of −18°, but freezes instantaneously; as soon as the impediment, caused by the resistance of the plug which hermetically closes the steel vessel, was removed, free play was given

to the expansion of the liquid. It should be noted that the sides and bottom of the steel vessel alluded to were of such great strength as to be practically unyielding.

Sample of Incinerated Paper found among the Ruins of the recently burnt Ministry of Finance, at Paris.—E. Chevreul.—The author first exhibits to the assembly a lump of material more resembling a mineral than what it really is, the ash of paper burnt during the fire at the Ministry of Finance (purposely ignited and fired by the Communists). He next takes this opportunity to call attention to some points of the difference between the paper sized by the old and by the new process (hand-made and machine-made); the main fact being that, whereas in the hand-made and hand-sized paper the sizing (glue and alum) is only on the surface, the machine-made paper is sized in the paper mass (pulp) itself by the aid, partly of mineral, and partly of organic matter (resin and starch). These are all insoluble in water, and require, for their intimate incorporation with the pulp, that the latter be far more finely divided, to the detriment of the strength of the paper, as evidenced by the fact, for instance, that it does not stand folding without cracking and readily tearing. This, moreover, causes an essential difference in respect of the writing made on such machine-sized paper, which writing is by far more liable to be effaced, owing to not penetrating sufficiently into the mass and body of the paper. The author further observes, that upon the old-fashioned hand-made paper, sized with aluminated glue, indelible writing may be made with indian ink, finely divided, suspended in weak hydrochloric acid (sp. gr., 1·007); whereas, for the same purpose, the machine-sized paper requires the indian ink to be mixed with very weak caustic soda solution (same sp. gr. as just alluded to).

Manner in which the Mineral Constituents of Beet-Roots are Distributed in that Vegetable.—B. Corenwinder.—The fifth portion of the exhaustive memoir "On the Chemistry of Beet-Roots."

Method of Preparing Trichloracetic Acid.—A. Clermont.—The main gist of this paper is, that trichloracetic acid is readily obtained by causing hydrate of chloral to be acted upon by fuming nitric acid. The mixture, containing three times as much, by weight, of the acid as the quantity of hydrate of chloral, is first left exposed to direct sunlight for a few days, and afterwards submitted to distillation.

Dambonite and Nitrated Dambose.—P. Champion.—In the introduction to this paper, the author records, with a few words, that dambonite is a peculiar substance found recently by Aimé-Girard in the caoutchouc from Gabon, which substance is converted, by nitro-sulphuric acid, into nitrated dambonite, an explosive material; while dambose is obtained from dambonite by the action of hydriodic acid, the dambose thus prepared yielding, with nitro-sulphuric acid, also a nitrated compound, which explodes. The main portion of this essay is devoted to the description and mode of preparation of the following substances:—Bromhydric erythrite, $C_8H_8Br_2O_4$, obtained by treating erythrite in a sealed tube at 110° for a period of thirty hours along with a concentrated solution of hydrobromic acid; the body alluded to is a solid crystalline substance, insoluble in water, and fusing at 130°. Nitro-bromhydric erythrite, $C_8H_6Br_2O_4(2NO_4)$, obtained by treating the before-mentioned substance with nitro-sulphuric acid (1 part nitric, and 2 parts sulphuric acid, both concentrated); this compound is insoluble in water, fuses at 75°, is not explosive, and readily decomposed by heat. Nitro-chlorhydric erythrite, $C_8H_6Cl_2O_4(NO_4)$, a solid body, crystalline, soluble in alcohol, and fusing at 60°.

July 17, 1871.

The original papers relating to chemistry and collateral sciences contained in this number are—

Description of a Magneto-Electro Machine which produces a Continuous Current.—M. Gramme.—Illustrated by woodcuts.

Compressibility and Expansion of Gases.—M. Amagat.—The contents of this paper do not admit of any useful abstraction, owing to the fact that this would require the reproduction of a large number of tabulated results of experiments.

Existence of Nitrous Acid in Arable Soils, and on the Functions of that Acid therein.—M. Chabrier.—From this very lengthy monograph, we learn that nitrous acid is constantly present in soil, that this acid is partly converted into nitric acid, partly into other nitrogenous compounds. The average quantity of that acid found in the soil of market gardens amounts to 4·52 parts; corn-bearing soil, 2·16; orchard soil, 1·51; soil bearing fir-trees, 0·75 parts; while a soil named safre (dried slime deposited by the river Durance) was found to contain no nitrous acid at all. It appears that the quantity and quality of the water which impregnates the soil has a great deal to do with the presence therein of the acid just alluded to.

Artificial Production of Dulcite.—G. Bouchardat.—By treating inverted milk sugar with sodium amalgam (containing 2·5 per cent of sodium), the author has obtained a substance, $C_{12}H_{14}O_{12}$, solid, crystalline, not capable of fermentation, fusing at 187°, difficultly soluble in strong alcohol and in cold water. This body, therefore, appears to be identical with the dulcite obtained from Madagascar manna, and the substance found in the juice of the *Metampyrum nemorosum*.

Fermentation and Alcoholic Ferments.—M. Dubrunfaut.

Observation on Dynamite.—P. Guyot.—The more important part of this communication is that, instead of paper, parchment is used for making the cartridges filled with dynamite (see Chemical News, vol. xxiv., p. 21), so that no nitroglycerine can escape by soaking the paper, parchment being impervious to the liquid just alluded to.

Crystallised Aconitine.—H. Duquesnel.—This paper contains, in the first place, an exhaustive description on the best method of preparing aconitine in crystalline state for pharmaceutical purposes, and next a detailed account of the properties of the alkaloid alluded to. Crystalline aconitine, $C_{54}H_{40}NO_2$, is nearly insoluble in water, even at 100°; the substance is not volatile, but heated to above 130° is decomposed. Aconitine is soluble in alcohol, ether, benzine, and chloroform; insoluble in glycerine and petroleum oils. Aconitine readily forms salts with acids, and is even soluble in water impregnated with excess of carbonic acid. Although phosphoric and tannic acids, as also the double iodide of mercury and potassium, are tests for aconitine, they are not reliable unless taken in combination with its physiological effects.

July 24, 1871.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Crenic and Apocrenic Acids contained in the Mineral Waters of Forges-les-Eaux (Seine-Inférieure).—C. Bontigny.—This lengthy essay treats on the presence of proto-crenate of iron in the mineral water just alluded to, and on crenic and apocrenic acids, about which, however, nothing new is stated, the author merely drawing attention briefly to Dr. G. J. Mulder's excellent investigation on this subject. It appears that the acids alluded to are formed, in the instance of the water here mentioned, by the decomposition of organic (decaying vegetable) matter, while the iron is due in this instance to a vein of pyrites. The proto-crenate of iron is soluble in water; but that solution is instantaneously decomposed by contact with air, and hence an ochrey deposit is always found near springs, and in brooks and ditches containing the salt alluded to in solution, which salt cannot be obtained in dry pure state by any process. Crenic and apocrenic acids were first discovered by the late Berzelius in the water of Porla, Sweden.

Second Memoir on the Presence of Nitrous Acid in Mud (Slime from Rivers) and in Water employed for Irrigation.—M. Chabrier.

Researches on the Action which is Exerted by the Substances which Aid the Decomposition of Chlorate of Potassa when employed for making Oxygen.—E. Baudrimont.—The conclusions drawn from the author's researches are—(1) That chlorate of potassa is evidently an endothermic compound; (2) that the decomposition of that salt into oxygen and chloride of potassium, by the aid of certain oxides (CuO, MnO_2, &c.), is simply due to the effect of contact; (3) that the phenomenon of incandescence, which accompanies the decomposition of this salt in the presence of the oxides alluded to, is due to the sudden expulsion of the caloric of formation (*calorique de formation*) of that salt; (4) that chlorate of potassa, while in contact with the oxides of copper or manganese, possesses the property of becoming liquefied below its ordinary melting-point.

Quantity of Caloric Set Free during the Formation of Organic Nitrated Compounds.—Dr. Berthelot.—This exhaustive memoir treats on nine different compounds, viz.:—Nitric ether, nitro-glycerine, nitro-mannite, gun-cotton, xyloidine, nitro-benzine, binitro-benzine, chloro-nitrated benzine, nitro-benzoic acid. The investigation of the author has been mainly directed to ascertain the amount of caloric set free during the formation of these substances.

Fermentation and Alcoholic Ferments.—M. Dubrunfaut.

New Theory of Fermentation.—A. Petit.—The contents of these papers, however valuable in a scientific point of view, are not suited for useful abstraction.

Estimation of Free Hydrofluoric Acid.—P. Guyot.—The author proposes to apply, for the purpose alluded to, the reaction between fluoride of potassium and sesquichloride of iron, yielding a white-coloured precipitate of sesqui-fluo-ferrate of potassa, Fe_2Fl_32KFl, the reaction taking place according to the following formula:—

$$Fe_2Cl_3+5KFl=Fe_2Fl_32KFl+3KFl.$$

The liquid, which contains free hydrofluoric acid, is first exactly neutralised with pure carbonate of potassa, and next, after filtration, a titrated solution of perchloride of iron is added.

This number contains also several important meteorological, astronomical, and physico-geographical papers and essays.

Les Mondes, July 20, 1871.

This number contains the two following original papers relating to physico-chemical sciences, but, both being accompanied by woodcuts absolutely required for the proper understanding of the subject, we only quote the titles:—

Magneto-Electric Machine which Produces Continuous Currents.—M. Gramme.

Support with Total Reflection for the Projection of Moving Images.—J. Duboscq.

A large number of pages of this number are devoted to a subject of public and political economy on—

Taxation by One Single Impost—C. Tellier—Which certainly deserves the serious study of political economists and others, the main and very important points being that the author's proposals tend to create the most simple, most productive, and most equitable tax.

Moniteur Scientifique, Nos. 349 and 350 (double number), July 1 and 15, 1871.

This number contains the following original matter relating to chemistry and allied sciences:—

Processes for Detecting, Distinguishing, and Separating from each other Silk, Wool, and Vegetable Fibres in Mixed Woven Fabrics.—Dr. E. Kopp.—This lengthy memoir contains, in

a condensed form, all the information on this subject found dispersed in various published works, including, also, the various methods employed on the large scale for separating animal and vegetable fibres from each other when they occur in mixed fabrics. From the contents of this paper we cannot make any general abstract; but among some of the particular reactions we find the following for detecting wool in silk, and *vice versâ*, based upon the fact that wool contains sulphur, while silk does not. The tissue to be tested—it should be, however, white, not dyed—is put into a solution of caustic potassa or soda, wherein, previously, oxide of lead has been dissolved; woollen fibres become black when immersed in this liquor, whereas silk remains unchanged. Another test for the same purpose is ordinary nitric acid, which dissolves silk in the cold, but hardly affects wool.

Changes which the Progress of Modern Chemistry has wrought in Therapeutics and Hygiène.—F. Papillon.—This exhaustive monograph is divided into the following chapters:—General action of medicaments upon the human system; alkaloids; anæsthetics; disinfectants, antiseptics, antimiasmatics; phenic acid; iodine, bromine, and compounds thereof; acids and mineral salts; artificial essences.

The American Journal of Science and Arts, July, 1871.

This number contains the following original papers and memoirs:—

Some Phenomena of Binocular Vision.—J. Le Conte.—The continuation and fifth part of the author's essay on this subject. This portion, copiously illustrated with woodcuts, treats on stereoscopic phenomena.

Three Masses of Meteoric Iron from Augusta County, Virginia.—J. W. Mallet.—The author describes, and illustrates by means of woodcuts, three specimens of meteoric iron found in the county above named. The sp. gr. at 15° of these samples was respectively found to be 7·853, 7·855, and 7·839. The composition of the substances was ascertained to be, in 100 parts, the following:—Iron, 88·706, 88·365, 89·007; nickel, 10·163, 10·242, 9·964; cobalt, 0·396, 0·428, 0·387; copper, 0·003, 0·004, 0·003; tin, 0·002, 0·002, 0·003; manganese, a trace in two out of the three samples; phosphorus, 0·341, 0·362, 0·375; sulphur, 0·019, 0·008, 0·026; chlorine, 0·003, 0·002, 0·004; carbon, 0·172, 0·185, 0·122; silica, 0·067, 0·061, 0·056;—totals, 99·872, 99·659, 99·947. The chlorine, the author states, is not an essential constituent of the original masses, but has been derived from the soil in which the iron has lain imbedded.

Application of Photography to the Determination of Astronomical Data.—A. Hall.—An important astronomico-physical essay.

Ralstonite, a New Fluoride from Arksut-Fiord, Greenland.—G. J. Brush.—The mineral is colourless to white, with a vitreous lustre, crystalline in octahedra; hardness equal to about 4·5; sp. gr., 2·4. When heated in a test-tube, the mineral whitens, yields water at first, then gives off fumes and a copious white sublimate, while the walls of the tube are etched; the vapour in the tube, as well as the water, exhibit an acid reaction. Heated before blowpipe-flame, the mineral whitens without fusion, and colours the flame a soda-yellow; heated with cobalt solution, a bright alumina blue appears. In salt of phosphorus the substance was readily dissolved, giving a colourless bead. The mineral was, on examination with a magnifier, found to be so intimately associated with thomsenolite, that it was deemed impracticable to separate a sufficient quantity for anything more than a preliminary qualitative investigation in the wet way, which led to the result that the mineral is essentially a hydrous fluoride of aluminum, with probably a small amount of calcium and sodium. Its isometric form and its infusibility distinguish it from all other fluorides yet described as occuring at the cryolite locality in Greenland. The only mineral which, in general chemical characters, approaches it is the fluellite from Stenna-Gwyn, in Cornwall, a rare mineral which, according to Wollaston, is a fluoride of aluminum.

Atomic Weights of Cobalt and Nickel.—R. H. Lee.—Reserved for complete reproduction, an observation also applicable to the following paper.

Note on the Spectrum of the Corona.—C. A. Young.

Jahrbuch der Kaiserlich-Königlichen (Austro-Hungarian) Geologischen Reichsanstatt, No. 1, 1871.

In addition to a large number of strictly geological papers and memoirs, this number contains—

In Memory of Wilhelm Haidinger.—F. Ritter von Hauer.—An excellent biography of the lately deceased celebrated *savant* just named.

Studies on the Saline Region of Siebenbürgen (Transylvania).—F. Posepny.—The second section of a lengthy memoir containing a very large number of results of chemical analysis of the water of saline springs, and of the produce of various layers and deposits of rock-salt and of various mineral waters met with in the country alluded to.

Polytechnisches Journal von Dingler, second number for June, 1871.

The original papers and memoirs relating to chemistry and collateral sciences are the following;—

Analysis of a Sample of Universal Manure (Universal Dünger).—Dr. H. Vohl.—Under this name, the firm Hösch, at Enderrich, near Bonn, has for some years sold an artificial manure which exhibits a yellowish-grey colour, is acid to test-paper, does not give off any strong smell, and is composed, in 100 parts, of—Water, 14·714; residue left after ignition, 58·593; loss by ignition, 26·808; nitrogen, 6·407; total phosphoric acid, 17·185; of this quantity, 6·188 is readily soluble, and 10·995 described as difficultly soluble; sulphate of potassa, 8·456.

Note-Paper which Contains Arsenic.—Dr. H. Vohl.—The author calls attention to the fact that there is now in the trade, at least on the Continent, a kind of beautifully light and deep rose-coloured note-paper, which, on being exposed to sunlight, is readily bleached, and, on being further investigated by the author, was found to be coloured with the arsenical residues of the fuchsine manufacture, and to yield, when treated with Marsh's apparatus, a considerable arsenical deposit.

Results of the Application of Various Kinds of Manure to Beet-Roots.—Dr. O. Tech.—This paper contains, in tabulated form, the results obtained on the large scale by the use of various kinds (23 in all) of manures, as applied to beet-roots in Bohemia.

Beet-Root Sugar Industry in Europe.—Dr. Dingler.—At the end of last year, there existed in Europe 1507 beet-root sugar works, of which 483 belong to France, 310 to the German Confederation, 283 to Russia, 228 to Austro-Hungary, 153 to Belgium, 42 to Poland, 20 to the Netherlands, 4 to Sweden, and 1 each to Italy and the United Kingdom of Great Britain and Ireland.

First number for July, 1871.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Stoddart's Suggestion Concerning the Concentration of Sulphuric Acid by Blowing Air through the Fluid while Hot.—F. Bode.—Inserted *in extenso*.

Application of Sodium as an Explosive Agent.—F. Springmühl.—The contents of this paper, illustrated with several woodcuts, describe a series of experiments made with the view to ascertain how far, and under what conditions, sodium may be applied as a substance suited to cause, by contact either with water or other materials, the explosion of vessels wherein these substances are contained. The force exerted is by no means small, as may be inferred from the following:—46 grms. of sodium and 18 grms. of water yield 2 grms. of hydrogen, a bulk of 22471·9 cubic centimetres. The space required for the sodium only amounts to 44·7 c.c. (the water is contained, previous to its coming into contact with the sodium, in a small bulb, which is solidly fixed by means of a neck to the bulb wherein the sodium is contained, which latter may be made of 50 c.c. capacity), taking 50 c.c. for the capacity of the explosion bulb, the pressure of the gas generated inside will be 450 atmospheres, equal to 6800 lbs. to the square inch.

Preparation and Use of Manganates and Permanganates of Alkalies.—E. Desclabissac.—This paper contains a description of the best and most practical methods suited for the manufacture of the salts alluded to, on the large scale.

Sulphuret of Cadmium (So-Called Cadmium Yellow), as a Pigment for Imparting a Yellow Colour to Toilet Soaps.—E. Schering.—The author, a manufacturing chemist, at Berlin, states that the pigment alluded to has been found to be the most durable and least expensive to impart to toilet soaps a fine yellow hue. The sulphuret is first rubbed up with some oil, and this mixture well incorporated by stirring with hot and liquid soap mass; the pigment does not dissolve therein, but is only finely divided. Two varieties of the cadmium yellow are now prepared on the large scale, one having a lemon, the other an orange-yellow colour.

Composition of Argol.—J. C. Sticht.—The author gives, in a tabulated form, the results of the analysis of 15 different samples, obtained from various wine-growing countries, of argol (crude bi-tartrate of potassa). The quantity of the salt was found to vary, in these samples, from 90 per cent to 34 per cent, while the quantity of tartrate of lime present in these samples varied from 52 per cent to 4 per cent.

NOTES AND QUERIES.

Distillation of Wood.—J. H. Mayor will find all the required information in a work entitled "Die Trockene Destillation der Holzes and die Verarbeitung der Durch Diesebbe Erhaltenen Roh Producti," von Dr. Ed. Assmuss (Berlin: 67, Verlag von T. Springa).—V. C.

Distillation of Wood.—(Reply to J. H. Mayor.)—We do not know of any book specially treating on this subject, but useful information will be found in vol. xxiii. of the Chemical News, pages 91, 105, 132, and 168. You can also refer to vol. i., part 1, p. 340 and following, of the "Chemical Technology" of Richardson and Ronalds.

Schio Liao.—I have read an account lately of a cement used in China called *schio liao*, which is composed of 3 parts of blood and 4 parts of slaked lime, the blood to be beaten to deprive it of fibrine. Will you kindly say what is the meaning of destroying the fibrine, and in what way I am to proceed?—E. J. L.

NOTICE TO AMERICAN SUBSCRIBERS.

In answer to numerous inquiries, the Publisher begs to state that Subscribers in the United States can be supplied with the CHEMICAL NEWS from this Office, post free, for the sum of £1 2s. 4d. per annum payable in advance.

THE CHEMICAL NEWS.

Vol. XXIV. No. 613.

NOTE ON THE

ACTION OF ALDEHYDE ON THE TWO PRIMARY UREAS.*

By Dr. J. EMERSON REYNOLDS.

The action of the dicarbon aldehyde of the fatty series, C_2H_4O, on certain derivatives of ammonia, has of late been studied with considerable care, and most interesting results arrived at in the course of the investigation. We have been long familiar with the reactions of aldehyde with aniline, described by Schiff, who has shown that the dyad group C_2H_4'', or ethyliden, as it is often called, can replace successively two distinct proportions of hydrogen in the double molecule of aniline, water being eliminated according to the equations:—

$$1.\ 2(C_6H_5,NH_2)+C_2H_4''O=\left\{\begin{matrix}C_6H_5,NC_2H_4\\C_6H_5,NH_2\end{matrix}\right\}+H_2O.$$

$$2.\ 2(C_6H_5,NH_2)+2(C_2H_4''O)=\left\{\begin{matrix}C_6H_5NC_2H_4''\\C_6H_5NC_2H_4''\end{matrix}\right\}+2H_2O.$$

We are also acquainted with analogous reactions which have been obtained with amides and aldehydes of the aromatic series; it therefore appeared to be a matter of some interest to examine the action of aldehyde on another class of ammonia derivatives. I refer to the group of so-called *ureas*. Of these, there are at least two primary bodies,—one the well-known product of the animal organism, or Wöhler's beautiful artificial urea; and the other, the sulpho-urea which I discovered a few years ago.

It is unnecessary now to discuss the question of the identity or otherwise of Wöhler's and the normal urea. It is sufficient here to mention that all my experiments have been made on Wöhler's urea and on the analogous sulphur compound.

It will be convenient for the present to regard the two ureas just referred to as ammonia derivatives respectively of carbonic (according to Dr. Kolbe, carbamic), and sulpho-carbonic acids. Thus—

Wöhler's urea .. .. .. $CO''\left\{\begin{matrix}NH_2.\\NH_2.\end{matrix}\right.$

Sulpho-urea .. .. .. $CS''\left\{\begin{matrix}NH_2.\\NH_2.\end{matrix}\right.$

My object being to attempt the partial or complete replacement of hydrogen in each urea by the ethyliden group, according to the equation

$$CS\left\{\begin{matrix}NH_2\\NH_2\end{matrix}\right\}+C_2H_4''O=CS\left\{\begin{matrix}NC_2H_4''\\NH_2\end{matrix}\right\}+H_2O.$$

I may now be allowed very briefly to state the chief results arrived at in the course of the inquiry.

Action of Aldehyde on the Sulpho-Urea.

The first experiments were made with the sulpho-urea. A quantity of the pure compound was dissolved to saturation in nearly anhydrous aldehyde. The hot saturated solution was digested in a hermetically sealed flask, at a temperature of 100° C., for two hours. The solution was then allowed to cool. No urea crystals were deposited. After two days' standing, however, a number of minute, spherical, sub-crystalline masses were found to have attached themselves to the sides of the flask, and these gradually increased in quantity, until a considerable amount had been obtained. The clear liquid gave a copious white precipitate with water and with alcohol. The deposited body was carefully washed with cold alcohol, in which it is very slightly soluble, and then purified by solution in a large volume of boiling anhydrous alcohol, from which the new body separates out to a large extent on cooling a somewhat starch-like granular substance, seen under the microscope to be made up of extremely minute crystals. The analysis of the body gave numbers agreeing well with the formula:—

$$CS''\left\{\begin{matrix}NC_2H_4''\\NH_2\end{matrix}\right.$$

and is, therefore, derived from the urea by the replacement of half the hydrogen by ethyliden.

The new body is but slightly soluble in ether, rather more so in cold alcohol, but its solubility in boiling alcohol is much greater. In consequence of its relations to these solvents, the substance can be easily purified. It is but very slightly, if at all, truly soluble in cold water; but when digested at 100° C. with water, solution is obtained, —but solution in consequence of decomposition,—aldehyde being produced, and the urea separated with some ammonium sulphocyanate. The essential reaction is probably correctly represented by the equation—

$$CS''\left\{\begin{matrix}NC_2H_4\\NH_2\end{matrix}\right\}+H_2O=CS''\left\{\begin{matrix}NH_2\\NH_2\end{matrix}\right\}+C_2H_4''O.$$

or the converse of that, according to which the *ethyliden-sulpho-urea* is formed, dilute acids and alkalies act in the same way.

From the alcoholic solution I have obtained a platinum salt and a gold compound.

Action of Aldehyde on Wöhler's Urea.

The urea was dissolved nearly to saturation in aldehyde, and the solution digested in a sealed flask for two hours at 100° C. When cool, the flask was opened, and the contents poured into a suitable vessel, and the aldehyde slowly evaporated. No crystals of the urea were deposited, but a transparent pasty mass remained when the solvent had been almost wholly driven off. After standing for twenty-four hours, the residue was found to be white and friable. The mass was powdered, and digested in the cold with weakly-anhydrous alcohol, in which it is very slightly soluble at ordinary temperature, washed with the same liquid, and then boiled with alcohol. The filtered solution so obtained deposits, on rapid cooling, a considerable quantity of a flocculent body, seen under the microscope to be wholly made up of minute and considerably modified monoclinic crystals. Analysis gave the formula:—

$$CO''\left\{\begin{matrix}NC_2H_4''\\NH_2\end{matrix}\right.$$

for this body. A platinum compound has been obtained, but no gold salt.

The new substance is easily decomposed by digestion with water into aldehyde, and the products of decomposition of the urea. The first stage of the reaction, may, no doubt, be represented by the equation:—

$$CO\left\{\begin{matrix}NC_2H_4''\\NH_2\end{matrix}\right\}+H_2O=CO\left\{\begin{matrix}NH_2\\NH_2\end{matrix}\right\}+C_2H_4''O.$$

Having succeeded in replacing half the hydrogen in each of these ureas, directly, and by a very simple reaction, I endeavoured to go a step farther, and substitute a hydrocarbon group for the residual hydrogen within the molecule. All attempts in this direction have hitherto been fruitless.

In view of the facts above-stated and others well known, proving that half the hydrogen only is capable of replacement, and that each atom of nitrogen within the molecule of the urea is somewhat differently engaged, we are clearly warranted in slightly modifying the rational formula of each urea, in order to bring it into more complete harmony with the facts. The extent of the alteration is apparent,

* Read before the British Association, Edinburgh Meeting, Section B.

when we write the formulæ of the ethyliden-ureas referred to in this note, thus:—

$$\text{Ethyliden-urea}\left\{\begin{matrix}NC_2H_4\\COH\\NH.\end{matrix}\right.$$

$$\text{Ethyliden-sulpho-urea}\left\{\begin{matrix}NC_2H_4\\CSH\\NH.\end{matrix}\right.$$

ON THE CONSTITUTION OF SALTS.*

By J. ALFRED WANKLYN,
Corresponding Member of the Royal Bavarian Academy of Sciences.

Some time ago I made the observation that there existed a numerous class of chemical compounds isomeric with the soda-salts of the fatty acids, but radically different from them in constitution. The compound obtained by the action of acetic ether on ethylate of soda belongs to this class. Its composition is expressed by the empirical formula $C_4H_7NaO_2$, being an isomer of butyrate of soda; but instead of yielding butyric acid when treated with dilute sulphuric acid, it gives alcohol and acetic acid, showing that its four atoms of carbon are not bound together in one group. At first sight two theories of the structure of this singular compound present themselves. It might be acetate of sodinated-ethyl or sod-acetate of ethyl—

$$\left.\begin{matrix}C_2H_3O\\C_2H_4Na\end{matrix}\right\}O \quad \text{or} \quad \left.\begin{matrix}C_2H_2NaO\\C_2H_5\end{matrix}\right\}O$$

But the action of iodide of ethyl on it demonstrates that it is neither the one nor the other. Treated with iodide of ethyl it gives neither acetate of butyl nor butyrate of ethyl. Instead of yielding either of these products it breaks up into alcohol, isocaproate of acetylinated ethyl, and iodide of sodium, thus:—

$$2C_4H_7NaO_2+2C_2H_5I=Na_2I_2+C_2H_6O+C_{10}H_{18}O_3.$$

The mechanism of this reaction I have explained on former occasions. The fact to which I wish to call particular attention is, that herein we have an example of ethyl being *substituted* for sodium, without *true replacement* being effected. It is a critical instance showing that monatomic ethyl does not discharge the function of the metal sodium. As those who are familiar with my work will recollect, I assign to the isomer of butyrate of soda the rational formula—

$$Na'''\left\{\begin{matrix}OC_2H_4\\C_2H_3O\end{matrix}\right.$$

and the name acetate of ethylene-sodium.

Reasoning from this sodium compound and from the multitude of double sodium-salts which are known to exist, I have been led to assign a triatomic function to the metal sodium, and formulate such compounds as caustic soda and acetate of soda as follows:—

$$Na'''\left\{\begin{matrix}O''\\H\end{matrix}\right. \text{(Caustic soda).}$$

$$Na'''\left\{\begin{matrix}O''\\C_2H_3O\end{matrix}\right. \text{(Acetate of soda).}$$

Should these views prevail (and the more I enquire into the subject the more disposed I become towards them), most of the common formulæ of metallic compounds will be altered. The water-type, which is at the present moment employed to represent metallic salts, will, in many instances, have to give way to the ammonia-type; and so the metallic salt and the corresponding acid will be represented by chemical formulæ radically dissimilar.

One of the consequences of the new theory being, thus, that metallic salts and acids are radically unlike, it derives support from experimental differences between salts and their corresponding acids.

The salts of alumina are usually regarded as approximating most closely to the "so-called salts of hydrogen." The recognition of fundamental differences between salts of alumina and acids is, therefore, specially to the point. I have recently observed two such differences. Nitrate of alumina, unlike the so-called nitrate of hydrogen, does not dissolve chromate of silver. A mixture of nitrate of alumina with hydrochlorate of alumina in aqueous solution admits of being boiled without evolving chlorine.

These experimental facts exhibit striking difference between the salt and the acid. They also show that salts of alumina are not so prone to decomposition as is commonly believed.

* Read before the British Association, Edinburgh Meeting, Section B.

ON THE EFFECTS OF HEAT ON PROTOPLASMIC LIFE, PREVIOUSLY DRIED.

By F. CRACE CALVERT, F.R.S., &c.

The following series of experiments was instituted as a sequel to those already published, and with the view of ascertaining whether animalculæ which had been previously dried would resist a higher temperature without being destroyed than animalculæ when heated *with* the fluid in which they were living.

In hope of throwing some light on this point, small thin slips of glass, 3 centimetres in length and 5 m.m. in breadth, were taken, and one side of each slip was smeared with a thin coating of putrid albumen containing a considerable quantity of microscopic life.

Fifty-six of these slips of glass were prepared on the 5th of July, 1871, and allowed to dry in the air for twenty-four hours, when twenty-eight of them were taken and sealed in tubes of the same size as those used in the experiments already published, whilst the remaining twenty-eight were placed in an air-bath, and kept at a temperature ranging between 100° and 120° F. for fourteen hours, and than sealed in tubes.

Therefore there are two series of experiments—one in which the putrid fluid was merely dried on the slips at natural temperature; the other in which the fluid, after being dried in the air, was thoroughly desiccated in the bath.

Four from each series were set apart and not heated; the remaining tubes of both of the series were rolled in wire gauze to prevent, as far as possible, any danger arising from the accidental bursting of any of the tubes, and placed in an oil-bath, which was gradually heated and kept for half an hour at the following temperatures:—100°, 200°, 300°, 400°, 500°, and 600° F. Four tubes from each series were taken out at each temperature, and those that remained were kept in the bath with its temperature at another fixed point for half an hour.

The above experiments gave rise to three series of experiments:—

First.—Some of the glass tubes were broken; the small slips of glass they contained were taken out and laid on a microscopical slide, which had previously been moistened by a drop of pure distilled water, left for about fifteen minutes, and then examined.—July 8.

Second.—Other slips were taken from each of the series and placed in small tubes, 5 centimetres in length and 8 m.m. internal diameter, with equal quantities of pure distilled water, and then hermetically sealed.

These slips were heated on the 11th of July, and examined on the 15th.

Third.—Slips were placed in tubes, 7 centimetres in length and 15 m.m. in diameter. The tubes were then filled with a solution of albumen which had been prepared on the 22nd of April last, and was still absolutely free from life, having been prepared by the process described in my first paper.

This series was commenced on the 11th and examined on the 15th of July.

Series I.—Slips (*dried in air*) and simply heated at the various temperatures. Moistened with water on the slide of the microscope, and examined immediately.

Not heated.	Heated to 100° F.	Heated to 200° F.	Heated to 300° F.	Heated to 400° F.	Heated to 500° F.	Heated to 600° F.
1. Six or seven living animalculæ were present under each field. None were swimming, but all were moving to and fro with distinct vital motions. The majority are ordinary vibrios; a few of them, however, are long vibrios.	2. Life is present to about the same extent, and with about the same vitality, as exists in 1.	3. Same class of vibrios exist here as in 1 and 2, and to about the same extent and with the same amount of vitality. So that up to this point there appears to be little or no difference in the amount of life.	4. There is a very decided decrease in the amount of life here. All the long and nearly all the ordinary vibrios have been destroyed. Two or three small vibrios are still present, however, moving to and fro under each field.	5. No life present.	6. No life present. The albumen on the glass-slip has been charred, and pieces of this charred mass appear under the microscope to resemble shellac.	7. No life present. The albumen on the slip is charred to a greater extent than 6, and small carbonised pieces, mixed with the shellac ones, were present.

Series II.—Slips (*dried in bath for fourteen hours between* 100° *and* 120° *F.*) were simply heated at the various temperatures. Moistened with water on the slide of the microscope, and examined immediately afterwards.

Dried in bath, but not heated after.	Heated to 100° F.	Heated to 200° F.	Heated to 300° F.	Heated to 400° F.	Heated to 500° F.	Heated to 600° F.
1. There are seven or eight animalculæ under each field. They are principally ordinary vibrios, and there were also a few long and very long vibrios present.	2. Exactly the same class of life is present here as in 1. It exists to the same extent, and with the same amount of vitality.	3. There is no difference in the life present here to that existing in 1 or 2.	4. There is a very decided decrease in the amount of life present here to that observed in 1, 2, or 3. All the ordinary, long, and very long vibrios have been destroyed, and only a few small black vibrios are left, which are sufficiently distinct in their appearance and motion to show that they are still alive.	5. All the life has been destroyed.	6. No life present.	7. No life present.

Series III.—Slips (*dried in the air*), and afterwards heated to the different temperatures, were introduced into small tubes containing pure distilled water on the 11th of July, hermetically sealed, and on the 15th of July the water in each of the tubes was examined.

Water alone for comparison.	Not heated at all.	Heated to 100° F.	Heated to 200° F.	Heated to 300° F.	Heated to 400° F.	Heated to 500° F.	Heated to 600° F.
1. No animalculæ life present.	2. Four or five ordinary vibrios are present in the whole drop, two of which are swimming about.	3. About forty *bacteria* vibrios are sprinkled about under each of the bottom fields, and about ten or twelve long and ordinary vibrios are swimming about throughout the drop.	4. One or two large or ordinary vibrio is observed under most of the field moving to and fro.	5. A few energetically-moving dots and small vibrios are present throughout the whole drop. No *bacteria*.	6. No trace of animalculæ life is present, but a number of pieces of matter are oscillating to and fro.	7. No animalculæ life present.	8. No animalculæ life present.

Series IV.—Slips (*dried in bath at* 100° *and* 120° *F.*), afterwards heated to the different temperatures, and the slips then taken from their original tubes and introduced into tubes containing pure distilled water on the 11th of July, and examined on the 15th.

Merely dried in bath, not heated.	Heated to 100° F.	Heated to 200° F.	Heated to 300° F.	Heated to 400° F.	Heated to 500° F.	Heated to 600° F.
1.	2.	3.	4.	5.	6.	7.
About one ordinary vibrio was observed moving to and fro under each field.	The appearance of the fluid here is exactly the same as 1.	About seven or eight *bacteria* vibrios are present under each field, and one ordinary swimming vibrio is present under most of the fields.	About one or two ordinary swimming vibrios were observed throughout the whole drop.	No animalculæ life present.	No animalculæ life present.	No animalculæ life present.

Series V.—Slips (*dried in air*), afterwards heated to the different temperatures, were then introduced into tubes containing equal quantities of an albumen solution. They were hermetically sealed on the 11th of July, and examined on the 15th.

Albumen alone for comparison.	Not heated at all.	Heated to 100° F.	Heated to 200° F.	Heated to 300° F.	Heated to 400° F.	Heated to 500° F.	Heated to 600° F.
1.	2.	3.	4.	5.	6.	7.	8.
No distinct vibrio life is present.	Four or five distinct vibrios were observed moving to and fro throughout each drop. No *bacteria* vibrios were observed.	Four or five *bacteria* vibrios were present at the bottom of each field, and one or two ordinary or long vibrios were swimming about above them.	About one ordinary vibrio moving to and fro under most of the fields, and one or two *bacteria* vibrios were observed throughout the drop; but no swimming life is present.	A few *bacteria* vibrios were present throughout the drop, and a very few were moving to and fro.	No life.	No life.	No life.

Series VI.—Slips (*dried in bath between the temperature of* 100° *and* 120° *F.*) heated to the different temperatures, and introduced into the tubes containing albumen solution, and sealed on the 11th of July and examined on the 15th.

Albumen alone for comparison.	Not heated at all.	Heated to 100° F.	Heated to 200° F.	Heated to 300° F.	Heated to 400° F.	Heated to 500° F.	Heated to 600° F.
1.	2.	3.	4.	5.	6.	7.	8.
No distinct vibrio life present.	About ten or twelve ordinary *bacteria* vibrios are present at the bottom of each field, and twelve or fourteen ordinary and rather long vibrios are swimming. There is also a number of some fungi present, which gives the fluid a turbid appearance when shaken up.	There is about the same amount of life here, and the fluid has much the same appearance as 2.	There is life present here, but not to such an extent as it exists in either 2 or 3.	A few *bacteria* vibrios are present at the bottom part of each field, and one or two ordinary vibrios and microzymes are swimming about above them.	No life.	No life.	No life.

ON THE USES OF A NEW PRECIPITATING REAGENT OF COPPER.

By HUGO TAMM.

In the current work of analytical chemistry the use of apparatus is to be avoided on nearly every ground; and, on the contrary, reagents ought to be employed whenever this can be done with safety. But a reagent, to be perfect, must fulfil certain conditions.

(1). When employed for the determination of a solid substance it should be volatile, or, if it is fixed, it should not form, with the precipitate, compounds of indefinite composition.

(2). It should form, with the element to be determined, a compound as insoluble as possible.

(3). It should not introduce in the liquid separated from the precipitate any substance likely to alter the behaviour of its constituents, with general or respective reagents, and, least of all, it should not introduce any substance difficult of separation from any of the constituents.

(4). It should separate the element to be determined, in the shape of a compact precipitate, in neutral or acid liquors, and allow the other elements of the combination to remain in solution.

This is, perhaps, the most important principle in analytical chemistry.

The reagent which I now propose fulfils these conditions, and is, consequently, very perfect; in practice it will be found very useful. It is obtained by dissolving in distilled water equal weights of sulphocyanide of ammonium and of bisulphite of ammonia. This mixture keeps well, and can be used several months after its preparation, providing it is not left exposed to the air for any length of time; but, should a slight alteration take place in its composition, this would be of no consequence.

A mixture of equal weights of sulphocyanide of potassium and of bisulphite of potash or of soda answers equally well; in fact, it keeps still better than the former mixture, and the only objection to its use is its being composed of fixed salts.

Either of the five salts above mentioned can be obtained in a great state of purity, and, as both mixtures are equally perfect as regards the estimation of copper, I should recommend the first for analytical purposes and the second for simple assays of copper.

The important property of this reagent consists in forming, in solutions of copper acidulated with hydrochloric acid, an abundant white precipitate of subsulphocyanide of copper, which is completely insoluble.

The only precaution to take to ascertain the presence of copper in a solution is to neutralise any nitric acid which might be present with an excess of ammonia, and then to acidulate the solution with a slight excess of hydrochloric acid.

The behaviour of this reagent is easily explained. Bisulphite of ammonia, which, in ordinary circumstances, reduces but very slowly proto-salts of copper, reduces them instantaneously, in presence of sulphocyanide of ammonium, and this salt forms immediately with the subsalt of copper produced the subsulphocyanide of copper, which is precipitated, and thus the behaviour or the mixture is that of an ordinary simple reagent.

The qualitative uses of this reagent are somewhat limited; still it is most useful to ascertain at once beyond a doubt that a blue ammoniacal liquor owes its colour to copper. For this purpose the ammoniacal liquor is supersaturated with hydrochloric acid, a few drops of the reagent are added, and, if copper is present, it is immediately precipitated. If, on the contrary, the blue colour is due to nickel or iridium, no precipitation takes place, but if the colour is partly due to copper and partly to some other metal, then a separation takes place, copper is precipitated, and the filtrated liquor, saturated anew with ammonia, assumes a blue tinge.

It is needless to say that if, through neglect or through some unexpected reaction, a white precipitate were obtained with the reagent, and if some doubt existed as to its containing copper, it would only be necessary to oxidise and dissolve the precipitate in nitric acid, and saturate the solution with ammonia in excess to obtain—copper being present—the characteristic blue liquor. Or the white precipitate may be dissolved at once in ammonia. In presence of the air it oxidises rapidly, and soon imparts to ammonia the blue colour due to copper.

When the white precipitate of subsulphocyanide of copper is thoroughly washed—and this is the case, not as might be presumed when the washings are free from sulphocyanides as detected by perchloride of iron, but, on the contrary, when they are free from chlorides which adhere more strongly to the precipitate than sulphocyanides—and when the precipitate is thoroughly dried, its formula is Cu_2CyS_2, and it contains 52·30 per cent of copper.

As in chloride solutions the only metal precipitated by the reagent is copper, it affords easy means of separating this metal from all others, and of estimating it with promptitude, and with the greatest accuracy. In analytical researches and in quantitative determinations it is an invaluable reagent.

In the few examples which follow will be found the way of proceeding and the precautions to take to effect the separation and determination of copper, in the chief products containing this metal.

Estimation of Copper in Pure Copper and in Swedish and Russian Copper.

Twenty grains of the metal are dissolved in nitric acid. The solution, diluted with water, is supersaturated by ammonia, and a sufficient quantity of hydrochloric acid is added to make the blue colour disappear and to give a greenish solution quite clear. The liquor, which is very warm, is allowed to cool to a temperature of about 50° C., and enough water is added to make it occupy from ½ to ¾ of a pint. The reagent is then added little by little. At first a dark brown liquor is obtained which rapidly turns to a white precipitate* which settles rapidly. When the precipitation is complete, a few drops of the reagent are added in excess; the whole is allowed to rest in a warm place for some little time. The precipitate is collected on a double filter, and washed until no chlorine can be detected in the washings by means of nitrate of silver. It is then thoroughly dried, and afterwards weighed, and the quantity of copper is calculated from the composition of the precipitate given above. The drying of the precipitate being the longest part of the operation, whenever it is required to make a rapid determination the process can be modified as follows:—

The washed sulphocyanide of copper is detached while wet from the filter; the filter is burnt, and its ashes are mixed with the precipitate, which is digested for some time with an excess of sulphide of ammonium. By this means sulphuret of copper is obtained. It is filtered and thoroughly washed; it is then dried very rapidly in a small porcelain crucible, and calcined. This being done, a little excess of pure flour of sulphur is thrown in the crucible, which is then carefully covered, and all the sulphur is driven off at a low red heat. After cooling the residue of sulphuret of copper presents the constant formula Cu_2S, and it contains exactly ⅘ of its weight of copper.

Estimation of Copper in Bar Copper, and in Native Copper.

The complete analysis of this metal is very delicate, and it can safely be assumed that no analysis of it, previous to the use of sulphocyanides, was ever very perfect, or very reliable. On the contrary, by using the reagent every

* If the dark colour persisted, and if nitrous fumes were evolved the solution should be rejected at once as unfit for use. This happens when nitric acid has not been properly saturated.

trace of foreign metals can be easily detected and determined after the separation of copper is effected.

Twenty grains of the metal are dissolved in nitric acid, and, if the solution is quite clear, the copper is estimated exactly as in the former example. If, on the contrary, a precipitate of oxides of antimony or tin is manifest in the liquor, it should be dissolved by adding a little hydrochloric acid, or a fresh lot of metal should be dissolved in aqua regia. This being done, the determination of copper is proceeded with exactly as previously stated.

For the complete analysis, 100 grs. are dissolved in nitric acid or in aqua regia. The solution, supersaturated with ammonia, is re-acidulated with a slight excess of hydrochloric acid, and the liquid is made to occupy at least one pint. The reagent is then added, with the precaution already indicated, and in general, when the precipitation is complete, the supernatant liquid assumes a pink or red colour due to sulphocyanide of iron. The liquid is then filtered on a double filter (this precaution is useful because the sulphocyanide of copper is apt to pass through single filters), and the precipitate is well washed. The liquid, mixed with a little more hydrochloric acid, is boiled until no smell of sulphurous acid from the reagent can be detected; it is then submitted to analysis.

Lead, arsenic, and antimony will generally be found. Even coppers leaving no residue in nitric acid contain antimony which can be detected and estimated when separated in this way. The same remark applies to tin, which exists more often than might be supposed. Bismuth, nickel, and zinc are three metals which exist very frequently, also, in copper. Cobalt is found pretty often too, and silver and iron are nearly always present.

Sulphur, which exists frequently, must be determined in a special operation.

The usual method of analysing copper, by precipitating it with sulphuretted hydrogen, and by treating the precipitate with sulphide of ammonium, is most imperfect. The bulky precipitate of sulphide of copper holds the small quantities of sulphurets of antimony, arsenic, and tin, with an adhesive power nearly equal to the dissolving power of ammonia. If the dissolving power of this reagent is increased by addition of sulphur, a large proportion of copper is dissolved, and the analysis is complicated and inaccurate. Furthermore, the separation of the small quantities of the other metals precipitated with the copper is also difficult and imperfect by ordinary processes.

Estimation of Copper in Brass, in Bronze, and in German Silver.

The separation of copper in alloys containing considerable quantities of zinc presents great uncertainty when effected by means of sulphuretted hydrogen. This is due to the capricious behaviour of the zinc in presence of sulpuret of copper, and this process ought to be rejected without hesitation, the more so that the reagent answers admirably the purpose, and that the separation effected by its means is one of the neatest in analytical chemistry.

Quantities of the alloys, varying from 20 to 50 grs., should be dissolved for the determination of their chief constituents, and no less than 100 grs. should be employed for the determination of the smaller quantities of foreign metals. The proceedings are identical with those indicated in former examples.

In bronzes, tin can be separated by nitric acid. This mode of separation is sufficiently accurate for ordinary purposes, but in correct analyses it would be advisable to dissolve the alloy in aqua regia, and proceed first to the separation of copper.

With these alloys the copper reagent proves invaluable, not only as affording means of estimating with facility and accuracy the composition of important alloys, but also as enabling the chemist to determine the very important question of the cause or causes of brittleness in those alloys.

Estimation of Copper in Pyrites, in Copper Ores Generally, and in Slags.

The reagent proves much less useful and necessary in the analyses of these minerals and slags than in those of the former products, for the reason that ordinary methods answer well when applied to them. Indeed, it is not advisable to use the reagent at first to effect the separation of copper, unless this metal exists in large quantity, and is alone to be determined. However, if uniformity in the estimation of copper was an object, no objections would be raised against using the reagents which separate the copper with equal perfection whatever substances accompany it. But for analytical purposes it would be best to precipitate by sulphuretted hydrogen, copper, and the group of metals which are precipitated with it, and thus to separate them from the large proportions of iron and of earthy matters which may be present.

The precipitated sulphurets being re-dissolved in nitric acid or in aqua regia, this solution can be submitted to analysis, and, in most cases the reagent can be employed with advantage in this part of the operation, and if copper is the most abundant metal of all, it will prove as useful as ever.. If, on the contrary, copper formed only a small fraction it would be best not to use the reagent at all, but to apply the ordinary methods of separation.

Some pyrites and certain earthy minerals contain about equal proportions of bismuth and copper. In these instances it is best to separate bismuth first, to avoid all possibility of this metal being precipitated by water and mixed up with copper. The same remark applies to cases where antimony is present in large proportions.

As a general rule, when a metal, such as lead, silver, antimony, or bismuth, exists in large proportions, and when this metal can be easily separated from copper, it is best and safest to effect its separation at once.

There are instances in which the separation of copper is not only difficult but imperfect with ordinary methods. Such is the case when copper exists in a liquor with palladium, vanadium, molybdenum, and cadmium. In these instances no better means of separation can be resorted to than to use the reagent, which effects all these separations as, indeed, most separations with the greatest perfection.

THE VERTICAL LANTERN; A NEW INSTRUMENT OF DEMONSTRATION.

By HENRY MORTON, Ph.D.,
President of the Stevens Institute of Technology.

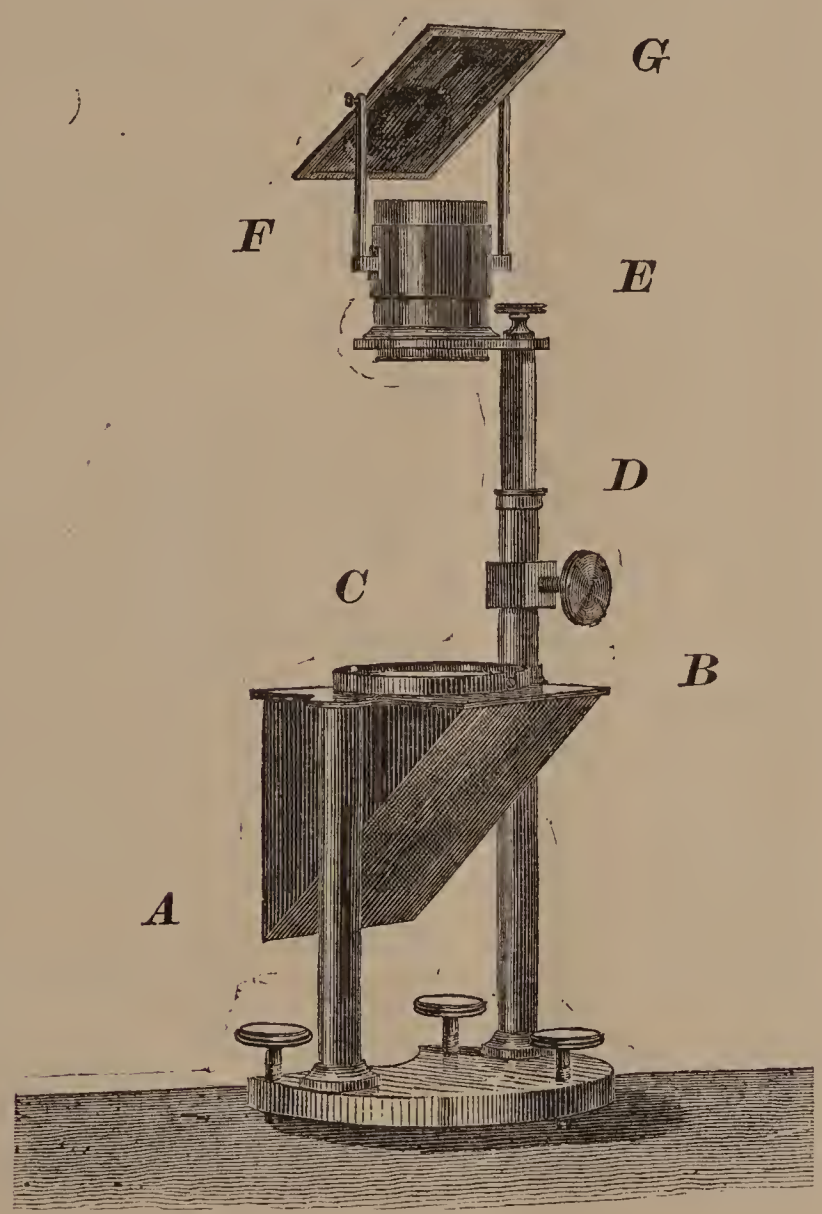
During a visit to Cambridge, Mass., last summer, Prof. J. P. Cooke was kind enough to show me an arrangement, which he had been using for several years, for the projection, on a vertical screen, of objects, such as "cohesion figures," which require to be kept in a horizontal position.

To effect this result a square box, containing a diagonal mirror, was attached to the front of a large lantern, so that the rays proceeding from the condensers were thrown vertically upon the object, such as a tank of water, placed above. Over this, again, was supported the object-glass, and a mirror, silvered on its front surface, by which the image was thrown on the screen. Among the objects which were then shown, I was particularly impressed with a tank of water, in which waves being made by falling drops gave a beautiful pattern of interfering lines and curves in delicate grey tints upon the screen.

The only defect in the action of this instrument was the want of an equal illumination in the field, resulting from the separation of the object from the front of the condenser.

I was so favourably impressed with the apparatus, however, that at the earliest opportunity I prepared a design, and had the instrument represented in the accompanying cut constructed by Messrs. Hawkins and Wale, apparatus makers to the Stevens Institute.

Its arrangement was as follows:—The lantern condenser in the first place was made of three lenses, the first two of such curve as to give with the light, at about two inches from the nearer one, a practically parallel beam, which was received upon a mirror, A B, at 45°, and, after reflection from it, fell upon the third lens placed horizontally at C, which concentrated it on the objective at E, from which it passed to the mirror, F G, which, in turn, threw it on the screen. This mirror, moreover, was not silvered on the exterior surface, but in the usual way, though with pure silver, on the back, and yet no want of definition was to be perceived in the image, owing, no doubt, to the fact that the faint reflection from the first surface was inappreciable in comparison with that from the metallic silver. In several articles published in the Chemical News and elsewhere, a square prism has been described as being used for the same purpose, but a little thought, or, still better, a moment's experiment, would show that this means would not answer, because about one-third of the cone of rays entering the prism would be at too great an



angle for total reflection, and would thus leave one-third of the field dark.

In producing waves in a tank of water, I have used with great satisfaction a little apparatus devised by Messrs. Hawkins and Wale, consisting of a metallic box with a sheet rubber cover, provided with a long thin metal tube; this was so placed that the tube was about one-quarter of an inch above the point in the tank which it was desired to make the centre of the wave motion. On tapping the rubber diaphragm, a momentary puff of air was driven from the tube, producing exactly the disturbance needed. An elliptical ring being placed in the tank, the properties of that curve with regard to reflection are very neatly exhibited, and, in fact, independent of their scientific interest, nothing could be more charming than the pearl-grey waves, crossing and interlocking and combining in complex patterns, which raced across the screen.

"Cohesion figures," "magnetic spectra," and the metallic vegetation developed by an electric current in a solution of chloride of tin, are among the illustrations specially suited to this instrument, and I have lately added another, by so supporting a large glass Chladni plate as to bring one of its corners over the condensers, covering this with a thin layer of water, kept in place by a thin ring of rubber cemented to the glass, and exciting the plate with a violin bow. The entire screen is then covered with a beautiful pattern of crispations, varying with the sounds obtained by variously damping the plate. This experiment I used with great satisfaction at a lecture lately delivered in the Academy of Music in Philadelphia, a building which seats over 3000 persons. This will afford some idea of the efficiency of the apparatus; I have, in fact, been greatly surprised by the amount of light which reaches the screen from this apparatus, which is far in excess of what I anticipated when considering the two reflections and other causes of loss.

ON RECENT INVESTIGATIONS AND APPLICATIONS OF EXPLOSIVE AGENTS.*

By F. A. ABEL, F.R.S., Treas. C.S.

In submitting to the Members of the British Association some account of recent progress made in the production and application of explosive agents, I cannot attempt to give much more than an outline of the nature and results of important investigations which have been instituted, and are still being pursued, relating to the development and regulation of the explosive force of gunpowder, and to the application of some other explosive materials, which are already supplanting gunpowder in several of its important uses.

The manufacture of gunpowder required for war purposes was carried on here and abroad for very many years without any important modification. The system pursued in this country in effecting the incorporation of the ingredients, and in converting the mixture into granulated gunpowder, of sufficient density and hardness to enable it to resist injury by transport and storage in all climates, furnished a product which was greatly superior to the generality of foreign gunpowders in regard to its keeping qualities, but which was also more violent in its action, because, in fact, the conditions essential to a rapid and complete transformation of the several constituents were more thoroughly fulfilled in its manufacture; and which hence earned on the Continent the name of *poudre brutale*.

The comparatively small charges used even with the heaviest cast-iron smooth-bore guns, which, until recently, constituted our most powerful armaments by sea and land, were, however, regarded in this country as not unduly trying to the endurance of those guns; and although, about fourteen years ago, some attention was directed to the question of modifying the form or proportions of heavy guns with a view to increase their durability, in consequence mainly of some very instructive experiments instituted in America by Major Rodman, it was not until some little time after the first great stride was made in the increase of power of our artillery (by the introduction of the 110-pounder Armstrong rifled wrought-iron gun), that attention became seriously directed to the importance of attempting to reduce the violence of action, or rapidity of explosion, of the gunpowder to be employed in the increased charges required to impart the requisite velocity and accuracy of flight to comparatively heavy projectiles.

A comparison of the weight of shot and of the charges of powder used in the heavy guns of the present day, with those employed in the most formidable *cast-iron* siege and naval guns, will at once show how greatly the conditions must have become modified which attend the application of gunpowder to projectile purposes. Much has been

* A Lecture delivered to the Members of the British Association at Edinburgh, August, 1871.

written and said, especially of late, as to our having been far behind other nations in devoting attention to the modification of gunpowder, with a view to meet the altered conditions attending its application in the heavy guns of the present day; but the fact is, that not only were the first investigations into the action of fired gunpowder made in this country, but steps were also taken in England, almost as soon as in any other country, towards the production of a gunpowder, by employment of which the full powers of heavy guns may be developed with the least detriment to their durability.

In 1858 a small committee was appointed to determine upon the best description of gunpowder to be used in the Enfield rifle, and not long afterwards this committee was instructed to extend its inquiry to cannon powder—the most powerful gun of the service at that time being the 110-pounder Armstrong gun. One of the members, General (then Captain) Boxer, had, some few months previously, called attention officially to the desirability of modifying the action of the charges of powder used in the larger natures of guns, either by employing a weaker powder, or a larger grain and denser powder, the charge being increased in amount in order to obtain the same average pressure, and, consequently the same initial velocity, as furnished by the quick powder then used. A careful consideration of the directions in which gunpowder was susceptible of modification, with a view to the reduction of the rapidity of its explosion, led the committee to institute a series of experiments, which resulted, in the first instance, in the introduction into the service, in 1860, of the so-called rifle large-grain powder for all rifled guns, and subsequently in the provisional introduction of pellet-powder for the heavier natures of ordnance. The means and appliances at the command of this committee for carrying out their experimental investigations were small and imperfect: but the results at which they arrived not only served as the starting-points of the successful results attained by the present Committee on Explosive Substances, but also became known to and aroused the attention of Continental Powers, through the agency of officers who visited this country at about the time of the Exhibition of 1862, at which date pellet-powder had already been experimented with for some little time. In America experiments on gunpowder were vigorously pursued at the same time as they were being slowly carried on, with comparatively imperfect means, in England, and the particular form of powder known as prismatic, the production of which was developed in Russia a few years ago, and which has been to some extent adopted in Prussia, appears to have been of American origin, though it has not found favour in that country, where a gunpowder similar in form and size to the new powder known as *pebble* is employed in guns of large calibre, under the name of *mammoth powder*.

The principles laid down by the first Committee on Gunpowder, in 1858, as their guide in attempting to reduce the violence of action of powder when fired in large charges, have been, up to the present time, adhered to by those since entrusted with the continuance of these investigations. Before specifying them it may be instructive to glance briefly at some ways in which gunpowder may readily be modified, with the object of increasing or diminishing the rapidity and violence of its explosion, and at the reasons why they have not hitherto been selected.

As gunpowder is simply an intimate mechanical mixture of a powerful oxidising agent—saltpetre or potassium-nitrate, with two readily-oxidisable substances, sulphur and carbon or charcoal—it is obvious that the behaviour of this mixture, *i.e.*, the rapidity with which it will explode, and the nature of the results furnished by its explosion, are susceptible of great modification by variations in the proportions of its ingredients.

According to the long-accepted chemical theory of the action of gunpowder, the function of the charcoal was to undergo conversion into gas by partial or complete oxidisation (*i.e.*, by conversion into carbonic acid or carbonic oxide), according to the proportion which it bears to the saltpetre employed, while the sulphur was considered to act in two ways—firstly, in promoting the ready ignition of gunpowder by reason of its great inflammability; secondly, by uniting with the potassium in the saltpetre, and thus rendering available the whole of the oxygen for the oxidation of the carbon.

That this view is, to say the least, only a very imperfect explanation of the action of the ingredients in gunpowder, has long since been demonstrated; but the broad facts are undoubted that the rapidity of explosion of a mixture of these three substances may readily be increased or diminished by modifications of the proportions of sulphur or charcoal, or of both, with which the saltpetre is mixed. A very notable difference may be observed in the rate at which two trains will burn, which consist of gunpowders in other respects alike, but differing, for example, in the proportion of charcoal which they contain.

A comparison of the composition of English and foreign gunpowders shows that some of them differ considerably from each other as regards the proportions of their ingredients; and there can be no doubt that these differences may exert a very decided influence upon the action of these gunpowders.

The extent to which the charcoal employed in their preparation has been burned (*i.e.*, the duration of the carbonising process, or the temperature at which it has been effected), and its consequent composition, also vary considerably, and it has been abundantly demonstrated, by the more recent experiments conducted at Woolwich, that, the other characters of cannon powders, tried one against another, being alike, the violence of action increases in direct proportion to the amount of volatile constituents (as indicated by the proportions of hydrogen and oxygen) which have been allowed to remain in the charcoal. This result was observed many years ago in connection with powder for small arms, the French having found that a highly inflammable charcoal (*charbon roux*), produced by exposure of wood to a comparatively low temperature, furnished a very violent gunpowder, which, on account of its destructive action upon the firearm, was termed *poudre brisante*. It was, however, not known that apparently small differences in the composition, and consequently in the physical properties and ready inflammability of the charcoal might be productive of very considerable differences in the action of gunpowder even when employed in large charges.

It need scarcely be pointed out after what has been said regarding the influence exerted by certain variations of composition upon the rapidity of explosion and consequent violence of gunpowder, that different modifications in the composition of powder, which are opposed in the results they produce, may be made more or less completely to neutralise each others effects. Thus, the reduction in rapidity of action of gunpowder, which may be effected by a diminution in the proportion of the inflammable ingredient sulphur, or of the oxidising ingredient saltpetre, may be counteracted by the employment of a slackly-burned, and therefore highly inflammable, charcoal; and in this way it may be possible that the composition hitherto fixed for gunpowder in this and some other countries may be susceptible of modification, with advantage in point of economy.

Sufficient has been said on this head to show that the explosive action of gunpowder is susceptible of very extensive modification by variation of its composition. But inasmuch as the force exerted by gunpowder is due not simply to the actual amount of gaseous products resulting from the explosion, but also, and in the largest proportion, to the heat developed by the chemical action, it follows that there must be particular proportions of ingredients which, leaving other conditions out of consideration, would appear the best, as furnishing the largest amount of gaseous matter compatible with the development of the highest temperature.

There can be no doubt that the proportions of saltpetre,

sulphur, and carbon, fixed upon in the earlier days of gunpowder manufacture (and which have hitherto undergone no *very* considerable modification, and indeed *none* made with any definite design), were not fixed upon by any theoretical considerations, but were purely the result of tentative experiments; but they very nearly correspond to those required for the development of the most energetic action of the saltpetre upon the carbon (regarding the charcoal for a time as pure carbon), though they are not calculated to furnish the largest amount of gas from a given weight of the mixture. The latter result would necessitate the employment of the carbon in the proportion to produce carbon monoxide, or carbonic oxide; while the amount actually used in gunpowder is approximately that required to produce only carbon dioxide or carbonic acid, assuming the sulphur only to exercise the function above indicated, and not to take to itself any of the oxygen of the saltpetre. It has now been long established that the sulphur does at any rate undergo partial oxidation; but it is also admitted that the employment of the proportions of saltpetre, carbon, and sulphur, indicated by the old theory, which provided for the full oxidation, or conversion into carbonic acid, of the greater part of the carbon, furnished a mixture by the explosion of which a comparatively very great amount of chemical energy, and consequently of heat, is developed (or of pressure, when the charge is confined).

It is upon such considerations as these that the late Committee on Gunpowder came to the conclusion that, in attempting to moderate the explosive violence of gunpowder when used in large charges it was inadvisable to make any change in the established composition of gunpowder which might be productive of a diminution of the total pressure developed by a charge, unless the desired results were unattainable by modifying the mechanical and physical characters of powder—in other words, by introducing changes in the *preparation* of gunpowder, and in the *form* in which it is employed. It required but few experiments to demonstrate that the rapidity of explosion of gunpowder was readily susceptible of great reduction by simple mechanical means, and hence those means have been adhered to by the present Committee on Explosive Substances, in elaborating the powder now manufactured for naval and siege guns.

The degree of perfection to which the ingredients of powder are prepared by grinding, and afterwards mixing or incorporating, affords an obvious means of modifying the rapidity of explosion of the mixture, but it would also evidently be both unphilosophical and unpractical to reduce the rapidity of burning of powder by diminishing the degree of completeness to which the ingredients would react upon each other, and thus employing them wastefully, which would be the case if they were not converted into as intimate a mixture as is attainable by known means and appliances. But, starting with as perfect a mixture as can be prepared of the ingredients in the proportions calculated to furnish the maximum attainable change of volume (and consequently of total pressure at the time of explosion), there are *five* different directions in which gunpowder may be modified as regards its physical and mechanical characters, and the means thereby presented of regulating the rapidity of explosion, have, up to the present time, proved quite sufficient for all requirements. These variable points are—*the size* of individual masses composing the charge of powder; *the form* of these masses, and the *mechanical condition* of their *exterior*; the *density* or compactness of the masses, and their *hardness*. The size and form of the masses are readily modified by moulding the mealed powder into forms of a particular size and shape, as in the case of pellet-powder, prismatic, cubical, or spherical powder; or by breaking up, to a greater or less extent, and in a symmetrical or irregular manner, cakes of compressed powder of different thicknesses, thus producing what is called granulated powder, which ranges in size from fine sporting powder to pebble powder. The surfaces of these masses may be left in their original rough condition, or they be more or less smoothed and deprived of sharp angles and edges by means of attrition and subsequent glazing or coating with graphite; and their ready inflammability may be correspondingly reduced. The density or compactness of the powder is determined by the pressure to which the material is submitted when converted into slabs, pellets, or other forms; and the hardness is regulated by the proportion of moisture contained in the powder at the time that it is submitted to pressure.

Experience has shown that it requires a very careful adjustment of the several mechanical and physical characters of gunpowder to reduce the rapidity of its action, and at the same time to develope the requisite total pressure and consequent velocity with sufficient uniformity. The first promising result obtained by the late Committee on Gunpowder were simply arrived at by increasing the size of the masses composing the charge; subsequently it was found that the results were greatly improved by paying attention to the density and hardness of the powder, and by adopting measures to promote uniformity in regard to these properties of the powder-particles composing a charge, the importance of which has become more evident as the means available for examining the action of fired gunpowder have been extended and perfected.

A very brief examination only can be attempted of the results which have been arrived at by earlier experiments with regard to the pressure developed by exploding gunpowder, and of those quite recently obtained by the Government Committee on explosive agents.

Although the first attempt was made by a Frenchman, M. de la Hire, in the beginning of last century, to explain the action of fired gunpowder, it was Robins who first investigated the subject experimentally, by carefully determining the quantity of gas generated by the explosion, and by endeavouring to estimate from experimental data the increase of elasticity of the gases due to the temperature developed by the explosion. He came to the conclusion that the permanent gases evolved from powder occupy about 240 times its volume, at normal temperature and pressure, and that the heat generated raised this volume to 1000 times that of the powder, causing the latter therefore to exert a force corresponding to a pressure of about 1000 atmospheres, or $6\frac{3}{4}$ tons on the square inch. The first experiments, of which the object was a direct determination of the pressure exerted by gunpowder when exploded in closed vessels, were made by Count Rumford in 1793, who confined a small charge of sporting powder (not more than 18 grains), in a very strong wrought-iron vessel, the opening of which was closed by means of a weight. The vessel or species of gun was supported vertically, and the charge was exploded by applying a red-hot ball to the lower extremity of the vessel, which formed a closed vent and was filled with powder. A given charge having been employed, the vessel was closed by a weight which was considered likely to be equivalent to the gaseous pressure to be developed. If this weight was raised by the explosion of the particular charge used, it was increased until it just resisted the force exerted by the explosion; this weight was then taken to represent the pressure exerted by the powder. The results obtained by Rumford were conflicting, but the conclusion arrived at by him was, that the total force developed by the explosion of gunpowder corresponded to 101,021 atmospheres, or a pressure of 662 tons upon the square inch. Rumford endeavoured to reconcile the development of this enormous total pressure with the fact that guns could endure it, by assuming that the explosion of powder takes place very gradually in a gun, being completed only when the shot leaves the bore.

Another method, first suggested by Colonel Cavalli in 1843, of determining the pressure in a gun's bore, consisted in inserting a number of small tubes or gun-barrels into the gun along its length; spherical bullets were inserted into these barrels, and the pressure at different parts of

the gun was estimated by ascertaining the velocities by which these balls were propelled when the gun was fired. An improved form of the same method of experiment was adopted in 1854 by the Prussian Ordnance Committee, but was only applied to guns of small calibre. It consisted in fitting a small gun-barrel into a hole drilled into the powder-chamber of the gun; after the gun was loaded, a cylinder, having the same longitudinal section as that of the projectile in the gun, was inserted into the small barrel. Assuming the pressure in the powder-chamber to be uniform throughout, the cylinder and the shot would travel through equal spaces in the same time, and the cylinder, after having travelled eight inches, would be out of the sphere of action of the gas. If the cylinder had a longitudinal section one-half that of the shot, it would require double the velocity, and so on; and thus, by knowing the relation of the longitudinal section of the cylinder to that of the projectile, the velocity of the latter, after it had prescribed a particular distance, could be ascertained by determining that of the cylinder.

The results of the Prussian experiments indicated that the maximum pressure in a 6-pounder gun is 1100 atmospheres, and in a twelve-pounder 1300 atmospheres. The same method subsequently applied to a 70-pounder rifled gun appears to have given an indication of a pressure of about 3000 atmospheres.

(To be continued).

NOTE ON TRINITRO-THYMO-METHOL.

By ROLAND J. ATCHERLEY.

Thymo-methol, prepared by acting upon a solution of thymol in methyl iodide with metallic sodium, is dissolved with the aid of a gentle heat in concentrated sulphuric acid, and added very cautiously, by means of a small pipette, to fuming nitric acid. The resulting deeply-coloured solution is diluted with a quantity of water. A large proportion of a resin will then rise to the surface, which may, when cold, be easily removed, while a fused substance remains at the bottom of the vessel. This, when crystallised from alcohol, constitutes trinitro-thymo-methol. It forms beautiful iridescent plates of a yellowish colour, fusing at 92° C., and exploding when heated on platinum foil. It is only slightly soluble in boiling water, but easily dissolves in alcohol and ether. Sulphuric acid dissolves it likewise; it is, however, re-precipitated on dilution with water in an unaltered state. Analysis shows it to be represented by the formula $C_{11}H_{13}O(NO_2)_3$. I have not yet succeeded in converting it into an amide, but hope shortly to do so, as well as to prepare the mono- and di-nitro derivatives of thymo-methol.

NOTICES OF BOOKS.

The Technical History of Commerce; or, Skilled Labour applied to Production. By John Yeats, LL.D., F.G.S., F.R.G.S., &c., assisted by several Scientific Gentlemen. London: Cassell, Petter, and Galpin.

Dr. Yeats considers all branches of industry as grouped under three heads, viz., Materials, Labour, and Commerce; and to each he devotes a volume of his series, of which the present is the second published, the former being entitled "The Natural History of the Raw Materials of Commerce." Industry is divided into:—Mechanical, comprising Engineering, Manufacturing, Mining, &c. Chemical—Bleaching, Dyeing, Smelting, &c. Physiological—Dealing with Agriculture, Gardening, and Cattle-rearing. And Mental, with Education and Government. After considering the origin of the useful arts and the knowledge possessed of them by the ancients, their present application is outlined, and it is from the clear definition of this outline that the full worth of the work obtains. Dr. Yeats thinks with Sir Humphry Davy, that all the great changes of nations are not to be confounded with changes in their dynasties, but that these changes are dependent upon the opinion of the people, and the peculiar spirit of the age and nation. The illustrative facts are drawn from all sources, and greatly from Germany, where the author, it appears, spent some time in studying the application of chemical and mining science. It must be borne in mind that Dr. Yeats is the head-master of a large school, and that this work is written for the use of his boys, not only while they are with him, but to serve the purpose of an introduction to the literature of the particular branch of industry the student may eventually follow, not forgetting that there are many established commercial men to whom Dr. Yeats's work will convey much that is interesting. The work enlarges the scope of our school books, showing how they may be written to be preserved in after life, not for mere curiosity, but for actual information. These volumes should certainly accompany the usual text-books of "our sixth."

CORRESPONDENCE.

SPECTRUM OF LIGHTNING.

To the Editor of the Chemical News.

Sir,—We had here, during a thunderstorm on Monday night, a magnificent display of lightning, the spectra of which I examined, but having only a pocket spectroscope, I was unable to determine the position of the bright bands with any degree of accuracy.

Two narrow blue-green bands most frequently made their appearance; they were somewhat narrower than those of the chloride of copper spectrum, and separated by a wider interval. At times when the flashes were particularly vivid, bands of various degrees of luminous intensity and of breadth were distributed over the whole spectrum; and, during the occurrence of a flash *en zigzag*, a group of narrow ones—two being very brilliant—appeared in the more refrangible part of the red, besides those bands in the blue and green, which were always most conspicuous.

The complexity of these spectra gave me the impression that this department of meteorological chemistry would prove a most promising field of investigation.—I am, &c.,

Joseph Gibbons.

Tywardreath, Cornwall,
August 16, 1871.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, July 31, 1871.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Second Memoir on the Action of Electricity upon the Coloured Tissues of Plants.—M. Becquerel.

Glacial Origin of the Peat Deposits of the Neufchâtel Jura, and on the Plants met with therein.—Ch. Martius.—A geologico-botanical essay.

New Mineral Found in the Tin Ore Deposit of Montebras (Creuse).—M. Moissenet and M. Des Cloizeaux.—This paper contains a brief description of the results of the mining operations at Montebras, where tin ore is found, and, among other minerals, also a fluo-phosphate of alumina, soda, and lithia, which will be mineralogically known as montebrasite. The composition of this substance, in 100 parts, is quoted as follows:—Fluorine, 26·50; phosphoric acid, 21·80; alumina, 38·20; soda, 6·70; lithia, 6·50; lime, 2·0; quartz (intermixed, not really belonging to the mineral), 2·25; loss by ignition, 0·60. Qualitatively, this mineral contains the same constituents as the amblygonite from Arnsdorff, but in the montebrasite a three times larger quantity of fluorine occurs; the sp. gr. of the last-named mineral is 3·11. The formulæ given are $2(Al_2Fl_3,3MFl)+4Al_2O_3,3PO_5$, and the atomic formula, $Al_4M_2O_9Fl_8P_2$. Wavellite and turquoise are also met with in the tin ore deposit alluded to.

Reversion of the Spectrum-Rays of Metallic Vapours.—A. Cornu.—A lengthy spectroscopical memoir.

New Method of Incineration of Vegetable and Animal Substances, and the application of that method to the Estimation of the Mineral Elements of Yeast.—A. Béchamp.—After first referring at length to the difficulty often experienced by analytical chemists, to ignite and burn off completely certain organic substances, especially such as yield a readily fusible ash, the author proposes the use of nitrate of bismuth in the state of an aqueous solution of known strength to be mixed with the material to be incinerated (in this paper yeast is only mentioned, and it is a well-known fact that that substance is very difficult to burn off completely), provided the water contained in the substance has been previously ascertained by drying at 100°. The nitrate of bismuth solution (the bulk thereof to ignite and calcine readily 100 to 150 grms. of substance should contain from 3 to 4 grms. of oxide of bismuth) having been mixed with a fresh and weighed portion of the yeast, the mixture is first dried gently on a water-bath, next heated on a sand-bath hot enough to cause the mass to blacken, after which it burns away as tinder, and, if required, the ignition is completed over the lamp. Should any fear exist that some metallic bismuth should have been formed, nitric acid is added to the ash, and the heating repeated, so as to destroy the nitrate of bismuth thus formed. The author, not desiring to estimate the chlorine in the ash of the yeast he had operated upon, dissolved that ash in hydrochloric acid, and removed the bismuth by means of sulphuretted hydrogen. This paper contains also a series of results of ash analysis of yeast made by the method alluded to.

Discovery of a Bone Cavern near Montrejeau (South of France).—M. Piette.

Bone Caverns of Baoussé-Roussé (Italy).—E. Rivière.—This and the preceeding paper are contributions to geology and palæontology.

Zeitschrift für Chemie von Beilstein, No. 8, 1871.

The original memoirs and papers contained in this number are—

Conversion of Dichlorhydrine boiling at 174° into that boiling at 182°.—H. Hübner and C. Müller.—By treating an allyl-alcohol (prepared from a dichlorhydrine boiling at 174°) with dry chlorine gas, the authors obtained a dichloride different from that which they expected to obtain (one that should boil at 174°), but a dichlorhydrine boiling at 182°, identical with that which is obtained by the action of chlorine upon allyl-alcohol from glycerine and oxalic acid.

On α Brom-Sulphotoluol and α Sulphotoluol.—H. Hubner and N. M. Terry.—The authors first describe the preparation of solid brom-toluol, a crystalline substance, fusing at 28°, and boiling at 185°; sp. gr. at 30°, 1·3999. This substance was first dissolved in fuming sulphuric acid, and several α sulphotoluol salts prepared. The α sulphotoluol, $C_6H_4CH_3.SO_2OH$, is a crystalline substance, soluble in water. The lead-salt of this acid, $[C_6H_4.CH_3.(SO_2O)]2Pb+4H_2O$, is a crystalline compound readily soluble in water. Nothing is mentioned in this paper on α brom-sulphotoluol.

The Sulpho-Acids of Benzol.—Dr. H. Rose.—The author describes the preparation of a sulpho-acid of benzol by treating pure nitrobenzol with fuming sulphuric acid, and next forming, first a baryta salt, from which the free sulpho-benzol acid was separated. That free acid is a solid substance, soluble in water and alcohol, hygroscopic, fusing between 60° and 70°, and insoluble in ether. The baryta salt, $C_6H_4NO_2SO_32Ba+H_2O$, is crystalline, yellowish coloured, somewhat soluble in water, and insoluble in alcohol. The paper further contains the catalogical quotation of several other salts of this acid.

Product of Decomposition of the Chlormethyl-Sulphurous Acid.—N. Jazukowitsch.—While preparing trichlormethyl-sulphite of potassa by treating the chloride of the acid alluded to with excess of caustic potassa solution, the author observed the formation of a salt insoluble in water, which was found to be also insoluble in alcohol, and to consist of $CH_2.SO_2.K_2O_2$. This salt is the potassa salt of a bibasic acid, which, however, could not be obtained in free state.

Ethyl-Diacetic Acid and some of its Derivatives.—A. Geuther.—This monograph contains the following sections:—Best method of preparation of ethyl-diacetic acid; action of pentachloride of phosphorus upon ethyl-diacetic acid; monochlor-quartenylic acid; monochlor-tetracylic acid, $C_4H_5ClO_2$; sodium salt—

$$2(C_4H_4ClO_2Na)+H_2O;$$

oily product; quartenylic acid, $C_4H_6O_2$; tetracrylic acid (solid crotonic acid); tetrolic acid; on diethyl-diacetic-amide, and the action of ammonia upon heated ethyl-diacetic acid ether.

Researches on the Allyl Group.—B. Tollens, A. Rinne, and G. Münder.—This essay is divided into the following chapters:—Conversion of allylic alcohol into normal propylic alcohol; oxidation of allylic alcohol; on allyl-cyanide (croto-nitrile); conversion of the chloride of allylic alcohol into the dichlorhydrine isomeric therewith.

Estimation of Chlorine, Bromine, and Iodine according to Carius's Method.—B. Tollens.—The author states mainly that small glass globules containing bromated or other substances, when heated in sealed tubes, along with nitric acid of 1·2 sp. gr., up to 160° and 220°, when made of ordinary glass, lose from 0·0071 to 0·029 grms. in weight; while globules made of Bohemian glass (best combustion-tube glass) lost, after six hours' heating to 220° along with nitric acid, only from 0·0008 to 0·0012 grms. By the application, therefore, of Carius's method, the glass globules should be made of best Bohemian glass, since ordinary glass, even if free from lead, is strongly acted upon by nitric acid under the conditions alluded to.

Bulletin de l'Academie Royale des Sciences, des Lettres et des Beaux Arts de Belgique, No. 6, 1871.

The original papers and memoirs contained in this number relate to geology, palæontology, mineralogy, and geometry.

Les Mondes, July 27, 1871.

This number opens with an article entitled—

Salle du Progrés.—Rev. F. Moigno.—The excellent and enlightened editor of the above-named periodical states, in this short paper, that he intends shortly to open, with the assistance and collaboration of others, a campaign against what the writer terms "l'ignorance, une des grandes plaies de la belle France;" in other words, to begin, in various districts of Paris and localities of France, a series of lectures suited to the general public, and intended to render true, in a moral, material, as well as scientific sense, the "ingenuas didicisse fideliter artes emollit mores nec sinit esse feros."

This number further contains the following matter relating to chemistry and collateral sciences:—

Light and Electricity.—P. Breton.—This paper, illustrated by a woodcut, does not contain a description of any experiment already made, but suggestions on researches which might, if made with care, perhaps tend to illustrate something concerning the nature of the undulations of the ether which produce the phenomena of light and electricity.

Essay on the Comparative Geology of the Vosges, Pyrenees, and Central Mountain Plateau of France.—Dr. G. Bleicher.—An important contribution to geology, here briefly reviewed, the original work having been published last year at Colmar.

Best means of bringing Waste Lands into Cultivation.—Rev. F. Moigno.—Although the contents of this paper bear more especially upon France, there is much in it suitable for application to other countries where heath, marsh, and moor land are yet found waiting to be turned to useful account.

New Manometer for Measuring High Pressure of Gases.—V. Regnault.—Illustrated by engravings; while, moreover, the contents of this paper are strictly algebraico-physical.

Aurora Borealis seen and observed in Italy on the 9th, 18th, and 23rd of April last.—Rev. Father Denza, S.J.—To this lengthy paper is added a short appendix, stating that, on the nights of the 7th, 12th, and 18th of June last the phenomenon alluded to was brilliantly seen in various parts of Italy, and accompanied by strong magnetic perturbations.

August 3, 1871.

Central Scientific Office for the Netherlands.—Dr. E. H. von Baumhauer states that, in imitation of what obtains in the United States, where the Smithsonian Institute at Washington is the central office for exchange of publications and periodicals of the learned and scientific societies, it has been arranged that, for the Netherlands, this will be the Hollandsche Maatschappij voor Wetenschappen (Holland Society of Sciences), at Haarlem, to which the *savant* just named is the Secretary. A large number of the various scientific and learned societies in different parts of the Netherlands have intimated their intention of sending and obtaining their exchanges by the mode mentioned. M. J. Baillière and Son, at Paris, are provisionally nominated as the agents of the office at Paris for France.

August 10, 1871.

Origin of the Principal Currents of Air (Wind).—Dr. Lartigue.—A meteorological essay.

Cause of Explosion (Accidental and Spontaneous) of Explosive Substances, and on a Preventative of such occurences.—Dr. Zaliwski.—The author says that the explosive property of the inflammable substance depends upon the hygrometric condition of the atmosphere—that is to say, that gunpowder and other explosive materials become, even without elevation of temperature, spontaneously explosive, and that the smallest trace of oxalic acid is, if mixed with the explodents, sufficient to prevent spontaneous explosion due to the cause alluded to, owing to a catalytic effect which precedes the loss of basic water of the acid alluded to. The author further says that this fact can be readily experimentally proved by adding, to a mixture of sulphur and chlorate of potassa, for instance, or to any other explosive mixture, a certain quantity of oxalic acid, after which these materials may be heated even up to their point of fusion without exploding.

Bayerisches Industrie und Gewerbe Blatt, May, 1871.

This number contains the following original matter relating to chemistry and collateral sciences:—

Schweizer's Coating for Stereochromic and other Purposes.—Dr. Fechtinger.—This lengthy paper contains a detailed account of the results of the practical application of what, in reality, is a peculiar cement or stucco mass, consisting of pulverised chalk, or marble, quartzose sand, cement, and silicate of potassa solution, which, originally employed, and first applied, by M. Schweizer, at Munich, has been used in that city for various architectural and other purposes, among others, the coating of sheets of iron, zinc, &c., upon which coating stereochromy was applied.

Chinese Varnish.—Dr. v. Scherzer.—Under the name of schioliao, the Chinese apply as varnish freshly-defibrinated blood, mixed with powdered slaked lime, and a small quantity of alum, in the proportion of 3 parts of previously-defibrinated fresh blood, 4 parts of lime, and a small quantity of powdered alum. The result is the formation of a glutinous yet fluid mass, which is ready for use at once, and especially used for rendering wood perfectly water-tight, and harden its surface. The author states that he has seen in China bags made of straw rendered so impervious for liquids by the application of this varnish as to serve for the transport of oil, while thin millboard painted with this varnish becomes as hard as wood.

Preventatives for the Ignition of Woven Fabrics.—A. Patera.—The author recommends the use of a solution consisting of —Water, 20 parts; borax, 3, and sulphate of magnesia, $2\frac{1}{4}$ parts. These salts are only to be mixed just previous to use. The muslins and other similar fabrics are thoroughly impregnated with the solution, next wrung out, and are, after having become nearly dry, ironed. The use of a mixture of sulphate of ammonia and sulphate of lime is also recommended. And, lastly, attention is called again to the application first made by Fuchs, so far back as 1823, of a solution of silicate of potassa, or soda, for rendering wood, and especially theatrical decorations, fire-proof, that is to say, preventing such from bursting into flame if accidentally ignited.

Action of Moist Ultramarine upon Silver.—J. N. Braunschweizer.—The author relates at length a series of experiments made by him, in order to explain some facts to which his attention had been called by parties, who found that silver foil (perfectly pure silver) and objects made of that metal—spoons and forks—became very deeply black-brown coloured under conditions which seemed to point to the presence of ultramarine (in paper wherein either the objects were packed, or in contact with) as the only cause of the discolouration and tarnishing of the metal alluded to. By the experiments, this opinion was fully confirmed, care being taken to have extra good quality of ultramarine, and to institute comparative experiments with other blue pigments, viz., indigo, litmus, Berlin-blue, mountain-blue, all of which, placed upon clean glass plates, and moistened with distilled water, were left in contact with silver foil for twenty-four hours, with the result that only the foil in contact with ultramarine was blackened. It thus appears that the sulphuret of aluminium present in ultramarine is slowly decomposed, and gives off, when moist, sulphuretted hydrogen.

Improved Mixtures for Red, Green, and Blue Bengal Lights.—J. N. Braunschweizer.—The following mixtures have been found, after a series of experiments, to be the best:—For *red*, 9 parts of nitrate of strontia, 3 parts of shellac, $1\frac{1}{2}$ parts of chlorate of potassa; for *green*, 9 parts of nitrate of baryta, 3 parts of shellac, $1\frac{1}{2}$ parts of chlorate of potassa; for *blue*, 8 parts of ammoniacal sulphate of copper, 6 parts of chlorate of potassa, 1 part of shellac. This latter ingredient need only be coarsely pulverised. The mixtures here alluded to are suitable for use in theatres and rooms, as by the combustion no injurious vapours are given off.

La Revue des Scientifique de la France et de l'Etranger, July 29, 1871.

This number does not contain any original papers bearing upon chemistry and allied sciences.

Journal für Gasbeleuchtung und Wasserversorgung, No. 13, 1871.

This number only contains such original matter as directly bears upon gas- and water-works' engineering and management.

NOTES AND QUERIES.

Logwood Test for Alum in Bread.—Can any of your correspondents inform me how the test for alum in bread, known as the logwood test, is performed, or where I shall find a description of it?—F. B. Munn.

Diamond Dust.—Could your readers tell me, through the medium of your paper, if there is a way of separating glass from jeweller's "diamond dust," the glass having been put in for adulteration?—Josiah Lowe.

Manufacture of Alum.—Desiring to obtain the fullest and latest information on alum manufacture, I should be obliged to your readers for directions. Muspratt, Richardson, and Knapp I have.—A.

Carbolic Acid.—(Reply to "Carbolic.)"—When quite pure—that is to say, free from other constituents of tar—carbolic acid has no disagreeable smell, and may be used by being dissolved in strong acetic acid, and next diluted with water. In the liquid thus obtained, the smell of acetic acid prevails, so as to make the peculiar odour of the carbolic acid quite imperceptible.

TO CORRESPONDENTS.

*** The Students' Number of the Chemical News will be published on Friday, September 8th. Gentlemen holding official positions in the Universities, Medical Schools, &c., of the United Kingdom, where Chemistry and Physical Science form a part of the Education, who have not yet forwarded the necessary information to our Office for publication in that number, will confer a favour by sending it with the least possible delay.

G. Maurice, Paris.—Your communication shall receive attention.

J. G.—The price of Dr. Schellen's work on Spectrum Analysis, reviewed in vol. xxii., p. 284, is 12s. 6d.

Dr. F. Crace Calvert, F.R.S., T. Bloxam, M. M. Pattison Muir, Dr. T. L. Phipson, R. J. Atcherley, Dr. C. R. A. Wright, Dr. Thorpe, N. S. Maskelyne, Dr. J. Emerson Reynolds, and J. Alfred Wanklyn.—These correspondents are thanked for their communications.

NOTICE TO AMERICAN SUBSCRIBERS.

In answer to numerous inquiries, the Publisher begs to state that Subscribers in the United States can be supplied with the CHEMICAL NEWS from this Office, post free, for the sum of £1 2s. 4d. per annum payable in advance.

Chemical Technology, or Chemistry in its Applications to the Arts and Manufactures. By Thomas Richardson and Henry Watts. Second Edition, illustrated with numerous Wood Engravings.

Vol. I., Parts 1 and 2, price 36s., with more than 400 Illustrations.

Nature and Properties of Fuel: Secondary Products obtained from Fuel; Production of Light: Secondary Products of the Gas Manufacture.

Vol. I., Part 3, price 33s., with more than 300 Illustrations.

Sulphur and its Compounds: Acidimetry: Chlorine and its Bleaching Compounds: Soda, Potash: Alkalimetry: Grease.

Vol. I., Part 4, price 21s., 300 Illustrations.

Aluminium and Sodium: Stannates, Tungstates, Chromates, and Silicates of Potash and Soda: Phosphorus, Borax: Nitre: Gun-Powder: Gun Cotton.

Vol. I., Part 5, price 36s.

Prussiate of Potash: Oxalic, Tartaric, and Citric Acids, and Appendices containing the latest information and specifications relating to the materials described in Parts 3 and 4.

Bailliere and Co., 20, King William Street, Strand.

North London School of Chemistry, Pharmacy, &c.—For Instruction in Practical Chemistry and Evening Classes for the Study of Chemistry, Botany, Materia Medica, &c. Conducted by Mr. J. C. BRAITHWAITE, *for thirteen years Principal Instructor* in the Laboratories of the Pharmaceutical Society of Great Britain, and Demonstrator of Practical Pharmacy, Pharmaceutical Latin, &c.

Mr. Braithwaite, having taken the premises adjoining his house, has been enabled *nearly to double the size of his Laboratories*, and, at the same time, procure a large piece of ground which *he has had laid out as a Botanic garden*. Every facility is, therefore, offered to Students desirous of acquiring a practical knowledge of this branch of their education.

The Session 1871—1872 will commence on the 2nd of October, when the Laboratories will re-open at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

THE CHEMICAL and TOXICOLOGICAL CLASS will meet as usual every Monday and Thursday evening, commencing October 2nd, at 8 p.m.

The LATIN CLASS for the reading of Physicians' Prescriptions, Cæsar's Commentaries, &c., every Tuesday and Friday evening, commencing October 3rd, at 8 p.m.

The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday evening, commencing October 4th, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will be continued every Saturday, until further notice, at 10 a.m.

Fee to either of the above Classes Half-a-Guinea per Month. Pupils can enter at any period.

Gentlemen Privately Prepared for the Examinations of the Pharmaceutical Society, and the "Modified Examination for Assistants," &c

All Fees must be paid in advance.

Letters of inquiry should be accompanied with a stamped envelope.

Mr. Braithwaite receives a few Pupils to Board in his house.

Address—54, Kentish Town Road, N.W.

Water-glass, or Soluble Silicates of Soda and Potash, in large or small quantities, and either solid or in solution, at ROBERT RUMNEY'S, Ardwick Chemical Works, Manchester.

THE CHEMICAL NEWS.

Vol. XXIV. No. 614.

LOCALITIES OF DIOPTASE.*

By Professor N. STORY MASKELYNE, F.R.S.

Dioptase has hitherto only been known as a product of the copper mine at Altyn Tubeh, in the Kirghese steppes of Tartary, if we except certain reputed localities in Germany; it has been recently met with among old specimens that have been traced to localities in Chili.

One of these was among the specimens preserved in drawers at the British Museum, which have lately been under careful examination with a view to their identification, and another similar specimen was obtained some years since by W. G. Lettsom, Esq., the well-known distinguished mineralogist, from a dealer at Vienna.

The crystals on both are minute but distinct, and are those of dioptase. The gangue is a compact micaceous hæmatite; the locality, traced to an old sale catalogue of Heuland's, is the Rosario Mine, Chili.

It is singular that other specimens of the same mineral should have been found among the carefully preserved treasures of the British Museum. One of these is associated with chrysocolla and ochre on a quartzose veinstone, another occurs as a thin crust on a schorlaceous rock, both being from a Chilian locality. A specimen recently obtained is associated with quartz and eisenkiesel, and is from the Mina del Limbo, Del Salado, Copiapo, Chili.

ON ANDREWSITE.*

By Professor N. STORY MASKELYNE, F.R.S.

A somewhat well-marked group of minerals would seem to justify the designation of the Dufrenite group, by reason of their having, as a common constituent (or being capable of being so represented), a compound of which the formula is $R_2P_2O_8+R_2H_6O_6$; R being Fe in the case of Dufrenite.

Dufrenite being $Fe_2P_2O_8+R_2H_6O_6$, or, in Berzelian symbols, $\dddot{Fe}\,\dddot{P}, \dot{R}\,\dot{H}_3$,

Peganite is $\dddot{Al}\,\dddot{P}, \dddot{Al}\,\dot{H}_3+3\dot{H}$,

Fischerite is $\dddot{Al}\,\dddot{P}, \dddot{Al}\,\dot{H}_3+5\dot{H}$.

Cacoxene is $\dddot{Fe}\,\dddot{P}, \dddot{Fe}_2\dot{H}_3+9\dot{H}$.

Wavellite is $2\dddot{Al}\,\dddot{P}, \dddot{Al}_2\dot{H}_3+9\dot{H}$.

A mineral recently found in Cornwall, and sent to the British Museum by Mr. Talling, may perhaps be referred to this group. It has been analysed in the Museum Laboratory, and Professor Maskelyne named it Andrewsite, in honour of the distinguished President of the Chemical Section of the British Association, Dr. Andrews, of Belfast.

Andrewsite occurs in occasional association with a bright green mineral in brilliant minute crystals, presenting a strongly marked resemblance to those of Dufrenite. This green mineral not having been as yet, from the small amount obtained of it, submitted to analysis, is only provisionally termed Dufrenite.

The Andrewsite which it sometimes thus accompanies presents itself in globular forms or in discs with a radiate structure, and in habit curiously resembles wavellite. Its colour is a slightly bluish green; its surface is generally formed of a very thin layer of the mineral provisionally termed Dufrenite, crystals of which occasionally stand out of the globules.

The interior of the globules is sometimes homogeneous, and consists of radiating crystalline fibres; oftener one perceives an almost sudden transition from an outer shell of some thickness, which consists of Andrewsite, into an inner core, formed of a brown mineral.

Seen under the microscope, the two minerals appear to a certain degree to interpenetrate each other, so that the selection of material for analysis is a work of much caution.

The spherules usually stand on the projections of a quartzose veinstone, protruding into a hollow, and covered with a mass of limonite, sometimes carrying a drusy crust of Göthite, and studded occasionally with a few brilliant little crystals of cuprite. The spherules are met with in one or two cases on cuprite formed round a nucleus of native copper. Andrewsite, in fact, contains copper, four analyses of separate specimens giving the percentages of—10·651, 10·702, 10·917, and 11·002.

The analyses of Andrewsite have proved sufficiently concordant to justify the formula—

$$3\{Fe_2P_2O_8+Fe_2H_6O_6\}+CuP_2O_8,$$

$$\text{or } 3\{\dddot{Fe}\,\dddot{P}, \dddot{Fe}\dot{H}_3\}+\dot{Cu}_3\dddot{P},$$

in which, however, a portion of the ferric phosphate is replaced by ferrous phosphate, as in Vivianite is frequently the case with the two phosphates.

The parallelism of Chenevixite ($Cu_3As_2O_8+Fe_2H_6O_6$) with a portion of the above formula is worthy of attention, and may justify the formula being written as—

$$2\{Fe_2P_2O_8+Fe_2H_6O_6\}+Cu_3P_2O_8+Fe_2H_6O_6+ +Fe_3P_2O_8.$$

A larger supply of the mineral will no doubt soon be forthcoming, when the formula may be fixed on the foundation of more certain analyses. The specific gravity of this mineral is 3·475, that of Dufrenite being (from Siegen) 3·2 to 3·4.

The chalkosiderite of Ullmann, the name by which nearly sixty years ago he designated a thin crystalline coating overlying the radiated variety of the Grüneisenstein (Dufrenite) of the Hollerter Zug, Sayn, Westphalia, does not seem to have been analysed by him. He states it to contain copper, but the subsequent analyses of Grüneisenstein do not appear to confirm this statement; indeed it appears more nearly to resemble the green crystallised mineral which has in this note been provisionally described as Dufrenite.

* Read before the British Association, Edinburgh Meeting, Section B.

ON THE GOLD ORE OF NOVA SCOTIA.*

By Dr. T. L. PHIPSON, F.C.S.

The gold-bearing rocks of Nova Scotia extend along the Atlantic border of the province for a distance of more than 300 miles. They are 12,000 feet in thickness, and are worked, in one district or another, through a vertical space of 6000 feet.

These rocks consist of clay slate and quartz, interstratified, and are supposed to be of lower Silurian age—in some places lying directly upon the gneiss, at others on the Cambrian rocks which cover the gneiss.

The other minerals besides gold found in this formation in Nova Scotia are sesquioxide of manganese, iron pyrites, mispickel (abundant), zinc blende, galena, copper pyrites (sometimes), calcspar, native copper, cuprite, mica, sulphide of molybdenum, malachite, and oxide of iron. But at least one-third of the country is yet unexplored, though it has been 120 years under uninterrupted British rule. In no place has the mining exceeded 300 feet from surface, and it is asserted to be well known that the quartz

* Read before the British Association, Edinburgh Meeting, Section C.

increases in richness with the depth. The few mines worked from 1860 to 1867 produced together about 3 tons weight (English) of gold, and since then the yield has gone on steadily increasing. I have lately examined a certain number of fine specimens of the above-mentioned rocks from the Pioneer Mine, in the Cariboo district, which has been recently opened. Two of these specimens weighed respectively 12½ lbs. and 8½ lbs. avoirdupois. They consist of a mixture of white quartz and dark green schist (termed clay-slate in the country). A fair sample of these two stones was taken, and 15 grms. of it treated with nitro-hydrochloric acid; the gold being precipitated as usual by sulphate of iron weighed 9 centigrammes. Another analysis gave, on 100 parts—

Gold	0·60
Silver	0·04

The gold stamped out of some rich specimens gave—

Gold	93·75
Silver	6·25
	100·00

which is similar to the richer kind of Californian gold.

The average yield of the mines now regularly working by the amalgamation process is about 1 ounce (troy) per ton; but much gold is wasted as well as mercury, as the ore is often very sulphurous, and roasting has hitherto failed from being incompletely carried out without kilns. In some instances the yield has been five to ten times as large, and in many districts, probably 3 or 4 ounces of gold per ton of ore could be reckoned on for a lengthened period. I am of opinion that a moderate amount of English capital and enterprise would soon make this colony one of the most successful gold regions on the globe.

I have examined the green schistous rock which accompanies the white quartz in the Cariboo district above-named, and which, like the quartz, contains gold. I have detected a notable amount of glucina in it and traces of some of the rarer earths. It is a dark leek-green schist, with an unctuous feel, like talc, gives a nearly white powder, which loses 2·32 per cent of water at a red heat, and takes a reddish tinge. It is only fusible with difficulty upon the thinnest edges before the blowpipe, and then whitens. The results of the only analysis I have made of it are as follows:—

Water	2·32
Silicic acid	41·20
Alumina	22·00
Glucina	0·33
Yttria and earths insoluble in potash	minute quantity
Oxide of manganese	2·20
Protoxide of iron	15·47
Magnesia	1·44
Lime	1·79
Alkalies	7·65
Portion not attacked by $KOCO_2$ + + $NaOCO_2$, with a little gold and silver.	5·60
	100·00

Whether this schistous rock should be termed *clay-slate*, *talc-schist*, *mica-slate*, *nacrite*, *or talcite*, is a question I must leave to the geologist, the composition of all these rocks presenting much similarity. There is a small quantity of peroxide of iron calculated here as protoxide. Gold is present in most of the minerals that are found in the quartz and green schist, especially in the arsenical pyrites and the iron pyrites, some specimens of which are very rich. I have little doubt that vanadic acid, titanic acid, and perhaps zirconia, could be detected in all these schistous rocks, as well as the rarer earths mentioned above, but I had only a limited period to devote to their examination.

ANALYSIS OF ENTIRE WHEATEN FLOUR.

By A. H. CHURCH, M.A.,
Professor of Chemistry, Royal Agricultural College, Cirencester.

It is well known that fine flour contains less nitrogen than the whole wheat grain. If we endeavour to supplement this deficiency of nitrogenous compounds by the addition of bran, though the chemical conditions of a satisfactory food rich in flesh-formers may be fulfilled, the mechanical texture of the material leaves much to be desired. Anxious to ascertain whether any article of commerce really contained all the materials of the wheat grain in desirable proportions, I made some trials of certain gluten preparations and of Chapman's Entire Wheaten Flour. The former scarcely fulfilled the necessary conditions, so far, at least, as fat and mineral matters were concerned, but the latter gave very encouraging results. Two determinations of nitrogen in the entire wheaten flour gave respectively

2·11 per cent nitrogen
2·12 ,, ,,

The mean of these results, when multiplied by the proper factor, 6·33, gives us 13·39 per cent of albumenoids or flesh-formers as contained in this preparation. This is a very large amount, seldom reached, except in certain horny long-grained foreign wheats, or in the translucent grains* of some of our home grown corn. Nor did the ash determination in this flour yield unfavourable indications. While the whole grain of wheat yields generally about 1·6 per cent of ash, the sample of flour now under notice gave 1·04 per cent, which compares well with the low percentage of 0·6 found in ordinary fine flour. This ash was also unusually rich in the most important ingredient of the mineral matter of the wheat grain, containing, as it did, no less than 51·8 per cent of anhydrous phosphoric acid, while the ash of ordinary whole wheat gives, on an average, no more than 46·2 per cent of this ingredient.

DETERMINATION OF NICKEL AND COPPER BY THE BATTERY.

By J. M. MERRICK, S.B.

The following analyses were undertaken recently to satisfy myself in regard to the accuracy of the electro-magnetic method of determining several metals. They show, in regard to nickel at least, what has already been demonstrated in the case of copper (*vide* Wolcott Gibbs, *Am. Journ. Sci.*, xxxix., pp. 64—65), that, where this method can be used, it is far more accurate, elegant, and satisfactory than any other.

The process employed is very simple. A platinum crucible, holding the solution to be decomposed, was made the cathode of a two- or three-cell Grove's battery, by setting it in the coiled-up end of the wire from the zinc plate, and the circuit completed by dipping into the solution, through a perforated porcelain cover, a platinum wire from the other pole. Some presumably-pure double sulphate of nickel and ammonia was first analysed. One gramme of this salt was found to require about 2½ hours for its reduction, with the aid of a battery of two ordinary Grove's cells.

(*a*). 0·9495 grm. of double sulphate gave 0·1405 grm. of metallic nickel = 14·79 per cent.

(*b*). 0·4444 grm. of double sulphate gave 0·0657 grm. of metallic nickel = 14·78 per cent.

(*c*). 0·134 grm. of double sulphate gave 0·0198 grm. of metallic nickel = 14·77 per cent.

The double sulphate of nickel and ammonia contains, theoretically, 14·72 per cent of nickel (*vide* Gmelin, "Handbook," vol. v., p. 381).

Theory.	*a.*	*b.*	*c.*
14·72	14·79	14·78	14·77

* *Vide* "How Crops Grow," Church and Dyer's edition, pp. 385, 392.

The above analysed salt, which had been supposed to be perfectly pure, had lain for some time in the sun, which may have caused a minute loss of water and so an increased amount—0·07, 0·06, 0·05 per cent; or, possibly, the deposited nickel may have faintly oxidised in drying the crucible.

The next salt experimented with was a commercial sulphate of nickel in coarse powder, roughly dried between folds of filter-paper.

(*d*). 0·85 grm. of sulphate of nickel gave 0·1878 grm. of metallic nickel = 22·07 per cent.

(*e*). 0·3282 grm. of sulphate of nickel gave 0·0718 grm. metallic nickel = 21·87 per cent.

(*f*). 0·4367 grm. of sulphate of nickel gave 0·0954 grm. metallic nickel = 21·84 per cent.

(*g*). 0·42 grm. of sulphate of nickel gave 0·09 grm. of metallic nickel = 21·43 per cent.

(*h*). 0·458 grm. of sulphate of nickel gave 0·101 grm. of metallic nickel = 22·05 per cent.

Sulphate of nickel, of the formula $NiO.SO_3.7HO$, should contain 20·71 per cent of nickel.

Theory.	*d.*	*e.*	*f.*	*g.*	*h.*
20·71	22·07	22·87	21·84	21·43	22·05

This sulphate of nickel contained crystals of different sizes and of unlike appearance, and no attempt was made to purify it, yet the results obtained, though too high, and showing that the salt was unduly dry, do not differ very widely. The extreme difference is 0·64 per cent, and the least 0·02 per cent.

The double sulphate of nickel and potassium, presumably perfectly pure and twice re-crystallised, was next analysed by the aid of the battery. As this salt does not deposit metal, but only oxide, when no ammonia is present, a considerable excess of ammonia was added to the solution in the crucible.

(*i*). 0·5175 grm. of double sulphate of nickel and potassium gave 0·069 grm. of metallic nickel = 13·33 per cent.

(*j*). 0·305 grm. of double sulphate of nickel and potassium gave 0·0408 grm. of metallic nickel = 13·37 per cent.

(*k*). 0·5 grm. of double sulphate of nickel and potassium gave 0·0662 grm. metallic nickel = 13·24 per cent.

Theory.	*i.*	*j.*	*k.*
13·29	13·33	13·37	13.24

The extremes here are +0·09 and −0·05 per cent.

A separation of copper and nickel was next attempted. The nickel and copper salts having been dissolved in hot water, the solution was made very strongly acid, and the copper first deposited out from the acid solution. The solution was then made strongly alkaline with ammonia, and the nickel plated out on the same crucible over the copper deposit. Sulphate of copper and the double sulphate of nickel and ammonia were employed. The results obtained, as well as some results with salts of zinc, must be reserved for another paper.

Laboratory, 59, Broad Street,
Boston, U.S., Aug. 1, 1871.

ON RECENT INVESTIGATIONS AND APPLICATIONS OF EXPLOSIVE AGENTS.*

By F. A. ABEL, F.R.S., Treas. C.S.

(Continued from p. 96).

Some very interesting experiments were instituted in the United States, in 1857, 8, and 9, by Major Rodman, who registered the pressures exerted in a gun on the explosion of a charge, by means of an ingenious instrument, well known as Rodman's Pressure Piston, which has since been extensively employed in similar experiments in France, Prussia, and other countries. To ascertain the pressure exerted in any portion of the gun's bore, Major Rodman drilled a hole in the gun at that part, and inserted a hollow cylinder carrying the indicating apparatus. This consisted of an indenting tool, resting upon a piston which fitted into the part of the cylinder nearest to the gun's bore. A small metal cup was inserted at the back of the piston, to guard against any rush of gas past the latter. A flat piece of soft copper was screwed down firmly against the knife-edge of the indenting tool, so that, when the piston was acted upon by the pressure which the exploding powder exerted, the knife was forced into the copper, producing a cut, the dimensions of which were accurately measured, and compared with indentations produced by application of known pressures.

Major Rodman applied this instrument to guns of various calibres up to 11 inches, and instituted several series of experiments, employing in the first instance different natures of cartridges, and afterwards powders of different size of grain, ranging from one to four inches in diameter. The results arrived at presented several anomalies and serious contradictions, but those obtained with the powders of different sizes were, generally, of a nature to warrant a conclusion similar to that arrived at by the late Committee on Gunpowder in the earlier stage of their experiments, namely, that the velocities furnished by small-grain gunpowder may be obtained, with a reduced strain upon the arm, by adapting the size of powder to the calibre of the gun. Major Rodman also fitted this pressure-gauge to a very strong vessel, in which he exploded charges of powder ranging from 700 to 7000 grains, allowing the products to escape through a vent 0·1″ in diameter. The pressure-indications obtained by him varied very greatly; in some they corresponded to 4900 atmospheres (or 32 tons to the square inch), while in the others they ranged as high as 12,400 atmospheres (or 82 tons).

In 1869, the present Committee on Explosive Substances were entrusted by Government with the investigation of the action of gunpowder, which had been taken up by the late Ordnance Select Committee in continuation of the Gunpowder Committee's experiments—the special object of the researches being to ascertain the pressures exercised in guns of different calibres by different descriptions of powder, and to deduce from the results the conditions to be fulfilled by a powder susceptible of safe and efficient employment in very large charges. In their earlier experiments the committee employed Rodman's pressure-gauge as one method of registering the pressure developed; but the very variable and anomalous results which that instrument furnished led them to devise a modification of it, in which the principal sources of error attending the use of the Rodman gauge appear to have been successfully avoided, and which, under the name of the crusher gauge, has been since employed throughout the Committee's experiments, in conjunction with another instrument, which will be directly referred to.

The crusher gauge consists of a hollow steel screw-plug, which, like the Rodman gauge, is inserted into holes drilled into the gun at the powder chamber, and at various other parts of the bore. The extremity of the plug nearest the charge is closed by a piston which presses against one end of a soft copper cylinder held by springs in the centre of a small chamber in the plug. The other end of the copper cylinder rests against an anvil. When the gun is fired the piston is pressed against the copper cylinder, and the latter is consequently compressed, thus registering the maximum of force exerted at that particular part of the gun.

The other instrument employed by the committee is a chronoscope, devised and elaborated by Captain A. Noble, by means of which they have been enabled to determine with ease and precision the time occupied by the projectile in traversing different parts of the bore of a gun. The principle of this instrument consists in registering, by means of electric discharges, upon a recording surface, which travels at a very high and uniform speed, the precise

* A Lecture delivered to the Members of the British Association at Edinburgh, August, 1871.

moment when a shot passes certain points in the bore. A series (eight or more) of thin metal disks, 36 inches in circumference fixed upon one horizontal shaft, are made to revolve very rapidly, by means of a heavy descending weight through a train of multiplying gear.

A stop-clock, which can be connected and disconnected at pleasure with one of the revolving shafts of the machine, serves to determine the precise rate at which the circumferences of the disks revolve. This is about 1200 inches per second, so that one inch represents the 1200th part of a second; and as, by a vernier attached to the instrument for the purpose of reading the results, an inch can easily be divided into 1000 parts, it is evident that the instrument is capable of recording differences of time less than one-millionth part of a second.

Upon the discharge of the gun, which is placed in connection with this instrument, the exact moment when the shot passes a particular point in the bore is recorded on one of the disks during the time that these are revolving at the speed just mentioned. The manner in which this is accomplished is as follows:—At definite distances from each other a number of hollow steel plugs, corresponding to the number of disks of the chronoscope, are screwed into holes drilled in the gun to receive them. Each of these plugs carries, at the end which is screwed in as far as the bore, after the gun is loaded, a steel cutter, which projects very slightly into the bore, and is held in position by a fine insulated wire, having its extremities protruding at the end of the plug, and therefore outside the gun. Each of these wires is then connected with conducting wires which bring it into circuit with a small voltaic battery, and with the primary wire of a volta induction coil, so that, when this arrangement is complete, a distinct voltaic current circulates through each insulated wire in the gun, and through the primary wire of a distinct induction coil. One end of the secondary wire of these coils is connected with the revolving disks, the peripheries of which are covered with strips of white paper coated with lamp-black, and the other end of each secondary wire is connected with a well insulated pointed discharger, there being one of these fixed in front of each disk, with its points adjusted so as to be just clear of the edge of the disk. When the disks are revolving at the full speed, the rate of which is ascertained by means of the stop-clock, the gun is fired, and as the shot rushes past the cutters which project slightly in the bore, it presses each one in succession level with the surface, and thereby causes it to cut the insulated wire. The primary current is consequently interrupted, and the induced current, which is thereby instantaneously developed in the secondary wire of the coil, passes from the particular discharger to the adjacent disk, producing a minute perforation in the paper at the point where it jumps across to the disk, and burning away the lamp-black at that point, so that a readily discernible mark is thus produced. Supposing it possible that all the primary wires could be severed at one and the same moment, then, as the disks are all travelling at the same speed, the spots which mark the discharge of the induced current upon each individual disk would be in exactly corresponding positions, and would therefore form a straight line across the disks; but as they are severed in succession, the series of spots follow each other upon the several disks—the distance between the spot on the one disk and that on the next being small in proportion to the velocity with which the shot has moved from one point to another in the gun.

Some idea is conveyed of the minute intervals of time which are measured by means of this chronoscope, by the fact that the distances between the parts of the 10-inch gun at which the time-records are obtained are in some distances only 2·4 inches, while the total time the projectile takes to reach the muzzle of that gun (a distance of 100 inches) when fired with a battering charge, is about the one-hundredth part of a second.

It will be seen from the foregoing outline of the nature and employment of this instrument, that by its means the time is recorded which the shot occupies, from the commencement of motion, in reaching different parts of the gun's bore; from these time-records are deduced the velocity with which the shot is passing through different parts of the bore, and the pressures in the gun which correspond to the velocities. With the aid of this instrument, and the crusher gauge employed simultaneously with it, the Committee on Explosives have compared the action in the gun of the powders hitherto used in the service with several gunpowders of foreign manufacture, and particularly with certain descriptions of powder which have been specially manufactured for employment in large charges. Guided by the results obtained, they have succeeded in producing a description of gunpowder (known as "pebble-powder") the physical and mechanical characters of which have been so adjusted with reference to one another, that the capabilities of large guns have become more thoroughly developed, and their powers of endurance at the same time much less severely tried, by its employment, than by that of any other descriptions of gunpowder which have been specially devised with those objects in view during the last four years. As regards the size of its pebble-shaped masses, this powder bears great similarity to one of the earlier experimental powders tried by the Gunpowder Committee (in 1859), which served as the starting-point in the development of pellet-powder; but it presents important differences in respect to density, hardness, and uniformity of form of the masses, and it is to the combined influence of these points of difference, in reducing the rapidity with which the pressure is developed in the gun, that pebble-powder owes its efficiency.

A comparison of the results arrived at, by means of the chronoscope and a 10-inch gun, with the powder hitherto used in all rifled cannon, known as R. L. G. powder, with the Russian prismatic powder (which for a time was regarded as superior to all other varieties), and with pebble-powder, at once demonstrates the superiority of the latter. The prismatic powder is shown by these results to light very slowly in the gun, and afterwards to burn rapidly, though not so rapidly as the R. L. G. powder. The slow lighting appears to be due to the fact that the prisms have a very hard and difficultly ignitable coating, which has been produced by the concentration of some of the saltpetre upon the surface of the masses, consequent upon the powder containing when pressed a considerable proportion of water, which, in evaporating, draws the saltpetre towards the exterior of the masses. The subsequent rapid burning of the prismatic powder is due to its comparatively low density. The old R. L. G. is both a rapidly inflammable and a very quick-burning powder when used in large charges, on account of the small size of the particles and their comparatively low density; while the large particles of the dense and comparatively hard pebble-powder light somewhat slowly, and also burn slowly as compared with the others. It should be mentioned that pellet-powder, of comparatively low density, as hitherto made for the service, approaches R. L. G. in the rapidity of its explosion when used in *large* charges, but that, when its density is assimilated to that which has been found most suitable for pebble-powder, it yields results similar to the latter, and there is little doubt that pellet-powder, with this modification, will prove interchangeable with pebble-powder. A comparison of curves, representing the velocities and pressures obtained with pebble, prismatic, and R. L. G. powders, in different parts of the gun, as deduced from the chronoscope results, shows that the velocities of the two first commence by being considerably below that of R. L. G., but that they gradually reach and pass it, the shot leaving the gun at a very considerably higher velocity (that of the pebble being the greatest). These curves also exhibit most important differences with regard to the pressure, the maximum being considerably greater with R. L. G. than with the other two, while the area of the pressure is much greater with these than with R. L. G. It should be stated that in ex-

periments instituted with the 10-inch gun, and even with the 12-inch 25-ton gun, the pressures recorded by the *crusher gauge*, which has been referred to, agree very well with the pressures deduced from the chronoscope results when pebble, prismatic, or pellet powder is used; but that, when R. L. G. or the old L. G. cannon-powder is employed, very considerable and perplexing anomalies are observed, not only between the results of the two methods of experiment, but also between the individual results furnished by the crusher gauge, applied in one and the same round in different parts of the powder-chambers. These anomalous results have been carefully discussed by Captain A. Noble, in a discourse recently delivered by him at the Royal Institution. The scope of the present Lecture does not permit of a full examination of their probable cause; it may, however, be stated that they appear to be due to a wave-action which is set up in the gases, consequent upon the *vis viva* acquired by these, especially with a rapidly-burning charge, before the shot begins to move in the gun, the *vis viva* being re-converted into pressure at the seat of the shot, and thus giving rise to intense local pressures for exceedingly minute periods of time. It has been shown in the course of the Woolwich experiments that, even with the slow-burning powders, pebble and pellet, when the charge is ignited at the point farthest from the shot, or when the cartridges are greatly increased in length, these intense local pressures, observed with the quick-burning powders, are also developed—a result which is greatly in support of the view that they originate in the *vis viva* acquired by the products of explosion, due to the distance which these travel before they are checked by the shot. An experiment made by Robins, in which he placed a bullet sixteen inches away from the ordinary charge in a musket-barrel, and bulged and burst the latter near the seat of the shot by the explosion, leads to the same explanation; and many anomalous results obtained with the Rodman pressure-gauge are obviously also ascribable to the *vis viva* acquired by the gases in the cylinder before they reach the piston which acts upon the cutter at some distance from the bore of the gun.

These somewhat perplexing results have been referred to mainly to show that although great advance has been made in the subject of the adaptation of powder to the ordnance of the present day, much still remains to be done before all conditions are understood which have to be fulfilled in the production of gunpowder thoroughly suited to different guns. There is little question that a powder which is in all respects most suitable for a 7-inch gun will not be equally efficient when applied in a 10-inch gun, and, most probably, the theoretically correct system of meeting the requirements essential to the safe development of the full powers of guns of large size would be the preparation of a special powder for almost every calibre of gun. The practical objections to such a course are, however, obviously insurmountable; hence the result to be aimed at is, the production of a powder which, while fairly utilising the powers of the smaller of our heavy guns, may be safely applied in such charges as are calculated to develope the full value of the largest ordnance.

By the employment of pebble or pellet powder, as now manufactured, not only is the strain upon the guns, up to that of 25 tons, greatly reduced, when velocities equal to those furnished by the R. L. G. powder are attained, but we are, moreover, enabled to obtain from these guns very considerably increased effects without submitting them to a greater strain than they would be exposed to in employing the former service powder to obtain the standard results. But in passing from the 25-ton gun to that of 35 tons, which is designed for a 700-lb. projectile, and a very much heavier powder-charge than has hitherto been used, the satisfactory results furnished by the new powder in other guns are less readily attainable, and it is still uncertain whether, and if so, in what way, further modifications in the manufacture will have to be introduced to meet the requirements of the largest guns. The more searchingly the nature of the action of fired gunpowder is investigated, and the more the methods of investigation are varied, the sooner, and the more readily and completely, may we hope to fulfil those conditions in its manufacture which will thoroughly establish its efficiency when applied to ordnance of all calibres. The subject is at present receiving in several quarters the careful study and practical investigation which it merits; and before passing to other topics which have to be discussed in this lecture, attention must be briefly directed to a special line of investigation now being pursued by Captain A. Noble, which promises to throw important additional light upon the nature of gunpowder as a propelling agent.

Count Rumford's early attempts to determine the pressure of fired gunpowder by exploding very small charges in a confined space, and experiments of a similar nature instituted some time afterwards by Major Rodman, have already been noticed. The conclusions to which these two experimenters were led by their results, as regards the pressure exerted by gunpowder, differed greatly from each other, and also from the conclusions arrived at in 1857 by Bunsen and Schischkoff, after an elaborate experimental investigation into the nature of the transformation which powder undergoes upon explosion, and of the heat developed when powder is fired in a close chamber. The latter was estimated at 3340° C., or 5980° F., and the pressure which they deduced from their experimental data as the maximum which powder can attain in a closed vessel was about 4374 atmospheres, or about 29 tons in the square inch. This result is no doubt nearer the truth than the estimates made by earlier experimenters; but recent experiments, which will be immediately referred to, appear to have shown conclusively that Bunsen and Schischkoff's estimate of the pressure of fired gunpowder is considerably too low, just as that of Piobert, which is founded upon the assumption that the *solid* products exist as vapour at the time of explosion, and is fixed at about 64 tons (or 9600 atmospheres), is regarded by many as considerably too high. Berthelot, who, like many other eminent scientific Parisians, was impelled by the exigencies of the period, during the recent ever-memorable siege of Paris, to devote his energies and talent to subjects of immediate practical importance connected with the defence of that city, has made an elaborate theoretical investigation into the force exerted by different kinds of gunpowder and by other explosive agents. In criticising the deductions made by Bunsen and Schischkoff, from their experiments with regard to the pressure of fired gunpowder, he points out that they have greatly under-estimated the latter, because they neglected to take into account the effect of the enormous amount of heat liberated by the compression of the gases when powder is exploded in a confined space; in other words, because the temperature of combustion was calculated upon a volume equal to that of the gases measured at zero and at normal atmospheric pressure, instead of upon *a volume equal to that of the powder itself*, to which volume the gases are obviously condensed when powder is exploded in its own space. He discusses the probable influence upon the pressure exerted by the dissociation of the gaseous products of explosion, at the very high temperature developed at the time of their generation; the counteracting influence of the pressure to which the gases are subject; the cooling effect of the expansion of gas while the shot is being propelled from the gun; and the probable consequent continual disengagement of heat, resulting from new chemical combinations which were not compatible with the original high temperature. The estimate which Berthelot is led to form of the pressure of fired gunpowder is not far below that which Rumford arrived at; thus, he gives the pressure of war-powder, exploded in its own space, as 62,700 atmospheres, an estimate about fourteen times greater than that which Bunsen and Schischkoff based their analytical data upon. His conclusions are not as yet borne out by experimental results.

The analytical examination instituted by Bunsen and

Schischkoff of the products of explosion of gunpowder dispelled the confidence up to that time entertained in the old theory of the chemical change of gunpowder, which assumed, as already stated, the conversion of the carbon into carbonic acid, or carbonic oxide, or both, and the conversion of the sulphur into potassium sulphide. According to their analyses, the largest proportion of the sulphur is oxidised to sulphuric acid potassium sulphide being one of the smallest products of the change. While there is no doubt that the old theory of the decomposition of powder is very wide of the actual truth, it is generally considered that the method pursued by Bunsen and Schischkoff in burning gunpowder, with the view of collecting the products for analysis, was not calculated to furnish results fairly respesenting those which would be obtained by exploding gunpowder in a closed vessel, as in the chamber of a gun. Some experiments, subsequently made by Karolyi, in which he exploded very small charges under conditions more nearly approximating to those of the actual employment of gunpowder, furnished analytical results not very greatly at variance with those of Bunsen and Schischkoff, but the value to be attached to them appears likely to be definitely determined before long by the experiments upon which Captain A. Noble is at present engaged. In iron vessels of great strength he explodes, by electric agency, charges of gunpowder ranging up to 2 pounds; the space in which the charges are fired is varied from that entirely filled by the powder to that in which the latter occupies only 10 per cent of the space, and the vessel is fitted with a crusher gauge, by which the maximum pressure developed by the explosion is recorded. The gases are in all instances entirely confined, and are allowed to escape gradually, as soon as expedient, after the explosion, with a view to the measurement of their volume and the collection of portions for analysis (their examination and that of the solid products having been undertaken by myself). It would be premature to enter upon any account of the analytical and other results furnished up to the present time by these experiments; it may be stated, however, that the maximum pressure of fired gunpowder, unrelieved by expansion, has been found to be about 40 tons to the square inch, and that an examination of the relation between the tension and density of the powder-gases, obtained in a closed chamber, furnished results closely corresponding with those deduced from the observation of the tension of gases in the bores of guns, made by the Committee on Explosives.

The imperfect outline which has been given of the investigations, both scientific and practical, which have been instituted during the last two or three years, and are still in progress, will suffice to show that these have not merely an important direct bearing upon requirements which the recent great progress in the construction of artillery has created, but that they are also contributing largely to the attainment of more correct and precise information with regard to the action of gunpowder when exploded in a confined space, and the operation of the various modifying influences which may be brought to bear upon it.

(To be continued).

FACTS DEVELOPED BY THE WORKING OF HEMATITE ORES IN THE ULVERSTONE AND WHITEHAVEN DISTRICTS, FROM 1844 to 1871.*

By THOMAS AINSWORTH.

I MUST preface the remarks I am permitted to make to you to-day by drawing your attention to the *Report of the Proceedings of the British Association for the Advancement of Science*, 1870, pp. 9 and 10. You will find there the following letter from Professor Stokes on the part of the committee appointed at Exeter to confer with Her Majesty's Government as to the completion of the investigations into the composition and geological distribution of the hematite iron ores of Great Britain and Ireland.

"To the Rt. Hon. the EARL DE GREY AND RIPON,
Lord President of the Council on Education.

"Lensfield Cottage, Cambridge,
"December 17th, 1869.

"My Lord,—I have the honour to inform your Lordship that, at the last meeting of the British Association for the Advancement of Science a resolution was passed appointing a committee for the purpose of calling the attention of Her Majesty's Government to the importance of completing without delay the valuable investigation into the composition and geological distribution of the hematite iron ores of Great Britain and Ireland, which has been already in part published in the *Memoirs of the Geological Survey*. Your Lordship is doubtless aware of the remarkable process invented some years ago by Mr. Bessemer for the conversion of crude cast-iron into steel or wrought-iron, a process by the application of which, those important materials can be manufactured at a much cheaper rate than formerly. The royalty which at present exists on iron, to which the Bessemer process has been applied, will shortly expire, and its expiration will probably give a great impetus to the iron trade of the country.

"It is not, however, every iron ore that ironmasters have been in the habit of employing which can be used for the production of cast-iron destined for conversion by the Bessemer process—for there are certain impurities which that process fails to remove, and which are extremely injurious to steel or wrought-iron. This difficulty is got over by peparing the iron from hematite, an iron ore which is free from those impurities. Accordingly, on the expiration of the Bessemer royalty, a great demand for hematite is likely to arise, and it will be important for the iron trade of the country that it should be known where hematite is to be found. For many of the counties of England the requisite information is contained in the *Memoirs* referred to in the resolution quoted above, and the object of the British Association is merely to urge on Her Majesty's Government the importance of continuing and completing without delay the investigation thus so ably begun.

"Although the application of the British Association relates to trade, I have addressed myself to your Lordship rather than to the President of the Board of Trade, because it is to be presumed that the investigation would be best completed by the same body by which it was begun, viz., the staff of the Geological Survey, and that belongs to the department over which your Lordship presides.

"The committee will be ready to wait on your Lordship should you think a personal interview expedient. The committee consists of Professor Harkness, President of the Geological Section at the Exeter Meeting of the British Association; R. Godwin Austen, Esq., F.R.S., Vice-President, and myself."—I have the honour to be, &c., G. G. STOKES.

To this application the following reply was received:—

"Science and Art Department, London, W.
"February 8, 1870.

"Sir,—Your letter to the Lord President of the 17th of December, 1869, stating that at the last meeting of the British Association for the Advancement of Science a resolution was passed appointing a committee for the purpose of calling the attention of Her Majesty's Government to the importance of completing without delay the valuable investigation into the composition and geological distribution of the hematite iron ores of Great Britain and Ireland, which has been already in part published in the *Memoirs of the Geological Survey*, has been under the consideration of the Lords of the Committee of Council on Education.

* Read before the British Association, Edinburgh Meeting Section B.

"I am directed by their Lordships to inform you that, after consulting with Sir Roderick Murchison on the subject, they have come to the conclusion that they are not in a position to direct that the former investigation shall be continued by the officers of the Geological Survey.

"The investigation referred to was not made at the public cost, and it does not appear to my Lords that a special inquiry of this nature, involving considerable additional expense, falls within the object for which the sum voted by Parliament for the geological survey has been granted. I am, Sir, your obedient servant,

"Norman M'Leod, Assistant Secretary.

"To Professor Stokes, M.A., F.R.S.,
"Lensfield Cottage, Cambridge.

I quite agree in all that has hitherto been done in this matter—that is, in the application to the Council on Education, for I think that to it and not to the Board of Trade this application should be made, but I quite agree in the view taken by the Council on Education, fortified as it is by the opinion expressed by the venerable and respected member of this association, Sir Roderick Murchison, and I hope the day is far distant when, as a nation, we are to ask for Government aid and assistance in every little difficulty, for, were it granted for the asking, the Anglo-Saxon characteristic of self-reliance would soon be undermined, and the English, while they lost the reputation of being a nation of shopkeepers, might probably obtain that of waiters on Providence incapable of private enterprise.

Now I do not not profess to be either a geologist or a chemist, but merely an owner and worker of hematite iron ore mines for nearly thirty years, an observer and recorder of some facts which my locality has presented to me, and which the kindness and intelligence of friends in other districts whose names I shall introduce to you have enabled me to verify from their longer experience. I shall speak of facts and not of theories, and I must premise that I shall refer to rocks and formations only by their common names and in their widest acceptations, and not according to the particular and minute classifications of the geologist.

The facts which I wish to bring before you came to my notice in the following order. When I came to reside in West Cumberland, a friend of mine had opened a colliery in the parish of Cleator, the proceeds of which were larger than could be disposed of in the neighbourhood, and hematite ore having been worked in the district to some extent for many years and exported to Wales, Scotland, and other iron-making countries, it seemed to us a reasonable speculation to retain the ore in the country and use it with the surplus coal. A company was formed to build furnaces on a site adjacent to the colliery; limestone and hematite iron ore being in close proximity thereto. These furnaces are the present Cleator Moor furnaces, belonging to the Whitehaven Hematite Iron Company. Limestone, as I before said, adjoined the site, and the owner of the limestone quarry was at first quite willing to sell us at a reasonable price what limestone we required for smelting, but finding the demand increase, he raised his prices so much as to place us in an awkward position. Believing that I had limestone in my own lands which adjoined this quarry, we commenced boring, and soon found the limestone at no great depth. Our neighbour then became amenable to reason, and my limestone was no longer needed, but being down at the limestone we thought we might as well bore a little farther. However, a kind friend one fine night dropped the boring chisel point upwards into the hole, and we were stopped. There is always some reason for every thing, and not knowing I had any enemies, it occurred to me that it was, perhaps, some iron ore raiser who did not wish his trade to be interfered with like our lime customer, so I determined to renew my boring, but, instead of going 10 fathoms to the limestone, I preferred coming to what I thought might be the outcrop of the lime and boring there. I did so, and at 7 fathoms came not on limestone, but on ore without any rock cover. This was at variance with the accepted theory that hematite iron ore was confined to the limestone, and this theory having been once found wrong, it caused me to doubt its general accuracy, and I have since found that hematite iron ores do not, as a rule, confine themselves to any particular rocks, but are found sometimes without any rock cover at all, as in my case. Sometimes in limestone fissures, as frequently in the Cleator district; sometimes in slate fissures, as at Knockmurton; sometimes in granite, as in Eskdale; sometimes in what we call whirlstone, but very frequently between two different rocks, *i.e.*, slate rock on one side and limestone on the other, as at Lindale Moor and Park Mines in Furness—whirlstone on one side and limestone on the other—sandstone on one side and limestone on the other, as at Lord Leconfield's Big Rigg mines; and sometimes in a fissure in trap, as at Hading, so that it can be said to belong to no particular rock, which is the first fact I have noted. The second fact which presented itself to my notice was that the hematite iron ore formation must have some relation to the coal fields, for as the development of the iron ore mines proceeded, we found that the chimnies of the iron ore pits took the outer range of the coal pit chimnies. By outer range I mean a line further from the sea than the coal, but nearer to the mountain range and the outcrop of the metals. This fact, however, was quite at variance with the hematite iron ore field in the Ulverstone district where there never was a trace of coal.

However, some years after, Mr. Kennedy, of Ulverstone, boring near the entrance to the Duddon estuary, came on what he called drift-coal lying in the running sand. Small though these pieces of coal were, they gave their voice in favour of the vicinity of the coal formations; and this has now distinctly and unmistakably announced itself by the exploration at Sturch, near Barrow, to the south of the previous workings, where Mr. Wadham, as mineral agent for the Duke of Buccleuch, has just opened out and taken to a depth of 97 fathoms a pit commenced nearly 200 years ago as a coal-pit, and which Mr. Wadham continued to deepen *as a coal-pit* till he came to a mass of hematite iron ore worthy of his perseverance. A section is on the wall, kindly provided by him, and will be explained by him.

In addition to this, you will find a section of the Montreal Iron Ore pit in the Cleator district, provided by another kind friend, Mr. Turner, passing through coal strata, and at last developing itself in hematite. This confirms my second fact, that all large hematite deposits are associated with a coal-field.

The third fact which we have chronicled in the Whitehaven and Ulverstone fields is, that these hematite deposits seem to run from north-west to south-east, as if they had some relation to the magnetic current. You will observe, on the index behind me, the red line denoting magnetic north and south,—and I will put upon it by the black pointer the direction of the hematite deposits in the Ulverstone, the Whitehaven, and the Haddington districts, and you will find that they have all a persistent tendency to take a north-west and south-east direction. To such an extent is this fact accepted in the Whitehaven district, that, whenever a deposit is struck in one property, the owners of adjacent royalties bore upon the well-known direction. Mr. Roper, a most valued correspondent, speaking of the Ulverstone district, says that if you take an ordnance map, and start from the line of their open workings (those of Messrs. Harrison, Ainslie, and Co., of Lindale Moor), you may, with a parallel ruler, get the line of every other vein in the district.

There is yet another point bearing on the magnetic correlation. I found, in testing borings, that what the magnifying glass did not reveal the blade of a knife would, and many times, when it was difficult to decide, even from the specific gravity, whether there was iron ore in the borings or not. The magnetised blade of a knife would do it; for it would attract particles of iron from the mass, just as a magnet attracts the iron filings from a mixture of brass and iron filings. Now I leave this matter in the hands of the electricians. We know a little,—but very

little,—of the magnetic current; we know it is constant, —that electricity applied to the magnet intensifies its power almost incalculably. Can this constant magnetic current weaken or dislocate the rocks in its course, and thus prepare a channel for any hematite deposit which may take place from the coal-fields? There is an affinity, but I am not prepared to say which is cause and which effect.

The fourth fact is the almost total want of carbonic acid in hematite deposits, and the vast amount of carbonic acid in the iron-stone deposits in coal-mines. This, I leave to the chemists. On the table you will see an extract from the *Memoirs of the Geological Survey of Great Britain*, and you will there find that, while the hematites give no certain return of carbonic acid, the iron-stones in all the coal-measures hold it in large quantities. The question naturally arises,—Can the chemist, by his art, reduce the iron deposit of the coal-measures to a hematite, and how would he do it? Having obtained a hematite, could he *resolve* it?

The fifth fact is that I know of no hematite deposit of any size or magnitude which is not bordering on a coal-field, and that coal-field at its dip under the influence of water. I refer you to the maps on the wall, and ask you to notice how the Furness district, the Whitehaven district, and the Haddington district have all that singular characteristic. I merely give it for what it is worth, but it is a fact. The Bristol field I have not examined myself, and therefore I say nothing of it, but I believe it has the same conformation; and I am told the hematite lodes have the same direction—south-east and north-west; but, as I do not know of my own knowledge, I say nothing about it.

There is, perhaps, one other circumstance attending the Ulverstone and Whitehaven fields which I ought to name, as otherwise, confusion may arise when we speak of hematite iron ores. The trade in general, the raisers as well as users of ore, speak of two kinds of hematite, rock, or blast ore, and smil, or puddle ore. The first is got with steel jumpers, double-handed hammers, and gunpowder; the second, or soft ore, with picks and shovels. Now, to all appearance, this latter ore is deposited by filtration, and the former has not this. The mines in Furness, until recently, were all of the former character. On the table, you will find a specimen of the soil from a field near Furness Abbey; and it is a fact that iron ore is re-deposited by filtration after the lapse of a few years.

IRON-STONES.

(From the *Memoirs of the Geological Survey*.)

District.	Analyst.	Carbonic Acid.
Weardale, Durham, (east line) ..	J. Spiller	*14·49
Ditto, ditto (Rispry) ..	A. Dick	†37·71
Black Bed, Low Moor, Yorkshire ..	J. Spiller	26·57
Thorncliffe, Black Mine, Parkgate	,,	31·39
Thorncliffe, White Mine, Parkgate	,,	29·38
Black Mine, Parkgate	,,	28·47
Swallow-wood Rale, Staunton, Derbyshire	,,	28·64
Brown Rale, Butterley, Derbyshire	,,	29·92
Ditto ditto ditto ditto ..	,,	26·74
Black Rale, Butterley, Derbyshire	,,	25·63
Dog-Tooth Rale, Staveley, Derbyshire	,,	37·61
Henry Croft Rale, Stanton, Derbyshire	,,	29·72
Civilly Rale, Stanton, Derbyshire..	,,	29·83
Dale Moor, Stanton, Derbyshire ..	,,	28·63
Cleveland, Yorkshire	A. Dick	22·85
Brooch Ironstone, Congreave, Stafford	J. Spiller	28·22
Pins, Dudley	A. Dick	30·21
Penry Earth, Dudley	,,	25·92
Grains, Dudley	,,	35·25
Gubbin Iron-stone, Dudley	,,	30·44
Ditto ditto Cannock, Dudley	,,	31·02
Ditto ditto Rubble, Dudley	,,	26·53
White Stone Bind, Dudley	J. Spiller	22·13
Bottom Stone Bind, Dudley	,,	32·16
White Stone Rough Hey Colliery, Darlaston	C. Tookey	26·89
Cakes, or Blue Stone, Darlaston ..	A. Dick	35·47
Ditto ditto ditto ditto ..	,,	34·00
Fire Clay Balls, Darlaston	,,	30·00
Ditto ditto ditto	,,	30·96
Poor Robins', Bunker Hill	,,	33·05
Rory Hill, White Stone, Darlaston	,,	29·03
Ditto ditto, ditto Bad, Darlaston ..	,,	20·94
Ditto ditto, ditto, Rough Hey Colliery, Darlaston	C. Tookey.	30·08
Gubbin and Balls, Bunkers Hill ..	A. Dick	28·08
Ditto ditto ditto ditto ..	,,	32·31
Ditto ditto Rough Hey Colliery..	C. Tookey.	30·80
Ditto ditto Gib Colliery ..	,,	32·05
Blue Flatts, Gib Colliery	,,	30·91
Silver Threads, Gib Colliery	,,	33·35
Diamonds, Gib Colliery	,,	29·13
Ditto ditto ditto	A. Dick	31·94
Brown Stone, Bloxaril	,,	32·04
	42—	1240·49
Average		29·52

* Lowest. † Highest.

Thomas Ainsworth, August 2, 1871.

HEMATITE ORES.

(The first four from the *Memoirs of the Geological Survey*, the last ten from private sources.)

District.	Analyst.	Carbonic Acid.
Cleator Moor	A. Dick	none.
Ditto ditto	,,	none.
Gillbrow, Ulverstone	,,	2·96
Lindale Moor, Ulverstone ..	J. Spiller	none.
Knockmurton	Professor Penny	none.
Ditto	,,	,,
Ditto	,,	,,
Cleator Iron Ore Co.	,,	*3·35
Ditto ditto ditto	,,	none.
Ditto ditto ditto	,,	3·35
Ditto ditto ditto ..	Pattison Newcastle Co.	none.
Ditto ditto ditto	,,	,,
Ditto ditto ditto	,,	†1·32
Sneletor, Haddington ..	D. S. McAdam, Edinbro'.	none.
	14—	10·98
Average		0·78

* Highest. † Lowest.

Thomas Ainsworth, August 2, 1871.

ON J. STODDART'S PLAN OF CONCENTRATING SULPHURIC ACID: REPLY TO F. BODE.

By JOHN GALLETLY.

WHILE engaged on some work for Mr. Young, at Bathgate, now fully two years ago, the idea of concentrating vitriol with the aid of a current of air in lead vessels suggested itself to me, and I made some experiments on the subject, which, being done entirely independent of those of Mr. Stoddart, a short account of my results may be interesting, in addition to any facts Mr. Stoddart may communicate.

I repeatedly concentrated a gallon of brown vitriol in a small lead box, the depth of the liquid being 4 or 5 inches,

and the temperature varying from 190° C. to 200° C., till the specific gravity was about 1·840. In these experiments I chiefly examined the lead box, and compared the appearance of the precipitate of sulphate of lead which this vitriol gave on dilution with water, with that from the same vitriol concentrated in glass bottles, and felt satisfied that the action on the lead was but slight, and would not be a practical difficulty with vitriol made from sulphur, although it might be with pyrites vitriol.

I have, however, a note of one experiment more definite. I used a lead box, 18 inches long by 12 inches broad, and had a lead shelf burnt in it, the full breadth and nearly the whole length of the box, at such a height that, when just covered, the box held 5 gallons. Below this shelf a lead pipe with small holes in it was introduced, though which air was forced, which passed along under the shelf and about an inch from the surface of the vitriol; it was the same arrangement that Mr. Young employed for saturating his solutions with chlorine in the manufacture of chlorate of potassa. In this apparatus I prepared from brown vitriol (1·745 sp. gr.) 5 gallons of vitriol, of 1·830 sp. gr., by keeping the temperature at 205° C. for one hour, and forcing 16¼ cubic feet of air through the liquid. The loss of monohydrated sulphuric acid was 11·19 per cent, as as against 8·8 per cent, which I found to be the loss by concentrating in the ordinary glass bottles; this, however, could be recovered by passing the air into the chambers or through a condenser. The quantity of air used in this case will appear small; it was only roughly measured by blowing air through the same lead pipe into a gas-holder in as nearly the same manner as possible, but, having a note that 24,000 cubic feet of gas was forced into a gas-holder by fanners, against a pressure of 5 to 6 inches of water, with the expenditure of 1 ton of coals, it did not appear necessary for my purpose to be more exact.

The water that came away at first contained practically no vitriol; the last fourth had a sp. gr. of 1·070. The object of my experiments was chiefly to effect the concentration of vitriol to about 1·840 sp. gr. in lead vessels at a temperature not higher than is usually reached in making brown vitriol (1·745 sp. gr.). I felt satisfied that the dissolving of the lead pans by the ordinary method of concentration was due much more to the increase of temperature required to expel the water from brown acid than to the action of the stronger acid on the lead, and my experiments confirmed me in this belief. I have not since, however, had an opportunity of carrying out this process on a working scale, although it has been the intention to do so at Addiewell for some months past. I have no doubt of the process succeeding, but must add that Mr. Napier, of Glasgow, aware of my results, did commence to give it a trial some time last year, without at once getting it to succeed. I understand his box did not keep its shape, a difficulty that could be easily avoided, but I have not heard that he has renewed the experiment.

Theoretical calculations of the advantages of this plan of concentrating vitriol, though not to be neglected, can only be wide approximations to working results. So much heat from even the best built pans passes into the flues that there is ample to spare for superheating the air and propelling a small engine for blowing it through the vitriol. Again, if the water can be evaporated at a heat lower by 80° C. by using a current of air than without it, the extra heat, communicated to the vitriol in consequence from the furnace, will be very considerable, but varying with each construction of furnace. Then, in the case of the concentrated acid, the heat would be communicated by direct contact with the lead vessel, whereas, in the ordinary glass bottle, it is radiated to the vitriol from the hot sides of an iron pot. The labour of filling and emptying so many bottles with syphons, and attending to so many fires, would also be avoided. It seems to me as if concentrated acid might almost be sold at about the present price of brown, allowing for the difference in strength.

Addiewell Chemical Works,
August 24, 1871.

NOTICES OF BOOKS.

The Elements of Plane and Solid Geometry. By H. W. Watson, M.A., sometime Fellow of Trinity College, Cambridge, late Assistant-Master of Harrow School. London: Longmans, Green, and Co. 1871.

In this, the sixth of a series of scientific handbooks published by Messrs. Longmans, Mr. Watson opens up new ground for the student of geometry, and, by an original method of treatment, makes Euclid much more comprehensible. The syllogistic form of enunciation has been retained, but with an extension of the principle of superposition, whereby much unnecessary reasoning has been dispensed with. The work is certainly to be highly commended to the student's notice.

Useful Chemical Tables, arranged for the Use of Teachers and Students. Oxides, Sulphides, and Chlorides, with Blank Forms for adaptation to other Compounds. By Adolphus Collenette, Teacher of Chemistry, Elizabeth College, Guernsey. Guernsey: F. Clarke. 1871.

These tables will be useful not only to students, but also to teachers of chemistry; they are intended—(1). To give a tabular view of the principal binary compounds of the elements with O, S, and Cl; (2) to give, at a glance, the number of compounds of any element with the metalloids just mentioned, and the number of oxides, sulphides, or chlorides having one formula. By means of the blank forms, the following compounds may be tabulated:—Iodides, bromides, fluorides, oxychlorides, oxybromides, oxyiodides, acids, &c. The author has adopted two methods of classification, viz.—(*a*) Quantivalence: the elements being classified under the heads Monads, Dyads, Triads, &c.; (*b*) Metalloids and Metals: the former are printed in red type, the latter in black, while thick type is employed for common metals and italics for rare. We have great pleasure in recommending this volume to all who are interested in having the study of chemistry simplified and methodically treated, as well as to chemists generally, not only as tables of easy reference for existing compounds, but also to register new discoveries. The typographical execution of these tables is highly creditable to the press of the Channel Islands.

MISCELLANEOUS.

An American View of Patent Laws.—The Hon. Charles Mason, an eminent Ex-Commissioner of Patents, has written to Mr. G. Haseltine, M.A., Chairman of the Meeting which passed the Resolutions on "Patent Law Reform," reported by us July 7th, an instructive letter on the subject, an abstract of which we append:—I have, he says, never had any serious doubt of the wisdom of a judicious system of patent laws. The public welfare is best promoted by inspiring individual effort in respect to invention, through the motive of private gain; and who can more justly claim the exclusive use of any property than he who has brought it into being?—The American system of examination is productive of much advantage to inventors and the public, but I doubt the wisdom of lodging in officials an unlimited power of rejection. If the duties of examiners were advisory and adjuvant, reserving to an applicant the ultimate right to a patent, at his own risk, the chief objection to this system would be removed. The fees by all means should be small—barely sufficient to defray the expenses of the patent office. Inventors are benefactors, and, as a class, poorly compensated for their labour. The imposition of large fees discourages invention, and thereby checks the progress of civilisation. This cannot be sound policy. Experience leads me to the conclusion, that patents should be granted for more than fourteen years, but this term, in most cases

of merit, is extended by our office to twenty-one, and often by Congress to twenty-eight years. The new law limits the term of a patent to seventeen years, which will, no doubt, hereafter be extended; and I do not think twenty-one years too long a period for the original grant. In one respect I like your system better than ours—your fees are paid in instalments, giving the patentee the option of keeping his patent alive. The French plan of annuities is carrying the matter rather too far. I think the English system better than the French or the American, and all that is needed is a reduced rate of fees. Experts are often very useful, but they are regarded with suspicion, and their opinions have little weight in our courts, therefore, what might be a great evil, carries in some measure its own remedy, and the interposition of jurors in patent suits is generally avoided by obtaining injunctions in chancery, which is our usual remedy for infringements.

Prosser's Spreading Fire Nozzle.—There is no greater enemy to life and property than fire, and although of late years the subject of fire-engines has received great attention from practical men, yet there is great room for improvement in detail. We have therefore great pleasure in calling the attention of manufacturers, warehousemen, mill-owners, railway companies, ship-owners, theatrical managers, &c., to "Prosser's Adjustible Spreading Nozzle." Yesterday evening we were invited to see this nozzle tried in practice, Mr. Holland, proprietor of the North Woolwich Gardens, having previously made arrangements for the attendance, with their engines, of three of the London Volunteer Fire Brigades—namely, the Wood Green, Pentonville, and the Ferdinand Volunteer engine from Camden Town, the whole under the superintendence of Mr. Reiney. Mr. Prosser welcomed the opportunity of showing the public what his nozzle could do; before being fitted on to the ordinary branch pipe of a fire hose, the structure was explained to us. It consists of a nozzle fitted with a number of movable and an equal number of fixed fingers. The movable fingers may be brought into the stream issuing from the jet, thus dividing the solid stream into a more or less fine spray. This is done by a simple turn of the wrist. The result of this ingenious mechanism is that the stream of water can be cut up into a spray more or less fine: thus at one time there were playing from the nozzle eight of the adjustible fingers, at another time ten, at another time four, the stream being finally varied from one resembling in its intensity a thunder shower to the ordinary spray of a shower bath. A wooden house had been built at one end of the North Woolwich Gardens, and between the walls were piled tar-barrels, timber, and other inflammable materials; shortly after a light had been applied the whole place was in flames; a signal was then given to the fire-engines to play upon them. Standing close to the fireman who had the working of Mr. Prosser's patent nozzle, we were enabled to watch its action narrowly. A stream of water first issued from it as from the nozzle of an ordinary fire-engine. The fireman then, by a slight turn of the wrist, altered the form of the jet at will according to the force of water he wished to bear on the fire. The conclusion that we have arrived at is, that Prosser's spreading nozzle is a valuable adjunct to the present known means of extinguishing fires, for by setting the internal mechanism at work the fireman is enabled to approach the flames when at their fiercest; as they gradually subside so he alters the form of his jet. In close quarters a good blaze has no chance whatever against the nozzle, for the water is spread out into a large shower of heavy rain in a conical form, or the jet may be so adjusted as to rush out like a vapoury tail of a comet. The water being thus thoroughly subdivided is formed into spray, every drop of which coming into contact with the heated materials, is immediately converted into vapour, against which the flames can no longer hold their own. It is at the commencement of a fire that assistance is most needed; quickness of action in extinguishing the origin of the fire being all essential. We therefore recommend all those who have already either engines or hose fitted, to procure one of these spreading nozzles, which we understand are adaptable to any branch as at present fitted, as they appear calculated to become the means of preventing the loss of much valuable property.—*Land and Water.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, August 7, 1871.

The original papers and memoirs met with in this number and relating to chemistry and collateral sciences are the following;—

Production, by Artificial Means, of the Calcareous Matter such as is met with in the Animal Organism.—M. Harting.—This paper is a preliminary communication on the subject alluded to, which may be termed a first attempt at synthetical morphology. It appears that the author has obtained results of great importance, which will be communicated at a future day in full, accompanied by engravings of the specimens, some of which have been sent to the Academy.

New Book on Applied Geology.—E. de Beaumont.—As one of the perpetual secretaries, the *savant* just named calls the special attention of the meeting to "Leçons Elémentaires de Géologie Appliquée à l'Agriculture," by M. Meugy.

Spectra of the Simple Gases.—A. J. Angström.—A lengthy monograph on this subject.

Calorific Phenomena which accompany the Conversion of Hyponitric into Nitric Acid, and on the Introduction of these Two Acids into Organic Substances.—L. Troost and P. Hautefeuille.—The contents of this paper bear upon calorimetry, and cannot be usefully abstracted without the reproduction of lengthy series of tabulated results of experiments.

Accidental Kindling of a Gas Burner by Lightning.—W. de Fonvielle.—During a thunderstorm at Paris on the 3rd of August last it appears that a building in the Rue Leclercq was struck by lightning, and that the gas of a gas burner placed close to a wall and near to a metal water-spout, was ignited by the electric spark.

This number also contains several papers relating to meteorology and geology.

Le Moniteur des Produits Chimiques pour l'Industrie, les Sciences et les Arts et du Matériel de ces Industrie Publié par une Société de Chimistes et d'Industriels, Nos. 1 and 2, 1870.

This periodical, published at Paris, made its first appearance just before the war broke out last year. Only two numbers appeared then, but the publishing having been now resumed, we shall be enabled to communicate to our readers any useful or interesting original matter which may be met with in the pages, of which the full title is given above. This paper appears on the 10th and 25th of each month.

No. 3, July 10, 1871.

This number contains the following original papers and memoirs:—

Sucrate of Hydrocarbonate of Lime applied to the Refining of Cane Sugar.—MM. Boivin, Loiseau, and Co.—This lengthy memoir is divided into the following sections:—Production of the lime and carbonic acid; slaking of the lime; preparation of the saccharo-calcic solution; formation of the sucrate of hydrocarbonate of lime; utilisation of the sucrate of hydrocarbonate of lime; filtration of the purified liquor; saturation of the filtered and purified liquor; boiling of the saturated liquor; filtration of the liquor after boiling; washing the residues; the chief advantages of the process of the sucrate of hydrocarbonate of lime. The contents of this paper bear essentially upon the practical application of the process alluded to.

Soap Manufacturing Industry of Italy.—E. Rousset.—Contains a few historical and interesting statistical matters on this subject.

Ancient Brevets d'Invention.—Under this title it is proposed to re-publish some of the more important *brevets d'invention* of old date. Very properly, the series is opened by a brevet granted for fifteen years to Nicholas Le Blanc, on September 15th, 1791, for the extraction of soda from common salt on the large scale.

Utilisation of Waste Leather Cuttings which contain Grease.—M. Picard.—During certain processes of the operations known as tawing and currying, leather is impregnated with fatty substances. The waste cuttings are submitted by the author, first to ebullition in water, and next, after decantation of the water, to strong pressure by means of an hydraulic press; the greasy matters are thus cheaply and readily recovered, and may be used for various purposes.

No. 4, July 25, 1871.

The original papers contained in this number are—

Chemical Products of Italy.—E. Rousset.—This paper treats on the following subjects:—Production of acids (viz., sulphuric, nitric, hydrochloric, citric, and boric), alkalies, and salts, including the gunpowder industry in the kingdom of Italy.

Soap Manufacturing Industry at Marseilles.—E. Rousset.—The ancient city just named has sixty-two soap-works, producing, on an average, annually 70,000,000 kilos. (70,000 tons) of hard soap made of olive oil. Although the bulk of this quantity is used in France, a greatly increasing export trade of this article is here spoken of.

New Method of Preparing Borax.—M. Jean.—When an alkaline sulphuret, boric acid, and water are put together, the fluid just named is decomposed; its oxygen combines with the metal, which, as oxide, combines with the boric acid, while sulphuretted hydrogen is set free. This reaction is elucidated by the following formula:—$SM+2BoO_3+HO=SH+2BoO_3MO$. The author carries on his process by first preparing sulphuret of sodium from sulphate of soda, which is thrown into a vertically-placed fire-clay retort filled with coke and previously heated to redness. The carbon reduces the sulphate of soda into sulphuret, which runs off at the bottom of the retort (the coke resting on a perforated slab of fire-clay). The sulphuret thus obtained is broken into small lumps, and, having been placed in a stout linen bag, is, along with the boric acid (also contained in a linen bag), suspended in the higher portion of a cylindrically-shaped tank filled with cold water. That tank is fitted with an air-tight cover, wherein a pipe is fixed to carry off the sulphuretted hydrogen.

Obituary.—Under this head we learn that the well-known Dr. Boucherie died lately at Bordeaux; the deceased was widely known by his investigations on the preservation of wood and timber, and was in early life one of the first who manufactured beet-root sugar in France on the large scale. Prof. Fritzche, of St. Petersburg, died on the 8th ult., at Dresden; the deceased occupied a prominent place among the *savants* of the Imperial Russian Academy of Sciences, and as the discoverer of aniline, not only science, but modern industrial chemistry, owes very much to him. It would be next to impossible to quote here, even briefly, the large number of the deceased's scientific labour.

No. 5, August 10, 1871.

The original papers contained in this number do not bear upon chemistry directly, and are only of local interest.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 210, June, 1870.

This number does not contain any original papers relating to chemistry and allied sciences.

Nos. 211 and 212, July and August (double number), 1870.

The contents of this number are entirely devoted to the publication of the proceedings of the general annual meeting of this Society, the distribution of prizes and medals, and the reports of various committees on divers subjects. The only paper more directly bearing upon chemistry is—

Report on the Prize Essay concerning the Utilisation of Manufacturing Residues.—Prof. Balard.—From this lengthy memoir, not well suited for any useful abstraction, it appears that the best essay on the subject alluded to was sent in by P. Buquet and W. Hofmann—the former manager, the latter chemist to the chemical works at Dieuze. The essay alluded to will be published by this Society.

Nos. 213 and 214, September and October (double number), 1870.

The only original paper met with in this number, and indirectly bearing upon chemistry, is—

Eulogium on Theophile Jules Pelouze.—M. Dumas.—However valuable the contents of this very lengthy scientific biography are, they are not suited for any useful abstraction here.

Nos. 215 and 216, November and December (double number), 1870.

The only original paper relating to chemistry contained in this number is—

Report on P. Thomas's Gas Burner.—M. Debray.—This lengthy paper is accompanied by several woodcuts illustrating a contrivance by means of which it is possible to obtain at pleasure, with the gas burner alluded to, either a far lower or very greatly increased temperature than is possible with the Bunsen burner.

Annalen der Chemie und Pharmacie, July, 1871.

The following original papers are contained in this number:—

Researches on the Constitution of the Doubly-Substituted Benzols.—E. Ador and V. Meyer.—The fourth and concluding instalment of a monograph on this subject, containing the following sections:—Sulphanilic acid; benzol-sulpho acid from sulphanilic acid; brom-benzoic acid and isophthalic acid; general review and appendix.

Gallic Acid Ethers.—F. Ernst and C. Zwenger.—This essay treats on the ethers which gallic acid forms, and may be prepared by first dissolving that acid in the respective absolute alcohol, and next passing through that solution, heated to the bolling-point, dry hydrochloric acid gas. The purification of these ethers is rather a tedious process. Gallic acid ethyl-ether—

$$C_6H_2\left\{\begin{matrix}(OH)_3\\CO.O(C_2H_5)\end{matrix}\right\}+2\tfrac{1}{2}HO$$

is a solid substance, soluble in warm water, crystalline, readily soluble in alcohol and ether. These solutions exhibit an acid reaction. This ether fuses at 150°, but at 90° if rapidly heated; it melts in its water of crystallisation. The gallic acid methyl-ether closely corresponds, in its properties, with the foregoing. The gallic acid amyl-ether—

$$C_6H_2\left\{\begin{matrix}(OH)_3\\CO.O(C_5H_{11})\end{matrix}\right.$$

is a solid crystalline substance, contains no water of crystallisation, fuses at 139°, difficultly soluble even in warm water, but readily so in alcohol, ether, and chloroform, which latter does not dissolve gallic acid. All these ethers act as acids, decompose alkaline carbonates, and yield, with proto-salts of iron, a violet colouration, which becomes blue by exposure to air. With the per-salts of iron a deep blue colouration is produced, while these ethers reduce nitrate of silver and chloride of gold at the ordinary temperature.

Researches on some of the Substances Crystallised in Fused Beads of Phosphor Salt and Borax.—A. Knop.—The continuation of the exhaustive monograph on this subject contains the following sections:—Crystallisations from phosphor salt; crystallisations from borax.

Normal Valerianic Acid.—A. Lieben and A. Rossi.—The acid alluded to is obtained by boiling normal cyanbutyl with alcoholic caustic potassa solution. The purified acid, $C_5H_{10}O_2$, exhibits an odour more akin to that of pure butyric acid than to that of the ordinary valerianic acid. The normal valerianic acid is a liquid which, even at −16°, is not congealed; it boils at 185°; its sp. gr. at 0° is 0·957. 1 c.c. of this acid requires for its solution 27 c.c. of water. The authors describe a series of the salts of this acid.

Researches on the Allyl Group. Seventh chapter: Conversion of Allylic Alcohol into Propylic Alcohol.—B. Tollens—And on—

Allyl-Cyanide, or Crotonitrile—A. Rinne and B. Tollens—And—

Oxidation of Allylic Alcohol—A. Rinne and B. Tollens—Are portions of the lengthy monograph on the allyl group. However valuable and interesting in a scientific point of view, this work is not suited for any useful abstraction.

Alleged Bibasicity of Gluconic and Lactonic Acids.—R. Fittig.—A reply to Prof. Hlasiwetz's paper (see Chemical News, vol. xxiii., p. 287) on this subject.

Action of Sulphurous Acid upon Platinum-Chloride.—(Second paper.)—K. Birnbaum.—After briefly referring to his former paper on this subject (see Chemical News, vol. xx., pp. 189 and 322), the author, in this portion of his essay, describes a series of salts obtained by the action of sulphurous acid upon platinum-sal-ammoniac. The soda salt may be obtained in orange-coloured, silky, shining, needle-shaped crystals; formula—

$$Pt\left\{\begin{matrix}Cl\\NaSO_3\end{matrix}\right\}+2NH_4Cl+H_2O.$$

The lime and magnesia salts are too deliquescent to be obtained in crystalline state. The baryta salt, $3Pt,2Ba,6NH_4,3SO_3,10Cl,3H_2O$, or—

$$\begin{matrix}Pt<\begin{matrix}Cl\\SO_3\end{matrix}\\Pt<\begin{matrix}SO_3\\SO_3\end{matrix}\\Pt<\begin{matrix}\\Cl\end{matrix}\end{matrix}>Ba+BaCl_2+6NH_4Cl+3H_2O,$$

is a crystalline body. The paper further refers to the potassa salt, and a series of double salts belonging to this group.

Temperature of Decomposition of Sulphuretted Hydrogen.—J. Myers.—From the author's experiments it appears that sulphuretted hydrogen is decomposed at between 350° and 400°.

Sulphuretted Hydrogen Contaminated with Arseniuretted Hydrogen.—J. Myers.—At the ordinary temperature the two gases alluded to can co-exist without decomposition, which only takes place at the boiling-point of mercury according to the formula—

$$3H_2S+2AsH_3=As_2S_3+12H.$$

The author, while experimenting, thought that the arseniuretted hydrogen might be due to the presence of some arsenic in the sulphuret of iron employed, but, on investigation, it turned out that the source of the arsenic was in the commercial sulphuric acid used for the evolution of the sulphuretted hydrogen.

Journal für Gasbeleuchtung und Wasserversorgung, No. 14, 1871.

The original papers in this number bear strictly on matters relating to gas- and water-works' engineering and management.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, May, 1871.

This number does not contain any original papers bearing upon chemistry, but we meet here with an essay on the—

Velocity of the Progress of Electro-Dynamical Action.—Dr. Helmholtz.—The author found that the velocity alluded to exceeds 314,400 metres (about 195 English statute miles) in one second of time.

Les Mondes, August 17, 1871.

This number contains the following original matter relating to physico-chemical sciences:—

Studies on the Geology, Meteorology, and Archæology of Constantine (Algeria).—M. Tissot.

Sound Produced by Discontinuous Vibrations, more especially those obtained by means of the Siren.—M. Terquem.—The contents of this paper bear strictly upon acoustics.

This number contains a series of papers bearing upon hygiene, and, among these, one on drunkenness among the French soldiers as a cause of the late disasters.

Pharmaceutische Zeitschrift für Russland, No. 6, 1871.

This number does not contain any original papers relating to chemistry.

No. 7, 1871.

The original papers and memoirs relating to chemistry and allied sciences in this number are—

Experiments made to Ascertain the Alleged Poisonous Nature of certain kinds of Fish.—Dr. A. Casselmann.—The contents of this paper bear upon some experiments made upon cats to which was given some fish (properly cooked), which, on being partaken of as food, had caused, in some thirty-five cases, symptoms of a peculiar kind of poisoning. The fish was, however, not quite fresh, but being partly cured with salt, and kept at the winter temperature of St. Petersburg, was not at all in a decayed state. The nature of the poison was not discovered, neither were the cats at all affected by the fish given to them, which, in this instance, belonged to the sturgeon tribe. It is a well-known fact that fish may become poisonous under conditions as yet entirely unknown.

Means to Distinguish Benzol from Benzine.—J. Brandberg.—Pitch is stated by the author to be dissolved readily and completely by benzol prepared from coal-tar, whereas benzine, also known as ligroine or petroleum spirit, hardly dissolves the substance alluded to at all.

No. 8, 1871.

The only original paper in this number is the pharmacognostic essay on the—

Gum and Gum-Resin producing Plants which are met with in the Steppe district of Central Asia.—Dr. R. Palm.

No. 9, 1871.

Does not contain any original papers relating to chemistry.

No. 10, 1871.

The only original paper relating to chemistry is on the—

Freezing of Aqueous Solutions of Salts.—Dr. G. C. Wittstein.—The author placed (at St. Petersburg) the undermentioned solutions of salts, prepared in larger quantity and kept in stoppered bottles, in a store-room, the temperature of which was for several consecutive weeks below 0°, but never below −6°. The saline solutions which remained unfrozen were—Ammonium chloride (1-5), antimoniate of potassa (1 of the granular salt to 240), hydrate of baryta (1-19), barium chloride (1-9), calcium chloride (1-9), acetate of baryta (1-9), neutral acetate of lead (1-9), basic acetate of lead (1-9), ferrocyanide of potassium (1-9), ferricyanide of potassium (1-9), iodide of potassium (1-9), sulphocyanide of potassium (1-9), hydro-fluosilicic acid (1-16), carbonate of ammonia (1-9), carbonate of potassa (1-9), carbonate of soda (1 cryst. salt to 6), molybdate of ammonia (1-19), oxalate of ammonia (1-29), bichloride of mercury (1-19), nitrate of baryta (1-19), nitrate of lead (1-9), proto-nitrate of mercury (1-19), proto-sulphate of iron (1-4), sulphate of potassa (1-14), sulphate of magnesia (1-9), tartaric acid (1-4), protochloride of tin (1-9). The following solutions were frozen:—Oxalic acid (1-9), phosphate of soda (1-14), nitrate of silver (1-49), and sulphate of lime (1-400). The figures between parentheses indicate the proportion of the salts to that of water.

No. 11, 1871.

The only original paper relating to chemistry is an essay on—

Aluminium Chlorhydrate (so-called Chloralum), and on some other Alumina Compounds.—Dr. E. Thorey.

Journal für Praktische Chemie, No. 10, 1871.

This number contains the following original papers and memoirs:—

Synthesis of Normal Propylic Alcohol, Ethyl-Alcohol being taken as the starting-point.—A. Rossi.—The author first prepared cyanethyl, converted that into propionate of lime, and, by distilling that along with formiate of lime, obtained the aldehyde of the propionic acid, which, being treated with sodium amalgam, became converted into propylic alcohol. That alcohol is a colourless, mobile fluid, soluble in water in all proportions, and boiling at 96°; sp. gr. at 0°, 0·8205; formula, C_3H_8O. The author further describes some of the haloid combinations of propyl obtained from the alcohol alluded to.

Mineralogico-Chemical Researches.—Von Kobell.—This paper treats on the following subjects:—Monzonite, a new mineral species.—The mineral here alluded to was found on the Monzoni mountains, in the Fassathal (Tyrol). The colour of the mineral is light greyish-green; it is hard and compact, rather readily fusible before the blowpipe, sp. gr.=3·0, and soluble in concentrated phosphoric acid. The composition of the mineral, in 100 parts, was found to be the following:—Silica, 52·60; alumina, 17·10; protoxide of iron, 9·0; lime, 9·65; magnesia, 2·10; soda, 6·60; potassa, 1·90; water, 1·50;—total, 100·40. Marcellin consists, in 100 parts, of—Oxide of manganese, 66·68; oxide of iron, 10·04; protoxide of manganese, 8·79; protoxide of iron, 1·30; lime, 1·14; magnesia, 0·26; silica, 10·24. Behaviour of sulphuret of bismuth with iodide of potassium before the blowpipe (bismuthite from St. José, in Brazil).—When iodide of potassium is mixed with sulphuret of bismuth, and ignited upon charcoal before the blowpipe, the coal is coated with a beautiful deep red-coloured film of iodide of bismuth. Pure metallic bismuth does not, under the same conditions, give this reaction; but, when the metal is rubbed along with some sulphur, and then ignited, as just alluded to, the same phenomenon is observed, but gradually the red colour fades and the film becomes yellow. Bismuthite, of a peculiar grass-green colour, and structure akin to green pyromorphite, was found by the author among some Brazilian minerals. On mixing this mineral (carbonate of bismuth) with iodide of potassium and sulphur, and igniting it before the blowpipe, it gave also the reaction above alluded to, which is highly characteristic for bismuth.

Observations made while Analysing various samples of Commercial Tin.—Dr. T. Scheerer.—The author chiefly points out the variable composition of some of the sulphurets of tin, and communicates an analysis of meta-sulphuret of tin dried over sulphuric acid, and found to consist, in 100 parts, of—Tin, 54·14; sulphur, 29·36; water, 16·50. Formula, SnS_2+2HO. The same substance, dried at 140°—Tin, 59·0; sulphur, 32·0; water, 9·0. Formula, SnS_2+HO.

New Method of Separating Magnesia from Potassa and Soda.—Dr. T. Scheerer.—Reserved for full translation.

Rosolic Acid.—H. Fresenius.—The contents of this paper, although valuable, are not suited for any useful abstraction.

NOTES AND QUERIES.

Diamond Dust.—(Reply to Josiah Lowe.)—By digesting the dust along with hydrofluoric acid, as commercially sold, in either leaden or platinum vessels, you will be able to dissolve the glass, leaving the diamond-dust unattacked.

Skein Silk.—C. R. Stevens will find that silicate of soda will decompose muriate of tin without the aid of heat. It may be used very much diluted, and does not injure cotton or wool. He will find, by experiment, the strength most suitable for silk.—T. F.

Schio-Liao.—(Reply to E. J. L.)—Among the constituents of blood is found a substance which, from its tough fibrous nature, has received the name of fibrine. This is eliminated from fresh and warm blood by beating it with a bundle made of thin willow or birch twigs. The fibrine adheres to the twigs, and blood so treated remains fluid, instead of, as is otherwise the case, coagulating. We think that at many of the larger slaughter-houses you can buy defibrinated blood.

Manufacture of Alum.—(Reply to "A.")—You would do well to consult Payen's "Chimie Industrielle," also Wagner's "Jahresberichte über die Fortschritte der Technologie," and Elsner's "Chemisch-Technischen Mittheilungen," all of which you may inspect at the Library of the Commissioners of Patents, where you will also find several other periodicals and books, published recently in various countries, treating on technology and chemistry applied to manufacturing industry.

TO CORRESPONDENTS.

*** The Students' Number of the Chemical News will be published on Friday, September 8th. Gentlemen holding official positions in the Universities, Medical Schools, &c., of the United Kingdom, where Chemistry and Physical Science form a part of the Education, who have not yet forwarded the necessary information to our Office for publication in that number, will confer a favour by sending it with the least possible delay.

Chemicus.—The subject is treated very fully in an English edition of Wagner's "Chemical Technology." The work is now in the press and will be published by Messrs. J. and A. Churchill.

G. J. Warner.—The volume containing index to Gmelin's "Handbook" has not yet been published.

A. Keiffinheim and Co.—One of the best works on the subject is "Traité des Arts Céramiques," par A. Brongniart; Paris: Bèchet. Mr. Murray has published a work by J. Marryat on "A History of Pottery and Porcelain, Mediæval and Modern."

T. Limmers, jun.—(1). You may be able to obtain the journal containing the paper through Nutt and Co., Foreign Booksellers, Strand. (2). Consult article on the subject in Ure's "Dictionary of Arts and Sciences.

W. Foster.—Received with thanks.

A. Glendinning.—Thanks for the communication: it shall receive attention.

C. J. S.—See reply to E. J. L. in our "Notes and Queries" column.

NOTICE TO AMERICAN SUBSCRIBERS.

In answer to numerous inquiries, the Publisher begs to state that Subscribers in the United States can be supplied with the CHEMICAL NEWS from this Office, post free, for the sum of £1 2s. 4d. per annum payable in advance.

THE CHEMICAL NEWS.

Vol. XXIV. No. 615.

(STUDENTS' NUMBER.)

SCHOOLS OF CHEMISTRY.

EXAMINING BOARDS.

UNIVERSITY OF LONDON.

Candidates for any Degree granted by this University are required to have passed the Matriculation Examination, to which no candidate is admitted unless he has produced a certificate showing that he has completed his sixteenth year.

The Fee for this Examination is £2.

The Examination will be held on Monday, January 8th, 1872, and includes the following subjects:—

Natural Philosophy.*

Mechanics—

Composition and Resolution of Statical Forces.

Simple Machines (*Mechanical Powers*):—Ratio of the Power to the weight in each.

Centre of Gravity.

General Laws of Motion, with the chief Experiments by which they may be illustrated.

Law of the Motion of Falling Bodies.

Hydrostatics, Hydraulics, and Pneumatics—

Pressure of Liquids and Gases, its equal diffusion, and variation with the depth.

Specific Gravity, and modes of determining it.

The Barometer, the Syphon, the Common Pump and Forcing-Pump, and the Air-Pump.

Acoustics—

Nature of Sound.

Mode and Rate of Propagation of Sound.

Musical Tones.

Optics—

Laws of Reflection and Refraction.

Formation of Images by Simple Lenses.

Chemistry.

Heat—its sources. Expansion. Thermometers—relations between different Scales in common use. Difference between Temperature and Quantity of Heat. Specific and Latent Heat. Calorimeters. Liquefaction. Ebullition. Evaporation. Conduction. Convection. Radiation.

Chemistry of the Non-Metallic Elements; including their compounds as enumerated below—their chief physical and chemical characters—their preparation—and their characteristic tests.

Oxygen, Hydrogen, Carbon, Nitrogen. Chlorine, Bromine, Iodine, Fluorine. Sulphur, Phosphorus, Silicon.

Combining Proportions by weight and by volume. General Nature of Acids, Bases, and Salts. Symbols and Nomenclature.

The Atmosphere—its constitution; effects of Animal and Vegetable Life upon its composition.

Combustion. Structure and Properties of Flame, Nature and Composition of ordinary Fuel.

Water. Chemical peculiarities of Natural Waters, such as rain-water, river-water, spring-water, sea-water.

Carbonic Acid. Carbonic Oxide. Oxides and Acids of Nitrogen. Ammonia. Olefiant Gas, Marsh Gas, Sulphurous and Sulphuric Acids, Sulphuretted Hydrogen. Hydrochloric Acid. Phosphoric Acid and Phosphoretted Hydrogen. Silica.

Bachelor of Science (B.Sc.)

This degree is conferred on candidates who pass a satisfactory examination in Mathematics, Mechanical and Natural Philosophy, Botany, and Vegetable Physiology, Zoology, and Chemistry.

First B.Sc. Examination.

No candidate (with the exception of such as have obtained Honours at the Matriculation Examination in the preceding January) is admitted to this examination within one academical year of the time of his passing the Matriculation Examination.

The Fee for this Examination is £5.

The examination will commence on Monday, July 17th, 1872. It is conducted by means of printed papers; but the Examiners are not precluded from putting, for the purpose of ascertaining the competence of the candidates to pass, *viva voce* questions to any Candidate in the subjects in which they are appointed to examine.

The First Examination includes the following subjects:—

Natural Philosophy.

Heat—

Sources of Heat; conduction—convection.

Effects of Heat; expansion generally—of water—of gases and vapours; liquefaction; vaporisation; latent heat; expansive form of steam; dew-point; gases and vapours compared.

Specific Heat.

Thermometers; Pyrometers.

Heat in the Radiant state.

Electricity—

Sources of Electricity.

Static Electricity; dual character—insulation—induction—specific inductive capacity—equivalent antithetic states—disruptive discharge — convection; Electroscopes—Leyden Jar, &c.

Dynamic Electricity; Conduction—the electric current—derived currents—induction of currents; Voltaic Pile and other voltaic arrangements.

Thermo-Electricity; Electro-Thermometer.

Magnetism—

Magnets, the Earth, &c.; Induction—communication—retention—Magnetic relations of iron, steel, &c.

Electro-Magnetism—as in the spark—in conducting media—in soft iron; Magneto-Electricity; principle of Electro-magnetic and Magneto-Electric machines.

Terrestrial Magnetism.

Inorganic Chemistry.

Matter; simple and compound.

Elementary bodies classed. Metallic and Non-Metallic bodies.

Chemical Combination and Mechanical Mixture. Solution.

Outlines of Crystallography. Isomorphism. Dimorphism. Allotropic conditions of matter. Chemical Affinity, Laws of Combination by weight and by volume, as deduced from the history of the individual elements. Equivalent Numbers. Equivalent Volumes. Symbolical Notation, including questions on the Unitary System. Formulæ. Nomenclature.

Chemical actions produced under the influence of Heat. Nature of Combustion. Structure and Properties of Flame. Principles of Illumination. Chemical action of Light. Photography.

Oxygen. Ozone.

Hydrogen. Water.

Nitrogen. Chemical constitution of the Atmosphere. Diffusion of Gases. The Oxides of Nitrogen; Nitric Acid. Ammonia.

Chlorine, Bromine, and Iodine. Their compounds with Oxygen and Hydrogen. Theory of Bleaching.

Fluorine and Hydrofluoric Acid.

* The Questions in Natural Philosophy will be of a strictly elementary character.

Sulphur. Sulphurous Acid. Manufacture and Chemical applications of Sulphuric Acid. Other Oxygen compounds of Sulphur. Sulphuretted Hydrogen.

Phosphorus. Oxygen and Hydrogen compounds of Phosphorus. Theory of Acids. Monobasic, Dibasic, and Tribasic Acids.

Carbon. Carbonic Oxide and Carbonic Acid. The principal Hydrogen compounds of Carbon. Manufacture of Coal Gas.

Silicon and Boron. Their compounds with the elements previously enumerated.

Metals. Characters of Metals as a class. Metallurgical Processes. Alloys. Classification of the Metals.

Potassium. Nitre. Gunpowder. Theory of the action of Gunpowder.

Sodium. Manufacture of Carbonate of Soda.

Barium. Strontium. Calcium. Mortars. Cements.

Magnesium. Aluminum. Glass. Porcelain.

Manganese. Iron. Composition and properties of Cast-Iron, Wrought-Iron, and Steel. Chromium.

Cobalt. Nickel. Zinc. Cadmium.

Lead. Manufacture of White-Lead.

Copper. Mercury. Bismuth. Tin. Arsenic. Antimony.

Silver. Gold. Platinum.

Principal compounds of the Metals with the Non-Metallic Elements. Theory of Salts.

Principles of Mineral Analysis.

Principles of Electro-Chemistry.

For the First Examination, a knowledge of Inorganic Chemistry only is necessary.

Examination for Honours.

Candidates for Honours in Chemistry are examined in any of the following subjects, at the option of the Examiners :—

Elementary Substances and their combinations.

Electro-Chemistry.

Radiant Chemical Action.

In the Examination for Honours, the Candidate, being not more than twenty-two years of age, who most distinguishes himself in Chemistry and Natural Philosophy, will receive an Exhibition of Forty pounds per annum for the next two years.

Second B.Sc. Examination.

This Examination commences on Monday, October 23rd, Candidates for this Examination who have not previously taken the degree of B.A. are required either to have passed the First B.Sc. Examination at least one Academical year previously, or to have passed the First M.B. Examination, in this University.

The Fee for this Examination is £5.

This Examination embraces Organic Chemistry, including the following subjects :—

Ultimate analysis of Organic bodies. Calculation of Empirical Formulæ. Methods of controlling Empirical Formulæ. Determination of the Equivalents of organic acids and bases; examination of products of Decomposition : determination of the Vapour-density of volatile bodies.

Law of Substitution. Compound Radicals. Homologous Series.

The Chemical History of the Cyanogen group. Cyanogen. Hydrocyanic Acid. Cyanic Acid and Urea. Fulminates. Cyanuric Acid. Sulphocyanic Acid. Chlorides of Cyanogen. Uric Acid.

Amylaceous and Saccharine substances. Fermentation. Alcohol, Wine, Beer, Bread, &c.

Homologues of Alcohol. Ethers, simple and mixed. Oxidation of Alcohol. Aldehyde and Acetic Acid, and their homologues. Anhydrides, simple and mixed. Compound Ethers.

Diatomic Alcohols and their Acids. Glycol and Oxalic Acid and their homologues.

Triatomic Alcohols. Glycerine. Fatty and Oily bodies. Saponification.

Vegetable Acids ;—the principal.

Ammonia and its Derivatives. Ammonium and Ammoniacal Salts. Amides and Amines ; their Classification. The chief Natural Organic Bases.

Colouring Matters. Indigo and its derivatives. Principles of Dyeing.

The chief constituents of the Vegetable organism. Cellulose, Vegetable Fibrin. Albumen, Casein, Glutin, &c.

The chief constituents of the Animal organism. Animal Fibrin, Albumen, Casein, Gelatin. Blood, Milk, Bile, Urine, &c.

Decay, Putrefaction. Destructive Distillation.

The Chemical Principles of the process of Nutrition and of Respiration in Plants and Animals.

Examination for Honours.

The Candidate, not more than twenty-three years of age, who, in the Examination for Honours, most distinguishes himself in Chemistry, will receive Fifty pounds per annum for the next two years, with the title of University Scholar.

Doctor of Science (D.Sc.).

This Examination is held within the first twenty-one days of June, and occupies four days.

No Candidate is admitted to the Examination for the Degree of D.Sc. until after the expiration of two Academical years from the time of his obtaining the Degree of B.Sc. in this University.

Candidates for the Degree of D.Sc. in any year, must give notice of their intention to the Registrar, and pay to him a Fee of Ten pounds, on or before the 1st of April.

Chemical Candidates can be examined either in Inorganic or Organic Chemistry ; but no Candidate will be approved by the Examiners unless he has shown a thorough practical knowledge* of the *Principal Subject*, and a general acquaintance with the *Subsidiary Subject*, or *Subjects*, specified as belonging to the Branch so selected.

Inorganic Chemistry.

Principal Subject—Inorganic Chemistry.

Subsidiary Subjects—Either Organic Chemistry ; or, Mineralogy, Crystallography, and Chemical Technology in its relations to Inorganic Chemistry.

Organic Chemistry.

Principal Subject—Organic Chemistry.

Subsidiary Subjects—Either Inorganic Chemistry ; or, Chemical Technology, in its relations to Organic Chemistry, and the Chemistry of Animal and Vegetable Life.

EXAMINATIONS IN CONNECTION WITH THE DEPARTMENT OF SCIENCE AND ART, SOUTH KENSINGTON.

A sum of money is voted annually by Parliament for scientific instruction in the United Kingdom.

This sum is administered by the Science and Art Department.

The object of the grant is to promote instruction in Science, especially among the industrial classes, by affording a limited and partial aid or stimulus towards the founding and maintenance of Science schools and classes.

The following are among the Sciences towards instruction in which aid is given :—Acoustics, Light, Heat, Magnetism, and Electricity, Inorganic Chemistry, Organic Chemistry, Geology, Mineralogy, Mining, Metallurgy.

The assistance granted by the Science and Art Department is in the form of—1. Public Examinations, in which Queen's Medals and Queen's Prizes are awarded, held at all places complying with certain conditions. 2. Payments on results to teachers. 3. Scholarships and Exhibitions. 4. Building Grants. 5. Grants towards the purchase of apparatus, &c.

* It must be understood that the candidate for the Degree of D.Sc. is expected to be so fully conversant with the principal subject he may select, as to be able to go through any examinational test (whether theoretical or practical) of his acquirements in it that can be fairly applied.

CHEMICAL LECTURES AND LABORATORY INSTRUCTION.

UNIVERSITY COLLEGE.

FACULTY OF SCIENCE.

Dean.—Professor A. W. Williamson, Ph.D., F.R.S.

Vice-Dean.—Professor G. Fuller, C.E.

The Session begins on Tuesday, the 3rd of October, and ends on Friday, the 21st of June.

It is divided into three terms, as follows: Michaelmas term, from October 3rd until December 20th; Lent term, from January 4th, 1872, till March 16th; Summer term, for Lectures, from March 18th till June 6th, all inclusive.

Chemistry.—Professor Williamson, Ph.D., F.R.S.

A. General Course.

Lectures daily, except Saturday, from 11 to 12 a.m.

Exercises on Tuesdays, Wednesdays, Thursdays, and Fridays, from 9 to 10 a.m.

Fee for the Whole Course of Lectures, £6 6s.; for a Half Course, £3 3s; Perpetual, £9 9s.; for the Organic Course alone, £2 2s.

Fee for the Exercise-Class—For the Course, £2 2s.; for the Half Course, £1 1s.

The Instruction in this Class is of two kinds, consisting partly of Experimental Lectures by the Professor, partly of Exercises and personal instruction on the subject of the Lectures by Tutors, under the direction of the Professor.

The First Half of the Course to Christmas includes those parts of Chemistry which are required for the Matriculation Examination of the University of London.

The Second Half of the Course, extending from January to March, includes the following subjects:—

I. Preparation and properties of the chief metals, including their characteristic reactions and most important salts. Detection of Metallic Poisons. Quantitative Estimation of Metals. Principles of Classification. Monatomic Diatomic Metals, &c.

A weekly *viva voce* examination is held during the First Half Course and the commencement of the Second Half Course.

II. *Organic Chemistry.*

This commences in the second week in February, and occupies Five Lectures weekly till about the end of March. It includes a study of the characteristics and metamorphoses of the chief organic acids, bases, alcohols, ethers, colouring matters, &c. Methods of ultimate and proximate analysis. Determination of molecular weights. Theory of types; of compound radicals. Phenomena of fermentation, &c.

Teachers of Chemistry are trained in the theory and practice of their profession. A two years' Course is absolutely requisite for this purpose; but Students will with advantage devote a longer period to it.

The first year is occupied with attendance on the Courses of Chemistry and of Analytical Chemistry. In the second year the Student again attends the Course of Chemistry, and is entrusted with teaching work in conjunction with the Tutors of the Class. At the same time time he continues to work in the Laboratory at analysis and original research.

In order to qualify themselves for rising to the higher ranks of the Profession, gentlemen remain for a further period, in which case they may obtain remunerative work in teaching through the recommendation of the Professor.

B. Analytical and Practical Chemistry.

I. Birkbeck Laboratory.

The instruction in the Laboratory is intended for beginners as well as for more advanced students. It includes practice in the construction and use of apparatus for preparing the common gases, acids, bases, salts, &c., study of the qualitative methods of detecting and separating mineral or organic bodies from one another; also quantitative analyses in the wet way, organic analyses, vapour-densities, &c.; instruction in gas analysis.

More advanced students are instructed in the methods of original research, especially in organic chemistry.

When accompanied or preceded by attendance on the Lectures on Chemistry, the Laboratory Course qualifies Students in the application of Chemisrry to the Manufacturing Arts, Metallurgy, Medicine, or Agriculture &c. Instruction is given in the principles and processes of Gas Analysis.

The Laboratory and Offices are fitted up completely with the most improved apparatus and utensils for experimental research, both for beginners, and for advanced Students. They are open daily, from 9 a.m. to 4 p.m., from the 4th of October until the end of July, with a short recess at Christmas and at Easter. Saturday, from 9 to 2.

Fees for the Session, 25 guineas; six months, 18 guineas; three months, 10 guineas; one month, 4 guineas; exclusive of the expense of materials. A deduction of about 40 per cent is made for Students who can attend only three fixed days per week.

A Gold Medal and Certificates of Honour are competed for by students entered for the Session.

II. Summer Courses.

I. *Elementary Course.*

About Forty Lessons, of one hour each, on Tuesday, Wednesday, Thursday, and Friday, from 11 to 12, commencing in the first week of May. Students are taught the construction and use of apparatus for the preparation of the most important gases, acids, &c. The characteristic tests for the presence of the common acids and bases, including the chief metallic and other poisons. Also the processes for separating these bodies from one another.

Solutions are frequently given in the class for investigation.

The first six weeks of the Course are occupied by the study of the chief non-metallic elements, and their simple compounds. Metallic salts, &c., are subsequently studied.

Fee, including cost of materials and apparatus, for the Course, £4 4s.; perpetual, £7 7s.

II. *Senior Course.*

This Course consists of Twenty Lessons, of two hours each, on Mondays and Saturdays, from 10 to 12, commencing in the first week in May. The first half of the Course includes tests for fixed and volatile organic acids, nitrogenised acids, sugars, glycerine, alkaloids, &c.

The second half of the Course includes tests for mineral poison in organic mixtures; also tests for organic bodies, such as uric acid, albumen, sugar, alkaloids, &c., when mixed with other organic compounds, as in urine, blood, &c., or in food.

Volumetric methods of the quantitative analysis of sugar and urea are practised.

Fee, including cost of materials and apparatus, for the Course, £4 4s.; perpetual, £7 7s.

C. Summer Matriculation Course.

Professor Williamson, F.R.S., assisted by Mr. F. S. Barff, M.A., F.C.S.

This Course includes those parts of Chemistry which are required for the Matriculation Examination of the University of London.

The Course consists of about Twenty Lessons in Practical Chemistry, and of an equal number of Oral Lessons. The Practical Lessons include the preparation of the common gases and acids, &c., and the study of their characteristic properties in relation to the elementary laws of combination.

The other lessons are chiefly devoted to those parts of the subject which require fuller oral explanation than is given in the practical lessons. They include numerous

exercises and questions, to which answers in writing are given by the Students. These Lessons will begin on Wednesday, April 5th, at 11 a.m.

The class will meet on Tuesdays, Wednesdays, Thursdays, and Fridays, from 11 to 12; and some other meetings will be announced when the Class has assembled.

Fee for the class, £4 4s., including cost of materials and apparatus.

EVENING CLASSES.

The Session is divided into three Terms, each of ten complete weeks, exclusive of vacations—

I. The Michaelmas Term, beginning on Monday, the 9th of October, and ending on Thursday, December 14th.

II. The Lent Term, beginning on Monday, the 8th of January, and ending on Thursday, March 14th.

III. The Summer Term, beginning on Monday, the 18th of March, and ending on Thursday, June 6th; the Easter Vacation extending from the 28th of March to the 8th of April, both days inclusive.

The object of these classes is to extend the benefits of the College Tuition especially to gentlemen engaged elsewhere during the day, and to provide Instruction in subjects not taught in the ordinary College Classes.

The Beadles have orders to admit gentlemen to any of the Classes, with the permission of the Professor or Teacher, as occasional visitors.

The Library is open for the convenience of the Students between 6.30 and 8.30 on the evenings when the Classes meet, except when it is wanted for other purposes.

Elementary Chemistry—Theoretical and Practical.

Professor Williamson, F.R.S., and Mr. Jones. Monday, from 6.30 to 8.30.

A Course of Twenty Lessons, of two hours each, in the Michaelmas and Lent Terms.

The elements of Chemistry are explained to the Class, and the experiments illustrating the subject are performed by the Students.

The subject will be the common Non-Metallic Elements and the common Metals, their compounds and chief Properties, and the best method of distinguishing and separating them.

All the experiments and analyses are repeated by each Student, or by not more than two Students jointly.

Fee, including the cost of materials, &c., £4 4s. for the whole course, or £2 2s. per Term.

ROYAL SCHOOL OF MINES AND COLLEGE OF CHEMISTRY.

Professor of Chemistry.—Dr. E. Frankland, F.R.S.

The instruction in Chemical Science embraces:—

1. A course of Lectures on Experimental Chemistry, with special reference to the applications of Chemistry in the Arts and Manufactures.

2. A systematic Laboratory Course for the Practice of Chemical Analysis.

Chemical Lectures.—The Course consists of Forty Lectures on Mineral Chemistry and Thirty Lectures on Organic Chemistry.

The Lectures are delivered at the Royal College of Chemistry, Oxford Street.

Chemical Laboratory.—The general Laboratory for instruction in chemical manipulation in qualitative and quantitative analysis, and in the method of performing chemical researches, is under the direction of Dr. Frankland, and will be opened on Monday, the 2nd of October, 1871. The Royal College of Chemistry being the property of the Government, its Laboratories are used for the instruction of the pupils of the Royal School of Mines.

There are three terms in the collegiate year, of three months each, commencing in the first week of October, January, and April respectively. The Laboratory hours are from 10 a.m. to 5 p.m., with the exception of Saturdays, when the Laboratory closes at 2 o'clock.

Each Laboratory Student works independently, there being no classes. All operations are superintended by the Professor and his assistants. A table with drawers, cupboards, and shelves, is appropriated to every pupil, The institution supplies gas, fuel, and reagents. The larger and more expensive instruments of the Laboratory, such as air-pumps, thermometers, barometers, condensers, &c., may be used by the students, who are held responsible for their safety. The students have to provide themselves only with the apparatus specified in the Laboratory regulations. More advanced students engaged in private researches have to supply themselves with such materials as are not included amongst the ordinary reagents of the Laboratory.

Professor of Metallurgy.—Dr. Percy, F.R.S.

The course of instruction in Metallurgy consists of Lectures and Laboratory Practice.

The object of the Lectures is the communication of such instruction as the student may be able to apply to the greatest practical advantage, when he may be subsequently engaged in conducting any metallurgical process.

Metallurgical Laboratory.—This Laboratory is conducted by Mr. R. Smith, under the direction of Dr. Percy, and is devoted to practical instruction in Metallurgy. It will be opened on the 2nd of October, 1871. The nature of this instruction will be adapted to the special requirements of the Students. It comprises:—Assaying in all its branches, especially of the more important metals, such as iron, copper, lead, tin, alloys of silver and gold, &c., and the examination of ores and metallurgical products.

The ability of the student to make trustworthy assays is in every case thoroughly tested; and no certificate of competency is given to a student who has not furnished satisfactory proof that he is able to obtain accurate results.

There are three terms in the collegiate year of three months each. The Laboratory hours are from 10 to 4 during November, December, January, and February; and from 10 to 5 during the other months, with the exception of Saturdays, when the Laboratory is closed.

The charge for instruction in the Metallurgical Laboratory is £15 for three months; £12 for two months; and £7 for one month.

Lectures to Working Men.—Short Courses of Lectures at suitable periods of the year are given in the evening to working men. These courses are systematic, and arranged so as to illustrate, within a period of two years, the principal subjects taught at the Institution. Those for the ensuing Session include Chemistry, Metallurgy, Physics, Applied Mechanics.

KING'S COLLEGE.

Professor of Chemistry and Practical Chemistry—C. L. Bloxam, F.C.S.

Demonstrator—W. N. Hartley.

Assistant do.—J. M. Thompson.

The session commences on the 2nd of October, 1871. Students of the first and second years are admitted to the Course of Theoretical and Applied Chemistry. The Course commences with a view of the forces which concur to the production of Chemical Phenomena, after which the laws of Chemical Attraction are discussed, and the Non-metallic Elements and their principal compounds are described.

The metals and their principal compounds are next examined, care being taken to point out the applications of the Science to the Arts, and the processes of the different Manufactures of Metallurgy, and of Domestic Economy, are explained and illustrated.

Examinations of the Class, both *viva voce* and by written papers, are held at intervals during the course at the usual Lecture hour.

Third Year.—Students who have completed six Terms in this Department are admitted to a course of Practical Chemistry, consisting of Twelve Demonstrations in each term; and they go through a course of Manipulation in the most important operations of Chemistry, including the first steps of Analysis.

Any Student of this department may be admitted to this Class at any period of his study, on payment of an extra fee.

Analytical and Experimental Chemistry.—Besides the Course of Chemical Lectures and the Summer Class of Practical Chemistry, provision is made for those Students who wish to become more minutely acquainted with the practical details of the Science. By means of this Class each Student is enabled to familiarise himself with the methods of analysis and research. After passing through a preliminary course of analytical operations, each Student devotes himself to such portions of the science as are most interesting to himself, or most likely to be practically useful to him. The Daniel Scholarship of £20, tenable for two years, is given every alternate year for original research in the Laboratory.

The Fees for admission to the Laboratory Class, exclusive of materials, are, for one month, £4 4s.; for three months, £10 10s.; for six months, £18 18s., &c.

EVENING CLASSES.

Classes for Evening Instruction are held at King's College from October to March, and during April, May, and June.

The Classes include one for the Elements of Chemistry and one for Practical Chemistry.

The fee for the former is £1 11s. 6d.; for the latter, £2 2s. The classes meet twice a week.

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN.

17, Bloomsbury Square, W.C.

School of Pharmacy. The Session (1871-72) will commence on Monday, October 2nd, and extended to the end of July.

LECTURES ON CHEMISTRY AND PHARMACY, BY DR. REDWOOD.

These Lectures will be delivered on Monday, Tuesday, and Wednesday mornings, at 9 o'clock.

Part 1.—Physics in relation to Chemistry and Pharmacy.
,, 2—Chemistry of Inorganic Bodies.
,, 3.—Chemistry of Organic Bodies.

Also Lectures on Botany and Materia Medica, by Professor Bentley. The first and second parts of this course, extending over the winter months, will be delivered at 17, Bloomsbury Square, on Friday and Saturday mornings, at 9 a.m. The third part of the course, on Systematic Botany, will be delivered at the Royal Botanic Gardens, Regent's Park, at 8 a.m.

Fees.—For registered apprentices and associates of the Society, for either of the above courses, £1 1s.; for either part separately, 10s. 6d. For those not connected with the Society, £2 2s. for either of the above courses; £1 1s. for either part separately. Students have free admission to the Library and Museum.

Laboratory.—The suite of Laboratories for Practical Instruction in General and Pharmaceutical Chemistry will be opened on Monday, the 2nd of October, under the direction of Professor Attfield, Ph.D. Fee for the entire session of ten months, Twenty-five Guineas. The Laboratories are open from 9.30 a.m. till 5 p.m. Students can enter at any period during the session.

Two Scholarships (the Jacob Bell Memorial Scholarship) of Thirty Pounds a year each, are open to competition annually in July.

The Board of Examiners meet monthly, and are required by the Pharmacy Act to examine "all candidates who may present themselves for examination in their knowledge of the Latin Language, in Botany, in Materia Medica, in Pharmaceutical and General Chemistry, and to grant Certificates of Competency."

CITY OF LONDON COLLEGE, LEADENHALL STREET, E.C.

The Annual Courses consist of three terms, each averaging ten experimental lectures: fee, 5s. per term. Subjects:—Junior Class, Chemistry—first year, Non-Metals; second year, Metals and (time permitting) Elements of Organic Chemistry. Senior class, 7 to 8 p.m., Practical Analysis.

BIRKBECK LITERARY AND SCIENTIFIC INSTITUTION.

EVENING CLASSES.

Inorganic Chemistry—Mr. G. Chaloner. Tuesday, 8 to 9.

Practical Chemistry and Analysis—From 8 to 10, Saturday evenings.

ISLINGTON SCHOOL OF SCIENCE, WINDSOR STREET, ESSEX ROAD, N.

A Course of Thirty Lessons on Inorganic Chemistry, by Mr. J. Howard, on Fridays at 8.30. Fee, 5s.

Practical Chemistry and Qualitative Analysis.—Fridays, at 6.30.

Electricity and Magnetism.—Wednesdays, at 8.

NEW KENNINGTON INSTITUTE.

Lectures and Practical Classes in Chemistry, Pharmacy, Practical Chemistry, Botany, Materia Medica, Latin, Physics, and all subjects connected with the Pharmaceutical Examinations, under the direction of Dr. Muter. Popular Chemical Evening Classes for Commercial Analysis.

POLYTECHNIC INSTITUTION.

Course of Thirty Lessons in Inorganic Chemistry, under the superintendence of Professor Pepper. Tuesday, 8.30 to 10 p.m.

ROYAL VETERINARY COLLEGE, CAMDEN TOWN.

Chemical Professor.—Mr. R. V. Tuson.

LECTURES AT LONDON MEDICAL SCHOOLS.

ST. BARTHOLOMEW'S HOSPITAL & MEDICAL COLLEGE.

WINTER SESSION.

Lecturer.—Dr. W. J. Russell. Monday, Wednesday, and Friday, at 10 a.m. One course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. W. J. Russell. One course, £2 2s.

CHARING CROSS HOSPITAL AND COLLEGE

WINTER SESSION.

Lecturer.—Mr. C. W. Heaton, F.C.S. Monday, Thursday, and Friday, at 11. One session, £5 5s.

The Laboratory is open daily.

SUMMER SESSION.

Practical Chemistry.—Mr. Heaton, F.C.S. Monday and Friday. One session, £2 2s.

ST. GEORGE'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. H. M. Noad, F.R.S. Tuesday, Thursday, and Saturday, at 11.30. One course, £6 6s.

SUMMER SESSION.

Practical Chemistry.—Dr. Noad, F.R.S. Monday, Wednesday, Thursday, Friday, at 10. One course, including the use of apparatus and materials, £4 4s.

GUY'S HOSPITAL.

WINTER SESSION.

Lecturers.—Dr. Debus, F.R.S., and Dr. Stevenson. Tuesday, Thursday, and Saturday, at 11. One course, £4 4s.

SUMMER SESSION.

Practical Chemistry.—Dr. Debus, F.R.S. Monday, Wednesday, and Friday, from 10 to 1. One course, £4 4s.

Practical Instruction is also given in the laboratory by Drs. Debus and Stevenson during the Winter Session.

The Course of Lectures on Experimental Philosophy (Heat, Electricity, Magnetism, and Electro-Magnetism) is given on Wednesdays at 12 noon by Dr. Stevenson.

LONDON HOSPITAL.

Lecturers on Chemistry.—Henry Letheby, M.B., and C. Meymott Tidy, M.B. Monday, Wednesday, and Friday, at 10.30 a.m.

Practical Chemistry.—Dr. Letheby, M.B. Monday, Tuesday, and Saturday, at 9 a.m.

ST. MARY'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. C. R. A. Wright, F.C.S. Monday, Tuesday, Thursday, and Friday, at 10.15. £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. C. R. A. Wright, F.C.S. Tuesday and Thursday, at 11.30 a.m.; and Saturday, at 9 a.m. One session, £3 3s.

MIDDLESEX HOSPITAL.

WINTER SESSION.

Lecturer.—Mr. Heisch. Monday, Wednesday, Friday, and Saturday, at 11. One session. £6 6s.

SUMMER SESSION.

Practical Chemistry.—Mr. Heisch. Monday, Wednesday, and Friday, at 11. One session, £3 3s.

ST. THOMAS'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. A. J. Bernays. Wednesday, Thursday, and Friday, at 9. One course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. A. J. Bernays. Tuesday and Thursday, 10 to 12; Friday, 11; Saturday, 10 to 1. One course, £3 3s.

WESTMINSTER HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. A. Dupré, F.C.S. Tuesday and Thursday, at 3 p.m.; Friday, at 3.30 p.m. One course, £5.

SUMMER SESSION.

Practical Chemistry.—Dr. A. Dupré, F.C.S. Tuesday and Thursday, at 10 a.m. One course, £2.

PRIVATE TEACHERS OF CHEMISTRY IN LONDON.

Mr. J. C. Braithwaite, 54, Kentish Town Road, N.W.—Chemistry and Toxicology, Monday and Thursday; Latin, Tuesday and Friday; Botany and Materia Medica, Wednesday and Saturday. All the classes commence at 8 p.m. Laboratory and Botanic Garden open daily, except Saturdays.

Mr. Henry Matthews, F.C.S.—Laboratory, 60, Gower Street, Bedford Square. Instruction in all branches of Practical Chemistry, particularly in its application to Medicine, Agriculture, and Commerce. Laboratory open daily, except Saturday, from 10 to 5; on Saturday, from 10 to 1.

Dr. John Muter, M.A.—Laboratory, 289, Kennington Road. Prepares for examinations of Pharmaceutical Society.

Mr. John Newlands, F.C.S.—Laboratory, 13, Knowle Road. Brixton, S.W. Gives practical instruction in Analysis, and prepares gentlemen for various public examinations.

Mr. A. Vacher, 20, Great Marlborough Street, Regent Street.

UNIVERSITY OF OXFORD.

Professor of Chemistry.—Sir B. C. Brodie, Bart., M.A., F.R.S.

Demonstrator.—E. Madan, M.A.

A commodious Laboratory is attached to the New Museum.

Scholarships of about the value of £75 are obtainable at Christ Church, Magdalen, and other Colleges, by competitive examination in Natural Science.

UNIVERSITY OF CAMBRIDGE.

Professor of Chemistry.—G. D. Liveing, M.A.

MICHAELMAS TERM.

Practical Chemistry, by the Professor, on Mondays, Wednesdays, and Fridays, at 1 p.m.

LENT TERM.

Chemistry, by the Professor, on Mondays, Wednesdays, and Fridays, at 12.

Practical Chemistry, on the same days, at 1 p.m.

EASTER TERM.

Chemistry, by the Professor, on Mondays, Wednesdays, and Fridays, at 12.

Practical Chemistry, on the same days, at 1 p.m.

The Chemical Laboratory of the University is open daily, from 10 a.m. till 6 p.m; so that students can work there at such times as may be convenient to them: and the Professor will attend to give instruction at the times above specified.

PROVINCIAL SCHOOLS.

BIRMINGHAM.—MIDLAND INSTITUTE.

Lecturer on Chemistry.—Mr. C. J. Woodward, B.Sc. Tuesday and Thursday, at 8 p.m.

Practical Chemistry.—Mr. C. J. Woodward, B.Sc. Saturday, 3 to 6, and 6.30 to 9.30 p.m.

BIRMINGHAM.—QUEEN'S COLLEGE.

WINTER SESSION.

Professor of Chemistry.—Alfred Hill, M.D., Borough Analyst. Tuesday, Thursday, and Friday, at 12.

SUMMER SESSION.

Practical Chemistry.—Professor A. Anderson. Thursday and Friday, at 2 p.m.

BRISTOL.—BRISTOL MEDICAL SCHOOL.

WINTER SESSION.

Lecturer.—Mr. Thomas Coomber, F.C.S. Monday, Tuesday, Wednesday, and Thursday, at 8.15. One Course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—M. T. Coomber, F.C.S. Daily except Saturday, at 8 a.m. One course, £3 3s.

ROYAL AGRICULTURAL COLLEGE, CIRENCESTER.

CHEMICAL DEPARTMENT.

Professor.—A. H. Church, M.A. Oxon.

Assistant.—E. Kinch.

The Autumn Session commenced on the 15th of August: it divides on the 6th of October, and terminates about the 21st of December.

The chemical instruction comprises Three Courses of Lectures and Laboratory Practice:—

(1). 32 Lectures on Inorganic Chemistry.
(2). 32 Lectures on Organic Chemistry.
(3). 24 Lectures on Agricultural Chemistry.
(4). 32 Lessons on Chemical Manipulation.
(5). 32 Lessons on Qualitative Analysis.
(6). 32 (or more) Lessons on Quantitative Analysis.

Catechetical Lectures are also given, while analyses of manures, oil-cakes, minerals, soils, waters, &c., are daily performed in the College Laboratories, and Chemico-Agricultural researches undertaken by the more advanced

Students, under the immediate direction of Professor Church.

The text-books used are Church's "Laboratory Guide," Roscoe's "Chemistry," and Church and Dyer's edition of "How Crops Grow."

LIVERPOOL ROYAL INFIRMARY SCHOOL OF MEDICINE.

Lecturer on Chemistry and Toxicology.—Dr. J. Campbell Brown.

1. Course of 100 Lectures. Monday, Tuesday, Thursday, and Friday, at 10.15. £5 5s.
2. Practical Organic Chemistry for Senior Students. £3 3s.
3. Practical Chemistry. Summer Class; Fifty Lessons. £3 3s.
4. Toxicology. Twelve Lectures.
5. Technical Students are admitted on five days of the week into the Private Laboratory, which is open from 10 to 4.

ANALYTICAL LABORATORY AND SCHOOL OF TECHNICAL CHEMISTRY.

7 and 9, Hackin's Hey, Liverpool.

Conducted by Mr. A. Norman Tate.

Pupils may attend at any time between the hours of 9.30 a.m., and 5 p.m. (Saturdays, 9.30 a.m. and 1 p.m.). and may work every day, or any numbers of days, or portion of a day in the week, and for any period most convenient to themselves.

The Laboratory is also open two evenings per week for practical work.

Lectures one evening each week.

A separate working bench is provided for each Student, and he is also supplied with all ordinary chemicals, gas, fuel, and the more substantial portions of Laboratory apparatus, but must provide himself with test-tubes, beakers, and other apparatus of a fragile nature.

In addition to the ordinary chemical studies, the course of instruction will, as far as possible, comprise all such studies as may be required for the successful prosecution of the particular branch or branches of Applied Chemistry in which the pupil is to engage; as, for example, in the case of one intended for manufacturing pursuits, he would study architectural and mechanical drawing, so far as is required for the preparation of plans, &c., of chemical apparatus and manufactories, the nature and use of building materials, and the scientific principles and practical rules involved in building and constructive operations, and other scientific and practical information required in the arrangement, construction, and management of chemical manufactories, and the application of Chemistry to industrial pursuits.

COLLEGE OF CHEMISTRY, LIVERPOOL.

Founder.—Dr. Muspratt, M.D., &c.

Principal.—Mr. Martin Murphy, F.C.S., Professor of Chemistry.

The Course of Instruction given in the College of Chemistry comprises the teaching of Chemistry as a science, and the general application of chemical knowledge; also the teaching of the principles of those branches of physics which are allied with chemistry, such as light, heat, electricity, &c.

Particular attention is devoted to instruction in the practice of systematic analytical operations, whereby students will be enabled to determine accurately the general and proximate constituents of substances, and so arrive at a knowledge of their nature and properties.

Instruction in the application of chemical data to medicine and agriculture, and to the chemical and metallurgical operations, comprising Technology, will be given, to qualify students for these avocations.

The students will invariably be controlled and directed in their study and work by the Principal and competent assistants. Ample laboratory accommodation is provided for students, and such general appliances as will facilitate their progress in acquiring a knowledge of the specialities taught in the college.

The student's laboratories are open throughout the year. Hours of attendance—From 10 a.m. to 5 p.m. daily.

Fees—10 guineas per quarter of 3 months, or 35 guineas per annum, payable in advance. Students provide all their own apparatus and books.

Medical and Pharmaceutical students are admitted for 1 hour per day. Fee for 3 months, £2 2s.

A Course of Lectures will be delivered to the students during the winter months. Evening Classes.

Certificates of attendance recognised by the University and Apothecaries' Hall of London, and Apothecaries' Hall of Ireland.

LEEDS SCHOOL OF MEDICINE.

WINTER SESSION.

Lecturer.—Mr. J. Chapman Wilson, F.C.S.

Daily, except Saturday, at 11 a.m. One course, £4 4s.

SUMMER SESSION.

Practical Chemistry.—Mr. Wilson, F.C.S.

Tuesdays and Thursdays, 11 to 12.30. One course, £2 2s.

LEEDS MECHANICS' INSTITUTION AND LITERARY SOCIETY'S LABORATORY.

SESSION 1871—72.

Chemical Classes for Instruction in Elementary, Practical, and Analytical Chemistry.

Teacher.—Mr. George Ward, F.C.S.

HIGH HARROGATE COLLEGE, YORKSHIRE.

Professor of Chemistry.—Mr. W. G. Mason, F.C.S., Certificated Science Teacher.

MANCHESTER GRAMMAR SCHOOL.

CHEMICAL DEPARTMENT.

Professor.—W. Marshall Watts, D.Sc. Lond.

Instruction is given in Inorganic Chemistry, Organic Chemistry, Metallurgy, and Analytical Chemistry. A lecture-room and second laboratory, affording accommodation for seventy-two students, have just been completed.

Michaelmas Term commenccs on Tuesday, September 19th.

MANCHESTER ROYAL SCHOOL OF MEDICINE.

Lecturer on Chemistry.—Mr. Daniel Stone.

The usual course for the Medical Boards.

A Laboratory is connected with the school.

OWEN'S COLLEGE, MANCHESTER.

(in connection with the university of london).

Chemistry.—Professor H. E. Roscoe, B.A., Ph.D., F.R.S., F.C.S.

Junior Class.—Wednesday and Saturday, from 9.15 to 10.15 a.m.

Subject: Inorganic Chemistry, comprising the laws of chemical combination, and a description of the properties and mode of preparation of the non-metallic elementary bodies and their most important compounds.

Senior Class.—Tuesday and Thursday, from 9.15 to 10.15 a.m.

Subjects: Inorganic and Organic Chemistry, including the properties of the metals and their compounds, and the composition and relations of the best defined groups of organic bodies, and the laws regulating their formation.

Students are expected to answer the written exercises and attend the *viva voce* examinations given in these classes.

Fee—For each class, £3 3s. For both classes, £5 5s.

A Recapitulatory Lecture, without additional Fee, will be given on Friday at 9.15 a.m., which members of both classes will be required to attend.

Extra Class.—Wednesday, from 4 to 5 p.m.

Subject: Technological Chemistry.

The Chemical Principles involved in the most important Chemical Manufactures will be chiefly considered in this course.

Students attending this class must be acquainted with the principles of Chemical Science. Fee, £2 2s.

Analytical and Practical Chemistry.

LABORATORY COURSE.

Professor.—Henry E. Roscoe, B.A., Ph.D., F.R.S.

Senior Assistant.—Mr. C. Schorlemmer, F.R.S.

The aim of this course is to make the student practically acquainted with Chemical Science, to enable him to conduct analysis and original research, and to fit him for applying the science to the higher branches of Art, Manufactures, and Agriculture. To accomplish this, an attendance of not less than four days per week during three whole sessions is as a rule necessary. It is very advisable that each Laboratory Student should attend or should have attended the course of Lectures on Theoretical Chemistry.

The College Laboratory will be open for students daily from 10.30 a.m. until 5 p.m., except Saturdays, when it will be closed at 1.30. The Laboratory is closed from 1.15 until 2, for dinner.

The Laboratory is fitted with every convenience for the prosecution of practical chemistry, all branches of qualitative and quantitative analysis, and original research.

Each student is provided with a separate working table, set of tests, fuel, water, and gas, free of expense; but he is required to find his own apparatus, a few of the more expensive reagents, and the chemicals required for his experiments. Other apparatus or instruments of a more expensive description may be obtained on loan from the Laboratory Steward, subject to regulations to be prescribed by the Professor.

Fees for the Session.—Students working six days per week, £21; ditto, four days, £17 17s.; ditto, three days, £13 13s.; ditto, two days, £9 9s.; ditto, one day, £5 5s.; Students entering the Laboratory Class at or after Christmas, for not less than two days per week, will be charged two-thirds of the fees for the whole session.

Special Fees for Shorter Periods.—For six months, six days per week, £17 17s.; five months, ditto, £15 15s.; four months, ditto, £13 13s.; three months, ditto, £10 10s.; two months, ditto, £7 7s.; one month, ditto, £4 4s.

Lectures on the methods of Qualitative and Quantitative Analysis, intended to supplement the instruction in Practical Chemistry, will be given by Mr. Schorlemmer, on Mondays, from 4 to 5 p.m.

First year's Laboratory Students are recommended to attend and answer the written exercises and the *viva voce* questions given in this class. Fee, £1 11s. 6d.

Chemical Calculations.—In this class, instruction and special practice is given, by Mr. Schorlemmer, on Wednesday, from 4 to 5 p.m., in the methods of Chemical Calculations, serving as supplementary to the Lecture and Laboratory Courses. Fee, £1 1s.

The Lectures on Chemistry in Owen's College are recognised by the University of London for its Medical Degrees, by the Royal College of Surgeons, and by the Apothecaries' Hall.

EVENING CLASSES.

Chemistry.

Professor H. E. Roscoe, B.A., Ph.D., F.R.S.

Lecture Class.—(First Course—The Non-Metallic Elements).—Monday, from 8.35 to 9.35 p.m.

Lecture Class.—(Second Course—The Metals). Friday, from 8.35 to 9.35 p.m.

Lecture Class.—(Third Course—Organic Chemistry).—Mr. C. Schorlemmer, F.R.S. Thursday from 8.35 to 9.35 p.m.

Laboratory Courses of Practical Chemistry.

Professor Roscoe, F.R.S., and Mr. Schorlemmer, F.R.S.

Junior and Senior Divisions.—Monday, From 6 to 8.30 p.m.

Pharmaceutical Course.—Monday and Wednesday.

COLLEGE OF PHYSICAL SCIENCE, NEWCASTLE.

(IN CONNECTION WITH THE UNIVERSITY OF DURHAM).

Professor of Chemistry.—A. Freire-Marreco, M.A.

First Course.—Michaelmas Term: General Principles of Chemistry; History of the Non-metallic Elements.

Second Course.—Epiphany Term: History of the Metals and their more important compounds; Principles of Qualitative Analysis, Monday, Tuesday, Wednesday, and Thursday, at 9 a.m.; Examinations, Friday at 9 a.m.

Third Course.—Easter Term: Elements of Organic Chemistry, Monday and Wednesday, at 9 a.m.; Examinations, Friday at 9 a.m.

Mineralogical Chemistry, Tuesday and Thursday, at 9 a.m.; Examinations, Saturday at 9 a.m. Fee, five guineas; single Courses, two guineas each.

Practical Chemistry.—The Laboratory is open from 10 a.m. to 1 p.m., and from 2 to 5 p.m., except on Saturdays, when it closes at 1 p.m.

Laboratory Fees.—Students working six days per week, five guineas per term. Students working alternate days, three guineas per term. Students working one day per week, one guinea per term.

SHEFFIELD.

SCHOOL OF CHEMISTRY,

1, Surrey Street, Sheffield.

Mr. A. H. Allen, F.C.S., delivers a Course of Twenty-four Lectures on Applied Chemistry, in connection with the Science and Art Department.

Day and Evening Classes for Analytical Chemistry.

SHEFFIELD SCHOOL OF MEDICINE.

During the Winter Session, Mr. A. H. Allen, F.C.S. will deliver a Course of Forty-five Lectures on Chemistry.

The Practical Chemistry Class, will meet three times a week during the Summer Session.

Mr. W. Baker, F.C.S., lectures on Chemistry at the Sheffield Collegiate School. Laboratory for Instruction in Theoretical and Practical Chemistry, 46, High Street, Sheffield.

SCOTLAND.

UNIVERSITY OF EDINBURGH.

Professor of Chemistry.—Dr. A. Crum Brown, F.R.S.

ROYAL COLLEGE OF PHYSICIANS AND SURGEONS, EDINBURGH.

Lecturer on Chemistry.—Dr. Stevenson Macadam. F.R.S.E.

The Courses of Instruction in Chemistry include its applications to Medicine, Agriculture, and the Industrial Arts; and they qualify for the University of Edinburgh and other Universities, the Royal Colleges of Physicians and Surgeons, the Navy, Army, and Indian Medical Service, and the other Medical and Public Boards.

The Lectures on Chemistry are delivered daily during the five months of the Winter Session. The Lectures form a complete Course; the New Nomenclature and Notation are employed throughout, and special Lectures in Technological Chemistry are given. Tutorial Class Examinations are held during the Session, and Excursions are arranged for visiting the principal Chemical Manufactories.

The Instructions in Analytical Chemistry are conducted in the Laboratories at Surgeons' Hall, which are now open daily, under the personal superintendence of Dr. Macadam, for the instruction of gentlemen in Chemical Analysis, and the prosecution of researches in Manipulative Chemistry.

The Prelections in Practical Chemistry are also conducted in the Laboratories at Surgeons' Hall. The subjects

selected for Examination are those with which Medical Students are specially called upon to exhibit a practical acquaintance.

Fees.—Lecture, £3 5s. (University Graduation, £4 4s.) Practical Chemistry (University, &c.), £3 3s.; Analytical Chemistry, £2 per month, £5 for three months, or £10 for six months.

UNIVERSITY OF GLASGOW.

Professor of Chemistry and Practical Chemistry.—Dr. Thomas Anderson, F.R.S.E.

ANDERSONIAN UNIVERSITY, GLASGOW.

Professor of Scientific Chemistry.—Dr. T. E. Thorpe.

GLASGOW MECHANICS' INSTITUTION.

Professor of Chemistry and Practical Chemistry.—Dr. R. Carter Moffat.

GLASGOW VETERINARY COLLEGE.

Professor of Chemistry.—Dr. R. Carter Moffat.

IRELAND.

DUBLIN.—TRINITY COLLEGE.

Professor of Chemistry.—Dr. Apjohn, F.C.S.

ROYAL COLLEGE OF SURGEONS, DUBLIN.

Professor of Chemistry.—Dr. Barker.

QUEEN'S COLLEGE, BELFAST.

Professor of Chemistry.—Dr. Andrews, F.R.S., &c.

QUEEN'S COLLEGE, CORK.

Professor of Chemistry.—Dr. Blyth.

QUEEN'S COLLEGE, GALWAY.

Professor of Chemistry.—Dr. T. H. Rowney.

A Laboratory for Practical Instruction is attached to all the Queens' Colleges. The usual Practical Course for the Medical Boards is given in the summer.

ROYAL COLLEGE OF SCIENCE FOR IRELAND, Stephen's Green, Dublin.

This college supplies, as far as practicable, a complete course of Instruction in Science, applicable to the Industrial Arts. The subjects of Instruction are:—Pure and Applied Mathematics, Descriptive Geometry, and Mechanical Drawing, Mechanism, Theoretical and Applied Chemistry, Chemical Analysis, Physics, Botany, Zoology, Geology, and Palæontology, Mineralogy, Mining, Machinery, Surveying, and Agriculture.

Professor of Theoretical Chemistry.—W. K. Sullivan, Ph.D., V.P.R.I.

Professor of Analytical and Applied Chemistry.—R. Galloway, F.C.S.

Assistant Chemist.—W. Plunkett, F.C.S.

A course of Lectures on Inorganic and Organic Chemistry is delivered by Dr. Sullivan three times a week during the session. Fee for the entire course, £2.

A course of Lectures on Technological Chemistry is delivered by Mr. Galloway twice a week during the session. Fee for the course, £2.

The chemical and Metallurgical Laboratories, under the direction of Mr. Galloway, are open every week day during the session, except Saturday. Instruction is given in the different branches of Analytical Chemistry, including Assaying, and in the methods for performing Chemical research. Each student is taught, not in class, but separately and independently; and he is supplied with a separate working table, with reagents, fuel, water, gas, and the larger and more expensive apparatus. Fee, for the session of nine months, £12; or for three months, £5; or for one month, £2.

There are four Royal Scholarships, of the value of £50 each, yearly, with free Education, including Laboratory Instruction, tenable for two years; two become vacant each year; they are given to students who have been a year in the College. There are also nine Exhibitions attached to the College, of the yearly value of £50 each, with free Education, including Laboratory Instruction, tenable for three years; three become vacant each year. These are awarded at the annual May Examinations of the Science and Art Department.

A Diploma of Associate of the College is granted at the end of the three years' Course.

The Session commences on Monday, October 2nd.

NOTE ON REGIANIC ACID.*

By Dr. T. L. PHIPSON, F.C.S.

Regianic acid is one of several new substances which I have obtained during the last few years from the fruit of *Juglans regia*, and also from another species of walnut. To these substances allusion has already been made at a previous meeting of the British Association, and in the *Comptes Rendus* of the Paris Academy. The green husk of the walnut yields to benzol a yellowish substance crystallising in very elongated octahedra or feather-like groups of crystals. This substance, which I call *regianine*, is easily decomposed, and, when treated with alkalies or ammonia, gives a splendid purple-red solution, whence acids precipitate a brown flocconnous substance. The latter, re-dissolved in a weak solution of soda, re-precipitated with hydrochloric acid, after the addition of which the solution is boiled and washed with boiling water, gives a jet black amorphous substance, which is pure *regianic acid*, yielding to analysis the composition $C_6H_6O_7$, and forming a brown lead salt, $PbO,C_6H_6O_7$, also a jet black silver salt, very similar in appearance to the acid itself, and a lime salt of a beautiful pink colour, the precipitation of which is hastened by boiling with a little ammonia. Regianic acid is insoluble in water, but dissolves in alkaline solutions with a fine red-purple tint. These coloured solutions have no peculiar action upon the spectrum. It appears to be derived from regianine by oxidation, for when the latter is introduced with a little soda into a given volume of air, the whole of the oxygen is absorbed. Regianine is soluble in water, alcohol, and benzol; but its solution in benzol is the only one that can be kept for any length of time. The alcoholic solution is rapidly decomposed by exposure to the air and regianic acid, more or less pure, deposited.

LABORATORY NOTES.

ON THE DISTINCTION BETWEEN A PHOSPHATE AND AN ARSENIATE.

It is well known that the difference in colour between silver phosphate and silver arseniate furnishes the most simple means of distinguishing between the two classes of salts. Presence of free nitric acid or ammonia interfering with the reaction, it is necessary to apply the test to a neutral solution, in which case many other salt radicals may be precipitated. If the phosphate or arseniate be first separated as the ammonia magnesium salt, it is usual to dissolve this precipitate in nitric or acetic acid before adding silver nitrate. This is quite unnecessary, the characteristic yellow phosphate or brown arseniate being immediately produced on addition of silver nitrate to the crystalline precipitate. This modification renders the test more delicate as the reaction takes place in a neutral liquid. A few streaks on a test-tube show the reaction very distinctly, hardly changing colour if due to

* Abstract of a Paper read before the British Association, Edinburgh Meeting, Section B.

phosphate, but turning quite brown if caused by arseniate, in each case becoming soluble in ammonia. On this account the ammonio-magnesium salt must be washed free from ammonia, which would either prevent the reaction or lead to confusion by precipitating brown silver oxide. Acetic acid dissolves both phosphate and arseniate of silver, the former far more readily than the latter. If, therefore, acetic acid be gradually added to a mixed precipitate of silver phosphate and arseniate, the phosphate dissolves first, and the brown colour of the arseniate becomes more apparent. If, after addition of a moderate quantity of acetic acid, the liquid be filtered, the dissolved phosphate may often be detected by cautious neutralisation with ammonia, when the yellow silver phosphate is thrown down, but this reaction is uncertain, as both phosphate and arseniate of silver are soluble in ammonium acetate, the phosphate more readily than the arseniate.

Alfred H. Allen, F.C.S.

Sheffield, August 26, 1871.

MISCELLANEOUS.

New Appointment.—Mr. James Kilroe, ex-scholar of the Royal College of Science, Dublin, has been appointed Science Teacher in the Trade School at Saltaire, Leeds.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Moniteur Scientifique, Nos. 331 and 352 (double number), August 1 and 15, 1871.

This number contains the following original papers and memoirs bearing on chemistry and collateral sciences:—

Anthracen and its Derivatives.—Dr. E. Kopp.—We regret that it is impossible to quote here more than the headings of the various sections of this very complete and exhaustive monograph on this subject:—The anthracens of commerce—(*a*) crude anthracen of German origin, (*b*) crude anthracen of English, (*c*) of French manufacture; preparation of chemically pure anthracen; properties of semi-purified anthracen; properties of absolutely pure anthracen; formation and synthesis of anthracen—(1) by means of toluol or toluen, (2) by the action of heat alone upon toluol, (3) by the reaction of ethylen and styrolen upon benzine; hydrogenated derivatives from anthracen; action of chlorine upon anthracen. This essay is to be continued.

Best means of Artificial Illumination of Workshops and Factories.—A. Jouglet.—This essay, illustrated by a woodcut, treats at length on Rouille's autogen gas apparatus, already alluded to by us before (see Chemical News, vol. xxiv., p. 74).

Short Notes on the Maritime Exhibition held at Naples last year.—A. Jouglet.—This paper contains, among other interesting matter, some particulars on a new instrument invented by M. Esposito, and termed a *nausismograph*—viz., a contrivance which may be briefly described as an automatic log-book. This apparatus is highly eulogised by naval authorities of high standing—English, American, Russian, French, and others—and especially, also, by the eminent mathematician, the Rev. Father A. Secchi, S.J. Very properly the author of this paper here observes, "Parlez moi de sciences mathématiques pour produire l'accord entre des hommes venus de points opposés."

Bayerisches Industrie und Gewerbe Blatt, June, 1871.

This number contains the following original papers relating to chemistry and collateral sciences:—

Milk and Lactometers.—P. Neumann.—A lecture on this subject in its most exhaustive sense, treating, not simply on milk as usually understood, but on that fluid as secreted by mammalia in general, and also quoting a series of analyses of milk, the modes of testing milk, preserving it, and statistics relating to the number of cows found in various countries, per mille of the population thereof, and a detailed description of the various lactoscopes, lactometers, and other similar instruments.

Utility and Value of Carbonic and Lactic Acids in Beer.—A. Vogel.—The contents of this paper really bear upon the question, What effect have newly-built cellars upon Lager beer which is kept in casks? From a comparative experiment made by the author, it appears that, when fresh lime can absorb the carbonic acid contained in beer, the effect thereof is that the liquor becomes rapidly stale. As regards the lactic acid, a permanent constituent of good beer, it is due to the malt, and is of importance for keeping proteine compounds in solution in beer.

American Journal of Pharmacy, August, 1871.

In addition to several original papers and memoirs more particularly bearing upon pharmacy, this number contains the following original papers relating to chemistry;—

Bromide of Cerium.—C. Bullock.—The author prepares this salt (which, it appears, is used as medicine in the United States) by first taking oxalate of cerium, which, having been calcined in a porcelain capsule, the resulting sesquioxide was dissolved in hydrochloric acid (with copious evolution of chlorine). To the chloride of cerium thus obtained, carbonate of soda was added, yielding white carbonate of cerium insoluble in an excess of the alkaline carbonate. The carbonate of cerium was dissolved in hydrobromic acid, requiring nearly twice the weight of the sesquioxide in bromine as hydrobromic acid for saturation. The solution of bromide of cerium decomposes while evaporating, even at a low temperature, disengaging acid fumes. When evaporated to dryness, and pulverised, the salt has a light chocolate colour; the taste is somewhat sweet and very styptic. The salt is very deliquescent, and dissolves in alcohol of 95 per cent. The dry salt leaves an insoluble sediment in water, which sediment, of a light grey colour, was found to be protoxide of cerium.

Note on Chloral Hydrate.—Ch. A. Bœhme.—The author relates at length an occurence which appears to lead to the conclusion that chloral hydrate may be spontaneously decomposed when kept in sealed bottles, two of these, each containing 1 lb. of the substance alluded to, having been obtained from a leading drug-house at New York. One of the bottles was opened at once, and nothing special noted in its contents; the other bottle was placed in a store-room, and on being after some time opened, a dense cloud of fumes was observed to issue from its mouth. These fumes had the characteristic odour of chloral hydrate, but were more stifling, reddened blue litmus-paper, and, on further testing, were found to consist partly of hydrochloric acid. The lumps of the hydrate near the top of the bottle had crumbled to a crystalline powder freely soluble in water, somewhat in chloroform, but insoluble in sulphide of carbon and oil of turpentine. The author's opinion is that the sample alluded to might have been pure hydrate of chloral at first, and been decomposed by standing.

Action of Chlorides on Calomel.—J. Cummings.—According to Mialhe, calomel is in part converted into bichloride of mercury (corrosive sublimate) and metallic mercury, by chloride of ammonium and the chlorides of sodium and potassium. Dr. Gardner denies this statement. The author communicates a series of experiments made for the purpose of correctly ascertaining the real truth about these different assertions with the result that, in the case of the ammonium-chloride, there is some minute quantity of bichloride of mercury formed at 119° F., when the ammonium-chloride is, along with water, in contact with the calomel. With the chloride of sodium, the calomel is not so readily converted into bichloride, requiring thereto a higher temperature; but the addition of some drops of hydrochloric acid hastens the reaction. Calomel, digested alone with the acid just named for twelve hours at a temperature of 120° F., undergoes the same change, but is not affected at a lower temperature.

Analysis of a Silver Ore from Austin, Nevada.—J. L. Beeler.—In 100 parts, this ore was found to consist of—AgCl, 0·94; AgS, 47·60; SbS_3, 11·31; PbS, 11·75; Cu_2S, 1·19; FeS_2, 3·23; SiO_2, 23·63 loss, 0·35—total, 100·0.

Shoe-Blacking without Acid.—Dr. Artus.—From 3 to 4 lbs. of lamp-black and ½ lb. of bone-black are well mixed with 5 lbs. of glycerine and treacle. Meanwhile, 2½ ozs. of gutta percha are cautiously fused in a copper or iron saucepan, and 10 ozs. of olive oil added, with continual stirring, and afterwards 1 oz. of stearine. The warm mass is added to the former mixture, and then a solution of 5 ozs. of gum senegal in 1½ lbs. of water, and 1 drachm each of oil of rosemary and lavender may be added. For use, the blacking is diluted with 3 to 4 parts of water. This blacking keeps the leather soft, and renders it more durable.

La Revue des Scientifique de la France et de l'Etranger, August 5, 1871.

This number does not contain any original papers relating to chemistry and thereto allied sciences, but we call attention to the lectures on the—

Influence of Heat Externally Applied to Animals.—Dr. C. Bernard.—Interesting in a physiological experimental view.

Climate of the Alsace.—Ch. Grad.—A valuable contribution to physical geography and meteorology.

August 12, 1871.

Contains no original papers relating to chemistry or collateral sciences.

Royal School of Mines.—Director, Sir Roderick IMPEY MURCHISON, Bart., K.C.B., F.R.S., &c.

During the Twenty-first Session, 1871-72, which will commence on the 2nd of October, the following COURSES of LECTURES and PRACTICAL DEMONSTRATIONS will be given:—

1. Chemistry. By E. Frankland, Ph.D., F.R.S.
2. Metallurgy. By John Percy, M.D., F.R.S.
3. Natural History. By T. H. Huxley, LL.D., F.R.S.
4. Mineralogy. } By Warington W. Smyth, M.A., F.R.S.
5. Mining. }
6. Geology. By A. C. Ramsay, LL.D., F.R.S.
7. Applied Mechanics. By T. M. Goodeve, M.A.
8. Physics. By Frederic Guthrie, F.R.S.
9. Mechanical Drawing. By the Rev. J. Haythorne Edgar, M.A.

The Fee for Students desirous of becoming Associates is £30 in one sum, on entrance, or two annual payments of £20, exclusive of the Laboratories.

Pupils are received in the Royal College of Chemistry (the Laboratory of the School), under the direction of Dr. Frankland, and in the Metallurgical Laboratory, under the direction of Dr. Percy.

Tickets to separate Courses of Lectures are issued at £3 and £4 each.

Officers in the Queen's Service, Her Majesty's Consuls, Acting Mining Agents and Managers may obtain Tickets at reduced prices.

Science Teachers are also admitted to the Lectures at reduced fees.

His Royal Highness the Prince of Wales grants Two Scholarships, and several others have also been established by Government.

For a Prospectus and information, apply to the Registrar, Royal School of Mines, Jermyn Street, London, S.W.

TRENHAM REEKS, Registrar.

PRACTICAL CHEMISTRY.

Laboratory, 60, Gower Street, Bedford Square, W.C.

Mr. Henry Matthews, F.C.S., is prepared to give Instruction in all branches of PRACTICAL CHEMISTRY, particularly in its application to MEDICINE, AGRICULTURE, and COMMERCE.

The Laboratory is open daily, except Saturday, from ten to five o'clock; on Saturday, from ten till one o'clock.

Mr. Matthews is also prepared to undertake ANALYSES of every description.

For Particulars and Prospectuses, apply to Mr. Henry Matthews, the Laboratory, 60, Gower Street, Bedford Square, W.C.

South London School of Chemistry and Pharmacy, directed by Dr. JOHN MUTER, M.A., F.C.S., &c.

Specially rapid preparation for Examination in CHEMISTRY, BOTANY, MATERIA MEDICA, PHARMACY, FORENSIC MEDICINE, and CLASSICS.

The New Laboratory has been fitted up on the most modern principles, and a complete Dispensing Department and Botanical Garden added to the School.

A few Articled Pupils received (when a vacancy occurs) for Instruction in Commercial Analysis and Microscopy.

*** Analyses and Research conducted for the Profession with rapidity, accuracy, and at special discount.

289, Kennington Road, London, S.E.

North London School of Chemistry, Pharmacy, &c.—For Instruction in Practical Chemistry and Evening Classes for the Study of Chemistry, Botany, Materia Medica, &c. Conducted by Mr. J. C. BRAITHWAITE, *for thirteen years Principal Instructor* in the Laboratories of the Pharmaceutical Society of Great Britain, and Demonstrator of Practical Pharmacy, Pharmaceutical Latin, &c.

Mr. Braithwaite, having taken the premises adjoining his house, has been enabled *nearly to double the size of his Laboratories*, and, at the same time, procure a large piece of ground which *he has had laid out as a Botanic garden*. Every facility is, therefore, offered to Students desirous of acquiring a practical knowledge of this branch of their education.

The Session 1871—1872 will commence on the 2nd of October, when the Laboratories will re-open at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

THE CHEMICAL and TOXICOLOGICAL CLASS will meet as usual every Monday and Thursday evening, commencing October 2nd, at 8 p.m.

The LATIN CLASS for the reading of Physicians' Prescriptions, Cæsar's Commentaries, &c., every Tuesday and Friday evening, commencing October 3rd, at 8 p.m.

The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday evening, commencing October 4th, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will be continued every Saturday, until further notice, at 10 a.m.

Fee to either of the above Classes Half-a-Guinea per Month. Pupils can enter at any period.

Gentlemen Privately Prepared for the Examinations of the Pharmaceutical Society, and the "Modified Examination for Assistants," &c

All Fees must be paid in advance.

Letters of inquiry should be accompanied with a stamped envelope.

Mr. Braithwaite receives a few Pupils to Board in his house.

Address—54, Kentish Town Road, N.W.

BERNERS COLLEGE of CHEMISTRY.—EXPERIMENTAL MILITARY and NAVAL SCIENCES, under the direction of Professor E. V. GARDNER, F.E.S., &c.: of the late Royal Polytechnic Institution and the Royal Naval College.

The Laboratory and Class Rooms are open daily.

Especial facilities for persons preparing for Government and other examinations.

Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

For particulars, &c., apply to Prof. E. V. G., 44, Berners-street, W.

Royal Veterinary College, Great College Street, Camden Town, London.

The Lectures will commence at the above Institution on Tuesday, October 3rd.

The Introductory Address will be delivered by Deputy Professor Pritchard, at 12 o'clock.

Anatomy, Physiology, and Pathology of the Horse—Professor Spooner.

Anatomy, Physiology, and Pathology of other Domesticated Animals—Professor Simonds.

Descriptive Anatomy, with Physiology—Deptuty Professor Pritchard.

Chemistry, Materia Medica, and Toxicology—Professor Tuson.

Anatomical Demonstrations—Assistant Professor Axe.

Infirmary Practice and Clinical Instruction daily—Professors Spooner, Simonds, and Pritchard.

Perpetual Fee to all the Lectures, with Infirmary Practice and Anatomical Demonstrations daily, 25 guineas.

It is desirable that intending Pupils should present themselves at the Royal Veterinary College for Matriculation at 10 o'clock a.m. precisely on Tuesday, the 26th of September next. Matriculation fee 1 guinea.

A Prospectus will be forwarded on application.

CHARLES SPOONER, Principal.

August 25th, 1871.

St. Mary's Hospital Medical School.—Open SCHOLARSHIP AND EXHIBITION IN NATURAL SCIENCE.

A Scholarship of the value of £40, tenable for three years, and an Exhibition of the value of £20, for one year, will be awarded by open competitive Examination in Natural Science, at St. Mary's Medical School, on September 26th and following days.

Any person will be eligible as a candidate who has passed an Examination qualifying him to register as a Medical Student, provided he has not previously completed a full year of medical study at a recognised Hospital.

Candidates are requested to call personally upon the Dean at the School, on Monday, Sept. 25th, betwen the hours of 3 and 5 p.m., and to bring with them a certificate of having passed the required preliminary Examination.

Further information as to the subjects of Examination, and the conditions under which the Scholarship and Exhibition will be held, may be obtained from Dr. Cheadle, the Dean, or from Mr. Knott, the Registrar, at the Hospital.

W. B. CHEADLE, M.D., Dean of the School.

ANALYTICAL LABORATORY AND SCHOOL OF TECHNICAL CHEMISTRY.

7 and 9, HACKIN'S HEY, LIVERPOOL.

Conducted by A. NORMAN TATE, Analytical and Consulting Chemist, and Chemical Engineer.

Established for Educational Purposes connected with Chemistry in its practical Applications to Manufactures, Commerce, &c.; for the performance of Analyses, Assays, and Chemical Investigations; and for affording information respecting the construction, &c., of Chemical Manufactories, and the conduct of Chemical Manufacturing Processes.

The Course of Instruction, in addition to the ordinary Chemical studies, comprises, as far as possible, all such other subjects as are necessary to give the scientific and practical information required in the Arrangement, Construction, and Management of Chemical Manufactories, and in the Application of Chemistry to Industrial Pursuits.

Students' Fees may be known on Application.

Plans, &c., for Chemical Apparatus and Manufactories are supplied, and the Erection of Plant and Buildings is superintended when required.

Liverpool Royal Infirmary School of Medicine.

Lecturer on Chemistry and Toxicology—
Dr. J. CAMPBELL BROWN.

1. Course of 100 Lectures. Monday, Tuesday, Thursday, and Friday, at 10.15. £5 5s.
2. Practical Organic Chemistry for Senior Students. £3 3s.
3. Practical Chemistry. Summer Class. Fifty lesssons. £3 3s.
4. Toxicology. Twelve Lectures.
5. Technical Students are admitted on five days of the week into the Private Laboratory, which is open from 10 to 4 for consultation and analyses.

OWEN'S COLLEGE, MANCHESTER,

IN CONNEXION WITH THE UNIVERSITY OF LONDON.

Principal—J. G. GREENWOOD, B.A.

PROFESSORS AND TEACHERS:—

GREEK.	Prof. J. G. Greenwood, B.A., Fellow of University College, London.
LATIN.	Prof. A. S. Wilkins, M.A., Fellow of University College, London.
ENGLISH LANGUAGE AND LITERATURE, ANCIENT & MODERN HISTORY.	Prof. A. W. Ward, M.A., Fellow of St. Peter's College, Cambridge.
MATHEMATICS.	Prof. Thomas Barker, M.A., Fellow of Trinity College, Cambridge. *Assistant Lecturer*—A. T. Bentley, M.A.
NATURAL PHILOSOPHY.	Prof. Balfour Stewart, LL.D., F.R.S. Prof. Thomas H. Core, M.A.
PHYSICAL LABORATORY.	*Director*—Prof. Balfour Stewart. Prof. Thomas H. Core, M.A. *Assistant*—Francis Kingdon.
CIVIL & MECHANICAL ENGINEERING, GEOMETRICAL AND MECHANICAL DRAWING.	Prof. Osborne Reynolds, M.A., Fellow of Queen's College, Cambridge. *Assistant*—J. B. Millar, B.E.
LOGIC AND MENTAL AND MORAL PHILOSOPHY. POLITICAL ECONOMY.	Prof. W. Stanley Jevons, M.A., F.S.S., Fellow of University College, London.
JURISPRUDENCE AND LAW.	Prof. James Bryce, D.C.L., Fellow of Oriel College, Oxford.
CHEMISTRY.	Prof. H. E. Roscoe, B.A., Ph.D., F.R.S.
CHEMICAL LABORATORY.	Prof. H. E. Roscoe, B.A., F.R.S. *Senior Assistant*—C. Schorlemmer, F.R.S. *Junior Assistant*—Francis Jones.
NATURAL HISTORY.	Prof. W. C. Williamson, F.R.S.
ORIENTAL LANGUAGES.	Prof. T. Theodores.
MODERN LANGUAGES.	Prof. Theodores. Hermann Breymann, Ph.D.
MINERALOGY.	C. A. Burghardt, Ph.D.
FREE-HAND DRAWING.	William Walker.

The Session commences on the 2nd of October.

Prospectuses of the Day or Evening Classes, and of the Scholarships and Entrance Exhibitions tenable at the College, will be sent on application.

J. HOLME NICHOLSON, Registrar.

TECHNICAL EDUCATION.

SCIENCE AND ART DEPARTMENT.

Royal College of Science for Ireland,

STEPHEN'S GREEN, DUBLIN.

SESSION—1871-72.

THIS College supplies, as far as practicable, a complete Course of Instruction in Science applicable to the Industrial Arts, especially those which may be classed broadly under the heads of CHEMICAL MANUFACTURES, MINING, ENGINEERING, and AGRICULTURE.

A Diploma of Associate of the College is granted at the end of the Three Years' Course.

The Course of Instruction is recognised by the Secretary of State for India as Qualifying for Appointments in the Engineering Department.

There are Four Royal Scholarships, of the value of £50 each yearly, with Free Education, including Laboratory Instruction, tenable for two years. Two become vacant each year. They are given to Students who have been a year in the College. There are also Nine Exhibitions attached to the College, of the yearly value of £50 each, with Free Education and Laboratory Instruction, tenable for three years. Three become vacant each year. These are awarded at the Annual May Examinations of the Science and Art Department.

The Fees are £2 for each Course, or £10 for all the Courses of each year, with the exception of Laboratory.

The Laboratory Fee is £12 for the full Course of nine months, or £2 per month.

SUBJECTS OF INSTRUCTION.

Applied Mathematics, Mechanism and Machinery, Descriptive Geometry, Geometrical, Mechanical, and Engineering Drawing, Experimental Physics, Chemistry (Theoretical and Practical), Botany, Zoology, Geology and Palæontology, Mining, Surveying, Agriculture.

The Laboratory is open for Instruction in Practical Chemistry, Metallurgy, and Assaying, from ten to four o'clock every week-day during the Session, except Saturdays and Holidays.

The Session commences on MONDAY, OCTOBER 2.

Programmes may be obtained on application to the Secretary, Royal College of Science, Stephen's Green, Dublin.

FREDERICK J. SIDNEY, LL.D., Secretary.

University of Aberdeen.—Chancellor, His

Grace the Duke of Richmond. *Vice-Chancellor and Principal*, the Very Rev. P. C. Campbell, D.D. *Lord Rector*, M. E. Grant Duff, M.A., M.P.

FACULTY OF MEDICINE—SESSION 1871-72.

WINTER SESSION, Commencing on Wednesday, November 1.

Anatomy—Professor Struthers, M.D. 11 a.m. £3 3s.
Practical Anatomy and Demonstrations—Professor Struthers and Demonstrator. 9 to 4, and 9 a.m. £2 2s.
Chemistry—Professor Brazier. 3 p.m. £3 3s.
Institutes of Medicine—Professor Ogilvie, M.D. 4 p.m. £3 3s.
Surgery—Professor Pirrie, C.M., F.R.S.E. 10 a.m. £3 3s.
Practice of Medicine—Professor Macrobin, M.D. 3 p.m. £3 3s.
Midwifery and Diseases of Women and Children—Professor Inglis, M.D. 2 p.m. £3 3s.
Zoology, with Comparative Anatomy—Professor Nicol, F.G.S. 2 p.m. £3 3s.
Medical Logic and Medical Jurisprudence—Professor Ogston M.D. 9 a.m. £3 3s.

SUMMER SESSION, commencing on the First Monday of May.

Botany—Professor Dickie, M.D. 9 a.m. £3 3s.
Materia Medica (100 Lectures)—Professor Harvey, M.D. 3 and 4 p.m. £3 3s.
Practical Anatomy and Demonstrations—Professor Struthers and the Demonstrator. 9 to 4, and 2 p.m. £2 2s.
Practical Chemistry—Professor Brazier. 10 a.m. £3 3s.
Zoology, with Comparative Anatomy—Professor Nicol. 11 a.m. £3 3s.

The Anatomical Course in Summer includes instruction in General Anatomy and in the use of the Microscope; and Instruction in Osteology for Beginners.

Matriculation Fee (including all dues) for the Winter and Summer Sessions, £1. For the Summer Session alone, 10s.

Royal Infirmary: Daily at Noon. Physicians—Drs. Harvey, Smith, and Beveridge. Surgeons—Drs. Pirrie, Kerr, and Fiddes. Junior Surgeon—Dr. A. Ogston. Ophthalmic Surgeon—Dr. A. D. Davidson. Dental Surgeon—Mr. Williamson. Pathologist—Dr. Rodger. Perpetual Fee to Hospital Practice, £6; or, first year, £3 10s; second year, £3.

Clinical Medicine—Drs. Harvey, Smith, and Beveridge. £3 3s.
Clinical Surgery—Drs. Pirrie, Kerr, and Fiddes. £3 3s.
Pathological Anatomy—Dr. Rodger. £2 2s.

A Three Months' Course of Practical Ophthalmology is given in Summer by Dr. A. D. Davidson, commencing early in May.

General Dispensary, and Lying-in and Vaccine Institution; Daily, Eye Institution: Daily.

Practical Midwifery, under the superintendence of Dr. Inglis.

Royal Lunatic Asylum; Physician—Dr. Jameson. Clinical Instruction is given for Three Months in the Year.

The Regulations relative to the Registration of Students of Medicine, and the granting of Degrees in Medicine and Surgery, may be had of Dr. Macrobin, Dean of the Faculty of Medicine.

Full information regarding the Classes and Degree in the Faculties of Arts, Law, and Divinity, and in regard to Bursaries and Scholarships, will be found in the UNIVERSITY CALENDAR, published by Messrs. Wyllie and Son, Union Street, Aberdeen—By Post, 2s. 2d.

Royal 8vo., with 7 Lithographs and 50 Woodcuts, price 6s. cloth,

Microscopical Manipulation; being the subject

matter of a Course of Lectures delivered before the Quekett Microscopical Club, January—April, 1869. By W. T. SUFFOLK, F.R.M.S.

London: Henry Gillman, Boy Court, Ludgate Hill.

Chemical Technology, or Chemistry in its

Applications to the Arts and Manufactures. By THOMAS RICHARDSON and HENRY WATTS. Second Edition, illustrated with numerous Wood Engravings.

Vol. I., Parts 1 and 2, price 36s., with more than 400 Illustrations.

Nature and Properties of Fuel: Secondary Products obtained from Fuel: Production of Light: Secondary Products of the Gas Manufacture.

Vol. I., Part 3, price 33s., with more than 300 Illustrations.

Sulphur and its Compounds: Acidimetry: Chlorine and its Bleaching Compounds: Soda, Potash: Alkalimetry: Grease.

Vol. I., Part 4, price 21s., 300 Illustrations.

Aluminium and Sodium: Stannates, Tungstates, Chromates, and Silicates of Potash and Soda: Phosphorus, Borax: Nitre: Gun-Powder: Gun Cotton.

Vol. I., Part 5, price 36s.

Prussiate of Potash: Oxalic, Tartaric, and Citric Acids, and Appendices containing the latest information and specifications relating to the materials described in Parts 3 and 4.

BAILLIERE AND CO., 20, King William Street, Strand.

THE CHEMICAL NEWS.

Vol. XXIV. No. 616.

OBSERVATIONS ON CLEAN AND UNCLEAN SURFACES IN VOLTAIC ACTION.*

By THOMAS BLOXAM.
Lecturer on Chemistry, Cheltenham College.

If a piece of amalgamated zinc is made to touch a piece of platinum in the presence of acidulated water, the well-known extraction of hydrogen bubbles takes place from the latter metal. Whilst trying a series of such experiments, and also some of a similar nature, I observed an unequal evolution of bubbles from some parts of the platinum plate, and accordingly submitted the matter to enquiry.

The first series of experiments had for their object to ascertain the amount of gas evolved in a given time from a zinc and platinum plate in contact.

Expt. 1. A tube graduated to 1 cubic inch was filled with water acidulated with $\frac{1}{6}$th of strong sulphuric acid; a strip of platinum as obtained from the apparatus makers was cut 7-in. long, $\frac{1}{4}$-in. wide; introduced into the tube which was then inverted upon a small plate of amalgamated zinc also standing in the same acid and water. The time at starting and at the termination was accurately recorded, as also the temperature and pressure throughout all the experiments. Time resulting from a *mean of many experiments* was 22 minutes.

Expt. 2. The strip cleaned by heating it in oil of vitriol, and thoroughly rinsing in distilled water, gave as a mean result. Time 14 minutes.

Expt. 3. The strip merely passed through the finger several times. Time 28 minutes.

It will be seen from these results that the platinum as it leaves the instrument makers is absolutely, so to speak, chemically dirty; but the mere contact with the hand is sufficient to materially modify the action.

The strip cleaned by oil of vitriol was dipped for a moment into solution of common salt, and again tried when the time required for collecting the cubic inch of hydrogen was nearly doubled.

The strip having been made dirty by touching, was ignited in the flame of a good Bunsen lamp for one minute, and then arranged in the cubic inch tube. The time required was fifteen minutes, thus showing that it had been in great measure cleaned, though hardly so satisfactorily as in the heating with oil of vitriol.

Expt. 4 was devoted to the action of copper negative plates in similar strips to the platinum; the mean results in these cases were that copper cleaned with nitric acid and washed in distilled water gave the cubic inch of hydrogen in twenty-one minutes. The strip passed through the fingers as in the platinum experiments. Time required $28\frac{1}{2}$ minutes.

A strip of copper oxidised by heating in air furnished the hydrogen in ten minutes.

It would appear from these results, that copper behaves in a similar way as to cleanness of surface as platinum, and that the oxidised surface tends rather to facilitate the liberation of the hydrogen—perhaps from mechanical action, like platinised silver.

Expt. 5. Platinised silver, as obtained from the makers, arranged in the same way as the foregoing experiments, furnished the 1 cubic inch hydrogen in $2\frac{1}{4}$ minutes. A strip cleaned with oil of vitriol as usual, time $2\frac{1}{4}$ minutes. A strip made dirty by the fingers, time 3 minutes.

Hence it appears that the mechanical action of the platinum surface is of great importance, as has been well known, and that as received from the makers it is very considerably cleaner than the new platinum, because, probably, of its method of preparation.

It was also found that, comparing *smooth* with mechanically *roughened* surfaces of platinum, the latter furnished the hydrogen in two-thirds of the time taken by the former.

Expt. 6. A cell of Smee's battery was examined by the galvanometer, using in every case a regular strength of acid, the same wires and all conditions the same, when the following results were obtained:—

The negative plate not chemically cleaned, deflection = 52°.

Negative plate chemically cleaned, 57°.

Negative plate made dirty by fingers, 48°.

The platinum taken off the surface gave deflection 50°.

Here it appears, then, that the cleaning of the surface of the platinised silver materially diminishes the resistance due to the counter-current and polarisation.

The last series of experiments were directed to ascertain the influence of chemically clean surfaces upon electrolysis.

A voltameter, the electrodes of which were in their ordinary state, was attached to two cells of Bunsen's battery, and the mixed gases collected with all precaution. The time taken for 1 cubic inch was 2 minutes as a mean of many experiments.

The electrodes were then cleaned with hot oil of vitriol, the Bunsens freshly charged, and the 1 cubic inch of gases was furnished in $1\frac{1}{4}$ minutes; thus showing that electrolysis is materially affected by the state of cleanness of the electrodes at the time.

* Read before the British Association, Edinburgh Meeting, Section B.

ON THE DISSOCIATION OF MOLECULES BY HEAT.*

By C. R. C. TICHBORNE, F.C.S., M.R.I.A., &c.

Dissociation has been, and is now, applied to phenomena somewhat distinct from ordinary decompositions.

Decomposition specifies that some molecular change has been consummated, whilst dissociation is used to convey a passive but present phenomenon. If this latter phenomenon is carried far enough, it must ultimately result in a rupture, and thus the phenomena of decomposition and dissociation are so intimately connected that they can hardly be investigated alone. We may familiarly illustrate the dissociation influence of heat to the stretching of a piece of india-rubber, in which the dissociative force of heat is here represented by the fingers; the particles (emblematic of molecules) of india-rubber are here held asunder by the force—but when removed the rubber regains its primitive construction. This stretch may be carried on to a wonderful extent, but there is a limit, for at last a point is attained at which the rubber breaks. Compound molecules exist as solids, liquids, and gases, providing that the temperature necessary to convert them into these physical modifications is not above the temperature at which their components are disssociated. Now we can easily conceive that a substance, A, may be of sufficient structural stability to pass through all the increasing vibratory action without dissociation of its component molecules, until it has passed through the solid, liquid, and far into the vaporous condition, whilst a substance, B, has, what I will call a thermanalytic point, or the point where the equilibrium is broken. If it lies below 100° C., we have dissociation in the liquid condition. A

* Read before the British Association, Edinburgh Meeting, Section B.

great number of compounds are dissociated above this point, *e.g.*, anomalous vapour density of chloride of ammonium; whilst those dissociated below 100° C. are less common and are much less easy of observation. I find that this dissociation influence is frequently at work when we little dream of it, particularly as regards solutions. I have lately made a well-known natural group of elements my study in connection with these phenomena, viz., the trioxides, aluminic, chromic, and ferric oxides, and find that, as might be inferred, all the compound molecules of these bases are more or less dissociated on heating their solutions. The ferric compounds are the most easily affected: thus the solution of their compounds, if pure, are almost colourless, the slight tinge being in most cases produced by the basic action of the water. By the cautious addition of dilute acid almost colourless solution will be procured (an excess of acid produces also a colouration). On the application of heat this solution becomes gradually darker and darker, until it becomes a dark reddish-brown fluid. If the water bears any considerable proportion to the salt a basic precipitate falls, before it has reached the boiling-point. The relative amount of the water is of the utmost importance in these phenomena, because its basic action lowers the thermanalytic point as I call it. The results of the dissociative influence of heat when a precipitate is not produced is the repartitioning of elements by which a basic and an acid salt is produced simultaneously in the same fluid by the dissociative influence of heat. If these experiments are carried on under pressure, or in the presence of a great excess of water, the dissociative influence is so great from the increased range of temperature that anhydrous oxide of iron can be produced, although in the presence of water.

The compounds of chromium are capable of dissociation in a similar manner, but, in this case, the point of dissociation is higher, and the phenomena are not quite so striking. A pure chromium salt, such as the sulphate when dissolved in water, gives a slightly basic solution from the action of the water. It is for this reason that the cautious addition of the "stylous" or acid molecule first of all makes it a purer blue—the original solution being violet, with a tinge of green; the addition of an alkali or the heating of the fluid produces a green solution; heated under pressure basic precipitates are procured; or, upon the addition of a large volume of boiling water, the precipitation of the basylous element is determined.

The aluminic molecules at first sight might be considered to differ from the other two, but such difference is only one of degree. They obey exactly the same rule, but, as the thermanalytic point is much higher, and, as there is no chromatic change to mark the dissociative influence of heat, it is difficult to discern this phenomenon. Under the influence of solutions boiling at an increased pressure of 11 or 12 atmospheres, I have not only procured basic salts but gelatinous alumina from the sulphate. As I have explained before, the same results may be obtained by increasing the basic condition of the solution by a very large volume of water. As the pressure retains the boiling-point of the water until we reach the thermanalytic point of the molecule, so the basic action of the water upon the stylous group lowers the thermanalytic point until we get it within the range of 100° C., so that the phenomenon can be exhibited at ordinary temperatures. There is no evidence of decomposition in solutions of any considerable strength on boiling, but if a very considerable proportion, 50,000 to 60,000 times its weight of water, is used to the amount of salt, a precipitate is produced at 100° C. This is best seen by passing a beam of electric light through the flask, as the precipitate produced from chloride of aluminium is almost optically invisible in daylight. A beam of electric light impinging upon the light flocculent precipitate at once reveals its existence. Most of the other precipitates can be observed by the eye, but they re-dissolve on cooling.

NOTES ON PHOTOMETRY.

By WILLIAM FOSTER.
Gas Examiner to the Metropolitan Board of Works.

It occasionally happens that three or four experiments made at regular intervals during two hours of any one evening agree so closely that the gas appears to be of the same value each time an experiment is made. The very reverse, however, sometimes occurs, the numbers representing the illuminating power of the gas during the evening differing to the extent of two candles. The readiest explanation of such results as the latter is, that gas of varying quality has been passing through the main at different periods of the evening; and such a view of the case appears to be the only feasible one, when the experiments are known to have been made under similar conditions. By similar conditions it is implied that the gas has the same temperature, and is passing through the meter at an uniform rate, the barometer stationary, and the candles burning the same amount of sperm, or about the same, in each experiment. The first three conditions are obviously necessary. The latter does not at first sight appear to be so, owing to the correction made at the end of each experiment for any variability in the rate of consumption of the sperm. For most practical purposes, this correction for different rates of consumption of the sperm is sufficient—that is, when the candles are burning about the standard quantity. Still it is desirable to restrict its application within as narrow a limit as possible. The instructions of the Gas Referees are, that each experiment shall occupy ten minutes, and that the two candles employed shall consume forty grains of sperm (120 grains per hour). These conditions are rarely ever fulfilled; and it is to wide variations from this standard that my remarks are especially applicable. I have long ago questioned the value of observations taken with candles burning at low rates—say from 33 to 35 grains, and sometimes have not recorded them. The method adopted for arriving at a corrected result is to multiply the sum of the ten photometrical readings taken during the ten minutes by the number of grains of sperm consumed, and to divide this product by two, since two candles are used in the experiment. This process involves the theory that the light emitted from sperm is in simple proportion to the quantity consumed. For instance, *cæteris paribus*, the photometrical readings, based on the law that the intensity of lights is in the proportion of the squares of their distances from the point of measurement, are inversely as the consumption of the sperm. In other words, that any deficiency in the amount of sperm consumed is compensated by a higher reading in the photometer, and *vice versâ*, so that the product obtained by the multiplication of the readings and the quantity of sperm consumed, fairly represents the quality of the gas. This does not appear to me to be exactly true, at least not so far as ordinary practice is concerned. During last winter I had a parcel of candles, many of which gave not only low rates of consumption, but also very variable ones. Some of my results at that time were very high; and since then I have incidentally noticed that a low rate of consumption of sperm is in the majority of cases attended with a high number representing the illuminating power of the gas. In order to speak with confidence on this point, a large number of experiments have been made, the majority of which bear out all that I had previously noticed. They were made on consecutive evenings, extending over a week, and one experiment followed the other as quickly as circumstances would permit, the object being to notice whether any difference in the quality of the gas could be detected in such short intervals, when the conditions of the experiment were the same. The following were taken on three succeeding evenings, the same pair of candles being used for all the experiments made on any one evening. The method pursued was slightly different from that recommended by the Referees, and was as follows:—

During the time that the candles were burning in order to be ready for the first experiment, the quantity of gas was adjusted by the meter clock, the meter clock being used only for that purpose. Having the candles burning at the required rate, they were then placed on a balance, and, when the turning point was reached, a clock was immediately started by the right hand. A 40 grain weight was then placed in the balance on the side of the candles, the whole removed to the photometer, and the observations taken in the prescribed time. Towards the end of the 10 minutes the candles were taken out of the photometer, placed on the balance, and, the moment that the turning point was again reached, the clock on the right was instantly stopped. The time which had been required to consume 40 grains of sperm was then noted, and from this was calculated the consumption in 10 minutes. Thus, suppose 625 seconds have been required to burn 40 grains of sperm, then $625 : 40 :: 600 : x : x =$ the consumption of sperm in 600 seconds (10 minutes), in grains. This method in theory is the true one, the object being to weigh the candles on the two occasions under the same conditions so far as currents are concerned. Apart from this consideration, it has two special recommendations; there is no danger of losing any particles as there is when the candles are blown out, and in the second place the candles are immediately ready for another experiment. The experiments here given were made at a time when the pressure in the main was extremely regular, so much so that, having once obtained the gas passing at the required rate, scarcely any further adjustment was necessary.

Time when an Experiment was commenced.	Sperm consumed in 10 minutes.	Illuminating power in candles.
	July 6, 1871.	
8.25 p.m.	40·0	16·16
8.40 ,,	40·0	16·26
8.55 ,,	40·9	16·38
9.5 ,,	36·6	17·00
9.30 ,,	37·3	17·28
9.50 ,,	42·1	15·45
	July 7, 1871.	
8.25 p.m.	36·6	17·00
8.50 ,,	42·9	14·69
9.40 ,,	36·7	16·90
9.55 ,,	37·3	15·85
	July 8, 1871.	
8.30 p.m.	37·4	16·79
8.50 ,,	36·1	17·03
9.7 ,,	44·8	15·90
9.20 ,,	37·5	16·81
9.35 ,,	40·8	16·07
9.50 ,,	40·0	16·68

Experiments are not wanting which, at first sight, would appear to upset what these now given are intended to show; but such are not numerous. Besides, it must be borne in mind that throughout the whole there was the possibility of a difference in the quality of the gas. Hence the necessity of making a large number of experiments before any satisfactory conclusion could be arrived at. These results may be objected to on the ground that the use of the same candles for showing the effect of different rates of consumption is faulty at the outset, simply because the wicks are not adapted for such varying quantities. I may add that my experience is, that candles will of themselves vary to the extent of several grains. The candles here used were trimmed in order to obtain the different rates, but in no case could I detect anything objectionable in the character of the flame—they did not smoke. These results practically show that the tendency is to report gas above the truth when the rates of consumption are low; or that the amount of light emitted by sperm when burnt in the ordinary way is not simply proportional to the amount consumed, but that it is proportional + a certain quantity. I regret that I have not the means of storing gas of uniform quality, so as to be able by further experiments to arrive at some satisfactory numbers showing the law which regulates this increment to the illuminating power.

The photometer used is that known as Evan's improved form of the Bunsen. It is a rectangular box, 112 inches long, 6·5 inches broad, and about 11·5 inches high. The whole of the interior is lined with black velvet, except the greater portion of the roof, which is rounded, and made of blackened sheet copper. Midway in this box is a fixed diaphragm containing the waxed disc. The box is thus divided into two chambers of equal size, the capacity of one of them being about 4200 cubic inches. In one of these chambers, 50 inches distant from the waxed disc, is a fixed burner for the gas to be tested. In the other box is a sliding support for the candles, this support carrying an indicator which moves along a graduated scale on the outside of the machine. Each chamber is provided with a large door at the side. When an experiment is being conducted, the two chambers are closed during the entire time. The 40 grains of sperm burnt in 10 minutes require 126·2 grains of oxygen from external sources in order to convert the carbon and hydrogen into carbonic acid (carbonic anhydride) and water. The amount of atmospheric air containing this quantity of oxygen is 1768 cubic inches, or nearly one-half the amount contained by the chamber in which the candles are placed. In addition to this a large quantity of air is always carried along with the spent vapours, by virtue of the current which they establish. Now what are the precautions taken for the supply of air, and the exit of the products of combustion and rarefied atmospheric air? Along the whole length of the under part of the machine is a narrow slit from $\frac{3}{16}$ to $\frac{4}{16}$ of an inch in breadth. Air cannot pass into the photometer through this slit without passing twice at right angles, thus avoiding all danger from draughts. This source of air is the only intentional one, and I imagine is sufficient to meet the requirements of both the gas and the candles. It is the means of exit of the heated vapours that appear to me to be faulty. Everyone accustomed to the use of the instrument must have noticed that nearly every time an experiment is made the numerical value of the photometrical readings gradually increases. This increase is such that where the first reading may be 8 the probability is that the 10th will be 9, or 9·5. This ought not to be, as it indicates that the candles do not give the same amount of light towards the end of an experiment that they do at the commencement. It is quite manifest that the gas does not suffer, at least not to the same extent, as the candles, otherwise the increasing value of the readings would not occur. My opinion is that the gas is tested under more uniform conditions than the candles, and for this reason: Immediately above the argand burner is a copper chimney, which at once takes away the heated gases and rarefied air, causing a proportionate influx of cold air through the slit below. The chamber containing the candles is also provided with a similar chimney, equally distant from the waxed disc, namely, 50 inches. The two chimneys, placed as described, not only maintain the symmetrical proportions of the instrument, but, if required, also permit two kinds of gas to be tested in it by burning one at each end. In addition to the two chimneys, one in each chamber, the eaves —so to speak—of the arched copper roof along their entire length admit of the exit of the heated vapours. The two slits, one on each side, are more complicated than the one at the bottom which supplies the air, and consequently the products of combustion of the candles have to pass by a very circuitous route before they can escape. There can be no question that the chimney placed above the gas-flame permits all the impurities to escape at once. The case of the candles is different. When testing 16-candle gas the two candles are then more than 30 inches distant from the chimney, so that its use for the purpose of ventilation is *nil*, or nearly so. The spent vapours and heated air must then escape promiscuously through the slits along the two edges of the roof, which appear to be in-

sufficient for the purpose. At first I was led to suppose that the increased value of the readings was due to an imperfect supply of atmospheric oxygen, owing to the narrowness of the slit supplying the air. But such a view is no longer tenable when one reflects that the supply to a flame eight times the size takes place through the same sized opening, without any apparent deterioration in the value of the flame. And yet there can be no doubt that it is owing to an imperfect supply of oxygen, although caused somewhat differently. The ingress of air is determined by the egress of the heated vapours, so that increasing opportunities of escape for the latter is simply causing a greater supply of the former. It therefore appears to me highly desirable that some form of chimney should be placed over the burning candles, so that they may be under conditions similar to those under which the gas is being tested in the adjoining chamber. If this chimney were constructed with a movable diaphragm, the draught would then be under control. As the instrument is at present worked, the candles are so near the roof that the need of this addition is shown by its very high temperature after the candles have been under it not more than 10 minutes.

104, Hill St., Peckham, London.
August 26, 1871.

ON RECENT INVESTIGATIONS AND APPLICATIONS OF EXPLOSIVE AGENTS.*

By F. A. ABEL, F.R.S., Treas. C.S.

(Continued from p. 104).

Numerous as have been the attempts during the last sixteen years to apply other explosive agents as substitutes for gunpowder in small-arms and even in artillery, no rival of the latter has yet thoroughly established any good claims to success as a propelling agent, except for sporting purposes. Nor does it appear probable, considering the difficulties which have to be encountered in sufficiently regulating the explosive action of gunpowder to adapt it to the heavy artillery of the present day, that even the apparently most controllable of other explosive bodies—gun-cotton—will ultimately prove susceptible of safe application in any larger artillery than field-guns. The ultimate failure of the repeated attempts made in Austria to apply gun-cotton to artillery and small-arms must not, however, be accepted as proof that no results of value are likely to be attained in this direction. A very decided advance had been made towards the successful employment of gun-cotton in field guns before the Government Committee on Gun-cotton ceased to exist in 1868; and if the experiments on this subject, which were then suspended, as well as those relating to the employment of gun-cotton in military small arms, have not been resumed, it is only because the Committee on Explosives, to whom the further investigation of these matters has been entrusted, has hitherto been fully occupied with the more immediately important investigations relating to gunpowder. Some considerable time was devoted by me, about three years ago, to the production of small-arm cartridges of compressed gun-cotton, suitable for the breech-loading arms of the service, and a system was already at that time pursued with considerable success, of regulating the rapidity of explosion of the material by its impregnation with minute quantities of a non-explosive and otherwise perfectly inert substance, which at the same time imparted considerable water-repellant properties to the cartridge. Experiments with cartridges prepared on this system will be resumed in due course; meanwhile a similiar method of treatment has been applied with great success to the production of sporting cartridges made of prepared and lightly compressed gun-cotton, by Messrs. Prentice, to whose energy and perseverance we are indebted for the firm establishment of gun-cotton as an important explosive agent.

Although gunpowder is still the only propelling agent susceptible of general application, it no longer enjoys a monopoly in connection with some equally important applications to naval, military, and industrial purposes. The very energetic action of potassium-chlorate upon readily oxidisable substances, and the great rapidity and violence of explosion of mixtures of that class, when compared with similar mixtures containing saltpetre, has given rise for many years past to repeated attempts, often renewed in the same directions, to apply that substance to the production of powerful substitutes for gunpowder. Mixtures of it with resin, powdered nut-galls, and other substances of vegetable nature or origin, have been suggested, and in some instances applied to a limited extent in directions where rapidity and violence of explosive action appear to present advantages, as in some kinds of blasting operations; even the old and well-known mixtures of the chlorate with potassium ferro- and ferri-cyanide and sugar, which, for many years past have been described in chemical handbooks as *white gunpowder*, and *German gunpowder*, have been more than once re-proposed of late, not merely as mining agents, but for use in firearms. The practical objection generally raised, and with reason, against mixtures of this class, that they are of detonating character, and consequently more or less dangerous to transport and handle, is always either met or forestalled by the proposal to keep the ingredients separate until the mixture is actually used, as the violent oxidising property of potassium-chlorate renders the production of powerfully explosive preparations possible by crude and rapidly-performed mixing operations, which would be altogether inadequate for the production of useful explosive mixtures with saltpetre. Such a proceeding is, however, inadmissible in naval and military service for several reasons; and the trouble which it would involve at the hands of miners using such preparations will probably always lead them to forego any advantages which might result from their employment, and either to adhere to gunpowder or to employ other materials supplied in the form in which they are actually to be used, even though considerable risk of accident may be incurred with these. Some of the preparations of this class, which, disguised by fancy names, occasionally find their way into miner's hands, are of so dangerous a character that it amounts to little short of deliberate criminality to endeavour to find a sale for such materials. Even mixtures consisting chiefly of potassium-chlorate and sulphur have been recently recommended as useful and safe mining agents. It need scarcely be said that a mixture of these substances is liable to explosion if submitted to a very slight friction or concussion; and although their sensitiveness to ignition may be very considerably reduced by the admixture of other substances, such mixtures will always be extremely liable to accidental explosion during the process of tamping, or unless handled with very great and constant care. A special application of the mixture of potassium-chlorate and sulphur, which merits brief notice, was made for war purposes in France at about the time of the late Exhibition. By converting the mixture into a paste, and then drying it, hard masses of the explosive agent can be produced, which are made to fit shells of lead, and afterwards completely enclosed in the metal by the operation of "spinning." A small-arm projectile is thus produced, which may be safely fired from a rifle, but which explodes with fearful violence even upon penetrating flesh, producing the most appalling wounds. It may be remembered that an account was published about a year ago of trials made in London upon horses with explosive bullets of this kind, the results of which established the success of the bullet as one of the most fearful destructive agents ever applied; but the agreement entered into long before the late war by the principal nations not to employ explosive bullets, has precluded any use being made of this ingenious mode of safely applying so highly detonating a mixture. It need hardly

* A Lecture delivered to the Members of the British Association at Edinburgh, August, 1871.

be stated that the conditions essential to safety, which can be readily fulfilled in enclosing a material of this kind in a leaden projectile, and firing it from a small-arm, do not bear comparison with those which arise when shells are fired from guns, even of small calibre.

The discovery of a more violent explosive agent than gunpowder, which may be employed as a charge for shells without any risk of accidental explosion resulting from the concussion to which they are exposed when the gun is fired, has been considered a desideratum for some years past. A few experiments were made by the late Committee on Gun-cotton upon the employment of that substance in shells, and spherical shells were safely fired from a mortar of 13 inches calibre, but disastrous results were obtained when this material was used as the charge of lead-coated and studded elongated projectiles fired from rifled guns. A few were safely fired, but, without any apparent alteration of conditions, others burst in the gun, and instead of simply indenting and scoring the bore, as would have been the case if a shell charged with powder had burst prematurely, one gun was rendered perfectly unserviceable by the violence of the explosion, and another was burst, the fragments being projected many hundred yards. Further systematic experiments have been continued for Government from time to time, with a view of discovering a safe and powerful explosive agent for shells. The relative disintegrating and scattering powers of a large number of explosive agents has been determined, in the first instance, by filling cast-iron shells of a particular calibre with the different materials; bursting these in a chamber of great strength, lined with wood; carefully collecting all fragments which could afterwards be found on the floor, and which could readily be extracted from the walls of the chambers, and determining the individual and total weights of these. In this way the extent to which the different shells were broken up by the explosion was correctly ascertained, and many explosive agents, for which great power had been claimed, but which proved to be not greatly superior to gunpowder, were eliminated, the most powerful being selected for further experiment. In illustration of the results thus arrived at, it may be stated that, when a shell weighing 16 lbs. 1 oz., filled with powder, was burst, all the fragments were readily recovered; they amounted to eighteen, including the plug of the shell, and of these twelve weighed above 2 ozs. and under 2 lbs., and only one fragment weighed less than 1 oz. Upon bursting a shell of the same kind and weight, filled with a mixture of potassium-chlorate and potassium-picrate, 100 fragments were recovered, and these weighed altogether only 2 lbs. 6 ozs., nearly 14 lbs. of the shell having been dispersed in fragments too minute to be collected individually. Only one of the recovered fragments weighed more than 8 ounces, and ninety-three weighed less than 1 oz. It need scarcely be stated that such a disintegration of the shell would be far too considerable to render the latter of value as a destructive missile, but the result showed that a small proportion in weight of this potassium-picrate powder if it could be used in shells, would suffice to produce the desired breaking up of the shell and violent scattering of the fragments, and that, therefore, the thickness of metal of the shell, and its consequent destructive power, might be very considerably, increased. The chilled iron or Palliser shells, which, being of considerable thickness, hold comparatively small charges of powder, would obviously be rendered much more destructive as shells, by substituting for the powder-charges an explosive agent even considerably less violent in its action than the one just cited as an example.

The shell experiments above referred to were followed by a series of another kind, instituted in the first instance for the purpose of determining the relative susceptibility to explosion, by concussion or other mechanical causes, of gunpowder, and of the explosive agents selected from the results of previous experiments as most promising in their nature. These experiments consisted in interposing definite quantities of the materials between flat brass plates, placing them upon a rigid support, and allowing a weight to fall upon them from different heights. It soon became apparent that by varying the weight employed, and the surface and thickness of the layer of explosive material operated upon, some interesting and probably very useful results could be obtained. These experiments have therefore been considerably extended, and I trust shortly to have completed them sufficiently for publication of the results. It should be stated that some similar experiments were instituted by MM. Girard, Millot, and Vogt, during the siege of Paris last year, with mixtures of nitro-glycerine with a variety of solid and liquid substances of inert character, for the purpose of discovering the safest and most suitable media for the application and preservation of that explosive liquid. A communication made at about the same time to the French Academy of Sciences, by M. Champion, on the application to war-purposes of the mixture of nitro-glycerine and siliceous earth, well-known as dynamite, contains a statement to the effect that a shell filled with dynamite was safely fired from a gun at Mont Valèrien, and the somewhat hasty conclusion is drawn from this single result that dynamite may be safely used in shells. More conclusively favourable results on the employment of nitro-glycerine in shells were obtained at Shoeburyness three years ago, when six shells (the entire number experimented with) were successsfully fired, containing charges of a solid nitro-glycerine preparation, in which a mixture of pulped gun-cotton and saltpetre is made the vehicle for the employment of the liquid, and which therefore consists entirely of highly explosive material. The power of this substance had been previously demonstrated by numerous experiments, among which a charge less than one-third that of the full powder charge, mixed with sufficient sawdust to fill the chamber of a shell, burst the latter into ten times the number of fragments obtained with gunpowder. Promising as these results were, it was deemed advisable to seek for some other explosive agent than a nitro-glycerine preparation as the material for shell-charges, for two reasons—firstly, because the well-grounded confidence in the safety of nitro-glycerine and its preparations, essential to their employment in naval and military service, does not yet exist; and secondly, because the explosive force of these preparations, as illustrated by the one experimented with, appeared considerably to exceed that required in connection with the most general application of shells. Eventually, one of the salts of trinitro-phenic acid or picric acid was found to furnish an explosive mixture, which, as far as experiments have been carried, has proved to possess all the essential qualifications of a material applicable in the service as "shell-powder."

Picric acid, or carbazotic acid, as it was first called, is one of the earliest explosive substances of organic origin known, having been discovered as far back as 1788. It is produced by the action of nitric acid on a variety of organic substances. One of the earlier methods of obtaining it readily was by the action of nitric acid on indigo; but a comparatively abundant source of it was pointed out about thirteen years ago by Stenhouse, who readily produced it in large quantities by acting with nitric acid upon the resin *Xanthorrhœa saxtilis*, which was imported in considerable quantities from Botany Bay. Since the manufacture of phenol or carbolic acid from coal-tar has become developed, picric acid has been very extensively produced from that substance, and, as a cheap and brilliant yellow dye, has become an important article of commerce.

The acid itself does not explode, but burns quickly with a bright flame; its salts are all more or less powerfully explosive, and detonate when struck. The potassium salt is that most easily prepared, on account of its very slight solubility in water. It is also one of the most highly explosive. When mixed with oxidising agents, and especially with potassium-chlorate, it furnishes very powerful explosive materials; indeed, the chlorate mixture approaches nitro-

glycerine and gun-cotton nearly in violence of action than any other explosive agent produceable on a practical scale. This mixture is, however, so susceptible of detonation by friction or concussion as not merely to render its employment in shells impossible, but also to preclude its application to any purpose without the adoption of very special precautions. Other mixtures containing potassium-picrate have been made the subject of experiment, especially in Paris, where so-called "*poudre picrate*" or *poudre Designolle*, composed of potassium-chlorate, potassium-picrate, charcoal, and saltpetre, was prepared and experimented with upon a considerable scale about three years ago, as a substitute for gunpowder in firearms, and for other purposes. A fearful accident at a factory in Paris, where large quantities of the potassium-picrate were manufactured, led to the abandonment of these experiments; but there appears little doubt that picrate preparations were included among the agents of destruction employed by the Communists in the recent struggle at Paris. In the course of the experiments with shells containing various explosive substances, to which reference has just now been made, I was led to examine the properties of mixtures of ammonium-picrate with oxidising agents. This picric compound, which may be readily prepared upon a large scale, differs importantly in its behaviour, when exposed to heat, from the potassium-picrate, and from several other salts of this acid. When heated over a flame it fuses, sublimes, and burns without any tendency to explosion, while the potassium salt detonates under the same conditions. The latter also detonates somewhat violently when submitted to a moderate blow, whilst it is difficult to obtain evidence of detonation of the ammonium salt when struck sharply and repeatedly. A mixture of the potassium salt with saltpetre, though less susceptible to explosion by a slight blow than the chlorate mixture, is yet powerfully detonating; while a mixture of ammonium-picrate and saltpetre requires a violent blow to develop slight and partial detonation, and exhibits no tendency to ignition when submitted to very severe friction, which would at once explode the least sensitive of the explosive mixtures proposed as substitutes for powder. When flame is applied to particles of the mixture of saltpetre and the ammonium salt (to which I have given the distinctive name "picric powder,") the individual particles deflagrate with a hissing sound like that of the sudden escape of steam, and the deflagration has little or no tendency to spread to contiguous particles; but if the mixture is strongly confined, as in shells, it explodes violently, and exerts a destructive action, less formidable than that of gun-cotton, nitro-glycerine preparations, and potassium-picrate powder, but considerably greater than that of gunpowder, and therefore likely to prove a valuable substitute for the latter when greater violence of action is desired with shells of small capacity. A number of shells charged with picric powder have been fired without a single casualty from guns of different calibres, ranging to the 9-inch gun with the employment of a battering charge of 43 lbs. of R. L. G. powder. The safety of this substance is therefore considered sufficiently established to warrant the institution of thorough trials of its powers as an explosive agent for shells. It is a curious and important circumstance connected with this mixture, that though ammonium-picrate and potassium-nitrate undergo mutual decomposition, with production of the deliquescent ammonium-nitrate, if the two be *dissolved* together in water, the addition of sufficient water even thoroughly to moisten the mixture appears to induce no such change, as the latter, when dried again, has no increased tendency to absorb moisture from the air, which it scarcely does to the same extent as gunpowder. The picric powder is therefore quite equal in permanence to gunpowder, and as water may be used in incorporating the ingredients without any detriment to the stability of the mixture, its preparation is, at any rate, not more dangerous than the manufacture of gunpowder, and it may be safely submitted to the pressing and the granulating processes which are applied to the latter. As, moreover, the cost of picric powder, as compared to its power, is not considerable, this explosive agent is now recognised as susceptible of advantageous application to service purposes, provided its sufficient superiority over powder in regard to violence of action is satisfactorily established. It should be stated that, some time after experiments had been in progress with this material, at my instigation, it came to my notice that a Frenchman, M. Brugère, had been also experimenting with mixtures containing ammonium-picrate, and had suggested the employment of a saltpetre-mixture as a general substitute for gunpowder. It does not appear that any steps were taken in France at the time to submit this proposal to practical test; and there is good reason to believe that, as regards naval and military uses, the picric powder is hardly likely to offer special advantages, excepting as a safe material for use in shells.

The sucessful application of the remarkable explosive liquid, *nitro-glycerine*, which is primarily due to the ingenuity and untiring perseverance of Mr. Alfred Nobel, and which has been developed chiefly within the last seven years, presents several points of great interest. Though this liquid was discovered as far back as 1847, Nobel was the first to attempt its practical application. His original proposal was to apply it in conjunction with gunpowder (*i.e.* that of adding to the explosive force of the latter when used in shells, and for mining purposes, by impregnating the grains with the highly-explosive liquid) was not attended by any tangible success. He then appears to have proceeded upon the idea that by raising some small portion of a charge of nitro-glycerine to a temperature sufficiently high for its violent decomposition, he might succeed in producing an initiative explosion of that part of the charge, which would be transmitted to the remainder, and he was thus eventually led to employ a small charge of a detonating material, such as percussion-cap composition, to bring about the violent explosion of the liquid. This ingenious expedient, the precise *rationale* of which I had afterwards occasion to investigate in its general application to the development of the action of explosive substances, was the foundation of the successful employment of nitro-glycerine in mining operations. The existence of several most serious obstacles to the use of nitro-glycerine in its pure liquid condition was, however, soon practically demonstrated—in several instances, indeed, by most disastrous accidents, not easily effaced from memory, and the ingenuity of Mr. Nobel was consequently taxed to devise some method of promoting safety, and also certainty of action, in the employment of this powerful explosive agent. These ends were attained, at any rate to a great extent, by mixing nitro-glycerine with some solid substance of perfectly inert nature and of absorbent character, through the medium of which the liquid is susceptible of employment in a condition assimilating to that of other explosive agents in practical use. The vehicle employed by Nobel is a light siliceous earth, known in Germany as "kieselguhr," which may be mixed with about three times its weight of nitro-glycerine without becoming more than moist to the touch, and is therefore readily susceptible of manipulation as a solid material. This mixture, to which the name of *dynamite* was given by Nobel, is also specified to contain a small proportion of alkaline matter, to be added for the purpose of counteracting any tendency to the spontaneous development of free acid in the nitro-glycerine. Dynamite is as readily susceptible of explosion through the initiative agency of a detonating fuse as nitro-glycerine itself: and though it obviously cannot be so powerful an explosive agent as that substance when successfully applied in its undiluted condition, its destructive powers are still very greatly in excess of those of gunpowder; and this fact, together with the circumstance that, when properly applied, it does not need confinement for the development of its explosive force, and that it may be employed, with certain precautions, in damp blast-holes, without great

detriment to its action, has led to its gradually becoming very extensively applied to industrial purposes. Certain defects are inherent in the material, such as its losing its susceptiblity to detonation by the ordinary means at a low temperature, and the tendency of the nitro-glycerine to partial separation from the siliceous earth during transport and storage; but, in balancing its advantages against those of other explosive agents, the special defects of these have also to be taken into account; so that, provided the uniform stability of the material becomes firmly established, and the apprehensions as to its comparatively dangerous character, to which certain accidents have given rise, are allayed by further experience in its storage and use, and possibly by improvements in its manufacture, a high position may be assigned to dynamite among the most useful explosive agents of the present time.

Several other methods of applying nitro-glycerine as a destructive agent have been brought to public notice since Nobel's dynamite first attracted attention. Among the proposed preparations, the most recent, and one for which special power and virtues have been claimed, is the substance to which its inventor, M. Engels, has given the name of *lithofracteur*, and which contains in addition to nitro-glycerine and an absorbing medium of the description used in dynamite, some proportion of other explosive materials (such, for example, as the constituents of gunpowder). This substance, which appears to have been applied to a limited extent by the Prussians during the recent war, is of a plastic and almost pasty nature, and is employed in the form of rolls made up in paper, which absorbs some proportion of the nitro-glycerine. Its tendency to yield to pressure, even when suddenly applied, renders its accidental explosion by mechanical force a matter of very considerable difficulty, probably more so than in the case of dynamite. As regards its claims to superiority in point of safety and power over the latter and other similar preparations, they are still matters of dispute, and their validity can only be satisfactorily determined by careful comparative experiment.

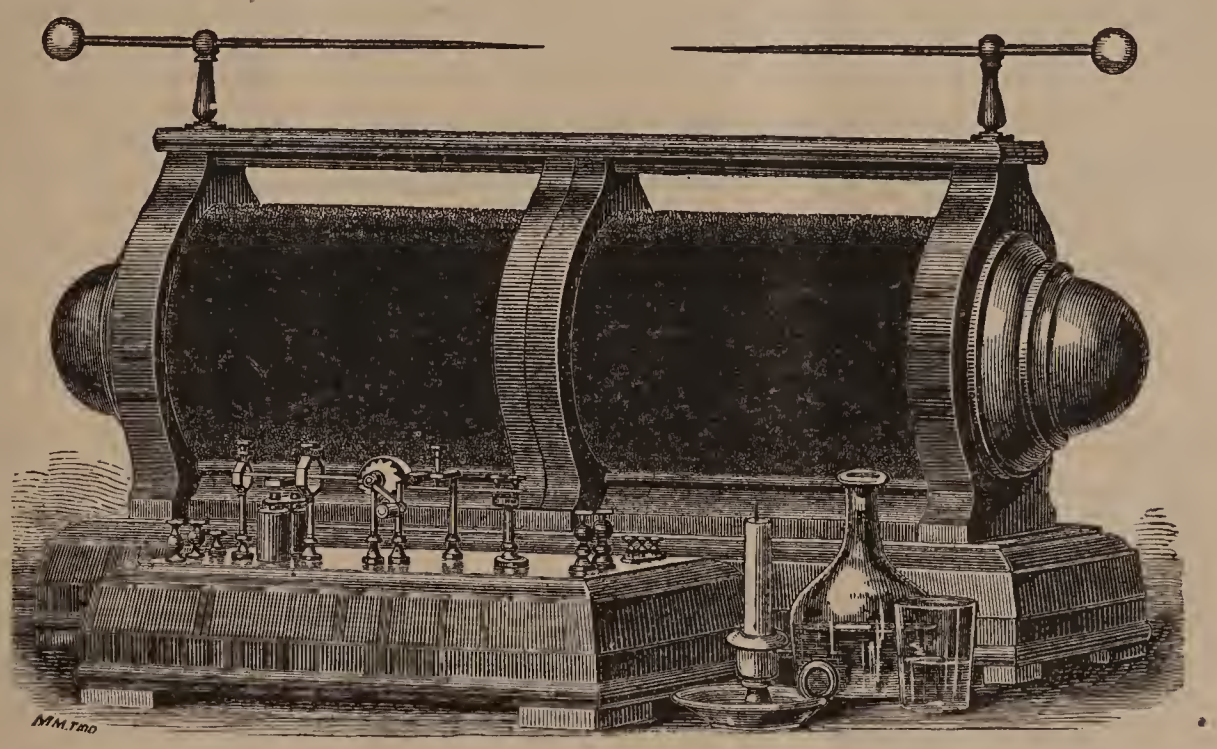
During the siege of Paris a dynamite factory was established in the outskirts of the city, and, in the absence of the particular siliceous earth which Nobel employs in its preparation, MM. Girard, Millot, and Vogt made a series of experiments, already alluded to in this lecture, with a view of ascertaining what substance could be best employed as a substitute for that absorbent material; their results indicated that, in addition to precipitated silica, the best media to be used are kaoline, tripoli, alumina, or sugar, the latter presenting the special feature that the nitro-glycerine can be rapidly separated from it by addition of water, a supposed advantage which Mr. Horsley had previously claimed for a mixture of nitro-glycerine and alum, but which may obviously constitute an important disadvantage in special applications of these mixtures —the tendency to separation of the liquid nitro-glycerine from them in wet blast-holes being a decided defect.

Sawdust and similar absorbent materials have also been used as vehicles for the application of nitro-glycerine, especially in America, under the name of *dualine*; and another preparation of nitro-glycerine, to which some years ago I gave the name *glyoxiline*, and with which some very effective blasting and engineering operations were carried out, consists, as already stated, of a mixture of gun-cotton pulp and saltpetre, which is saturated with nitro-glycerine. In the preparation of this material, one of the objections to the use of nitro-glycerine, arising out of its poisonous nature, and the readiness with which it is absorbed into the system, was, at any rate, partially met by providing the granules or masses of glyoxiline with a coating of some impermeable material. The injurious effects of nitro-glycerine upon the health of those constantly handling and employing it or its preparations, must unquestionably be frequently productive of series results, but are scarcely likely to interfere with their industrial applications, as it is well-known that risk of accident or of permanent injury to health will not deter men from persevering in the continuous use of means which may add to the productiveness of their labour.

(To be continued).

A LARGE INDUCTION COIL.

We give herewith a woodcut taken from a photograph of an induction coil, built last summer by Mr. E. S. Ritchie, of Boston, for Dr. Morton, President of the Stevens Institute of Technology, about which the latter gentleman writes us very favourable accounts. He has, during the past winter, had occasion to use the instrument constantly, and to transport it to Washington, Baltimore, Philadelphia, New York, and elsewhere, and has never found it fail of the most satisfactory performance. The entire weight of the coil without the condenser, which is in the separate base shown in the front of the woodcut, is 166½ lbs.



Its length from end to end of caps over primary coil is 40 inches, and its height to the upper surface of the long horizontal strip is 18½ inches. The length of each of the secondary bobbins is 13 inches, and their external diameter is 9 inches.

The primary wire is 200 feet long, and 0·1655 of an inch or $\frac{1}{6}$ inch in diameter; its electrical resistance is 0·13 of an Ohm. The secondary wire is 234,100 feet, or about 44⅓ miles, long, 0·007 of an inch in diameter, and weighs 44½ lbs.; its resistance is 404,000 Ohms. The condenser contains 325 square feet of coated surface.

The battery used with this coil consists of three glass jars, 10 inches diameter, and 12 inches high, into which are lowered by a windlass fifteen plates of zinc and fifteen of carbon, each 6 × 9 inches. The exciting liquid is the usual mixture of potassium bichromate and sulphuric acid. This battery has proved itself admirably efficient and reliable.

The performance of the coil is as follows:—With the above battery freshly charged and immersed 1 inch it gives freely sparks 21 inches long in air, and with the cascade battery of twenty coated panes, described by Prof. Morton in the Chemical News (vol. xvi., p. 149), it gives white Leyden jar sparks 14 inches long.

With a large Leyden jar its spark is reduced to $2\frac{3}{4}$ inches, but the light then afforded is sufficient to illuminate well a zoetrope disc 4 feet in diameter, and its sound is almost deafening.

Solid blocks of glass, 3 inches thick, can be pierced by the spark from this coil, and when the spark is repeated it takes a new path each time. When used to illuminate a Gassiot's cascade, a secondary condenser or cascade battery (as described by Prof. Morton in the article alluded to above) being in circuit, the effect is so brilliant as to allow of the use of this illustration in the largest public buildings. The entire coil is divided in the middle, so that it can be coupled for quantity effects.

EXAMINATION OF SAMPLES OF CHLORAL HYDRATE.*

By M. M. PATTISON MUIR, F.C.S. Glasgow.

As chloral hydrate has of late become a somewhat extensively used medicine, and as the purity of the compounds used in pharmacy is a matter affecting the interests of many, there was most properly noted in the circular of the British Pharmaceutical Conference among the subjects for investigation—"The Purity of the Chloral Hydrate of Trade."

Chloral hydrate, by the action of caustic alkalies, is broken up into chloroform, and a formiate of the metal of the alkali employed; thus with caustic potash—

$$C_2HCl_3O + KHO = CHCl_3 + KCOHO.$$

In this investigation I have endeavoured, in the case of each sample examined, to answer the following questions:—

(1). Does the sample yield, upon treatment with caustic alkali, such a percentage of chloroform as might reasonably be expected?

(2). Does the sample contain any, or any appreciable amount of, chloral alcoholate?

And, further, with regard to commercial chloral hydrate generally, I have endeavoured to show which samples, judging from their appearance and physical characters, are to be regarded as purest. And, lastly, I have sought to give an answer to the general question—Is the chloral hydrate now sold by druggists of a fair average purity?

Pure chloral hydrate is easily soluble in water; upon heating, it dissolves, leaving a perfectly clear fluid. Chloral alcoholate, on the other hand, heated with water, melts, but does not dissolve, and solidifies again, beneath the water, upon cooling. Pure chloral hydrate, again, with strong sulphuric acid, floats on the surface of the acid, and, on heating, slowly melts, forming a clear layer of liquid with the heavier acid beneath, with no browning or discolouring of the acid; chloral alcoholate colours the acid brown upon being treated in a similar manner. With nitric acid (25 per cent strength), pure chloral hydrate gives, on applying heat, little or no reaction; alcoholate gives violent reaction, red fumes being given off.† The boiling-point of pure chloral hydrate is 96°—98° C.; of alcoholate, 115° C.

The process adopted for estimating the $CHCl_3$ yielded by each sample was that described by K. O. Müller (Chemical News, vol. xxiii., p. 113), viz.:—Into a tube, graduated from the bottom in c.c., was introduced a certain known quantity of the sample; pure caustic potash solution of medium strength was then added, and, after standing ten to fifteen minutes, the tube and its contents were thoroughly shaken until all the chloral hydrate was dissolved. The tube being securely corked was then set aside, and, after three to four hours, the number of c.c. of chloroform which settled to the bottom of the tube was read off; this was multiplied by the sp. gr. of chloroform—the figure taken being 1·5—and so was obtained the percentage of chloroform yielded by the sample under examination. The results are embodied in the following table:—

Sample. Appearance.	Behaviour on heating with water.	Behaviour on heating with strong sulphuric acid.	Behaviour on heating with dilute nitric acid.	Boiling-point.	Percentage of $CHCl_3$ on treating with KHO.
1. Large pieces, crystalline, slightly moist to the touch, strong pungent odour.	Easily dissolved, nothing crystallised out on cooling.	Melted on the surface, no discolouring of the acid.	Dissolved, no fumes given off.	97°	67·70
2. Semi-transparent, not perfectly pure white, slightly moist, crystalline.	Do.	Do.	Do.	96·5°—97°	65·99
3. White cakes, no definite crystalline structure, falling easily to powder, moist to the touch.	Do.	Do.	Do.	96°—96·5°	68·07
4. Very pure white small non-transparent pieces, crystalline.	Do.	Do.	Do.	97°—97·5°	68·15
5. Had white cakes non-transparent and non-crystalline, seemingly dry.	Do.	Do.	Do.	97·5°—98°	70·83
6. Small round transparent pieces, no needle-shaped crystals, *very slightly* moist.	Do.	Do.	Do.	96·5°—97°	71·02
7. Small non-transparent pieces with very little crystalline structure.	Do.	Do.	Do.	97°—98°	67·71
8. Tolerably large pieces, crystalline, much more moist than any others.	Do.	Do.	Do.	96°—96·5°	60·98

Theoretically, pure chloral hydrate should yield, on treatment with caustic alkali, 72·20 per cent of $CHCl_3$.

From these results I would conclude—

(1). Generally, the samples were of a fair average quality.

(2). None of them, so far as I may infer from my experiments, contained chloral alcoholate.

(3). The purest was that sold in small transparent pieces, nearly dry to the touch, exhibiting no needle-shaped crystals, and not having a *very* pungent odour.

(4). The samples varied in the amount of chloroform yielded by each, chiefly, it seems to me, on account of the time they had stood in the shop—chloral hydrate easily

* Paper read before the British Pharmaceutical Conference, Edinburgh Meeting.

† *Year-Book of Pharmacy*, 1870, pp. 112—113.

absorbing moisture, and the stoppers being frequently removed, those samples which had been some time in the shop must necessarily be more moist than those newly received from the maker. This view is confirmed by the amount of chloroform yielded by Samples 5 and 6, which were obtained from wholesale dealers, and had not, therefore, been exposed to the varying fortune likely to meet them while standing on the shelves of a druggist's shop. Generally, these experiments show that the chloral hydrate now sold by druggists is of fair average quality.

SCHOOLS OF CHEMISTRY.

The following information arrived too late to appear in our "Students Number":—

Berners College of Chemistry, 44, Berners Street, W.—Conducted by Professor E. V. Gardner, F.E.S., &c. The course of study in each instance is directed to the express want of the pupil, or according to choice. A course embraces thirty or thirty-five lectures, of a practical character, of about one and a half hours' duration. The usual practice of a Laboratory can be obtained with every convenience, under the immediate direction and guidance of Professor E. V. Gardner. An evening class in practical chemistry for laboratory work, meeting for two hours twice each week during one term; fee, two guineas, to be paid in advance.

Ladies' Medical College.—The Ladies Medical College, established by the Female Medical Society in order to teach to educated women the theory and practice of Midwifery and the accessory branches of medicine. *President.*—Lord Shaftesbury. *Hon. Sec.*—Dr. James Edmunds. The eighth annual session will commence on October 2nd, 1871, and extend to April, 1872, with a vacation of two weeks at Christmas. The lectures will occupy the afternoons of the Mondays, Tuesdays, Wednesdays, and Fridays, from 3 o'clock till 5. *Elementary Materia Medica.* (Teachership now vacant.) *Elementary Chemistry.*—Mr. J. A. R. Newlands. Fee for two sessions' attendance upon the lectures on midwifery, anatomy, and physiology, medical science, and hygiene, £10 10s. Fee for each of the extra courses, one session, £1 1s.; two sessions, £1 11s. 6d. Further details as to the objects and operations of the society, and prospectuses of the college, may be obtained by letter to the Lady Secretary, 164, Great Portland Street, W.; or from the Hon. Sec., 4, Fitzroy Square, W.

The Hartley Institution, Southampton.—*Lecturer on Chemistry.*—A. W. Bickerton, F.C.S., A.R.S.M. *Assistant.*—G. Gray. *Junior Class.*—A Course of about thirty Lectures is given during each term. On Mondays, Wednesdays, and Fridays, from 10 till 11 a.m. *Senior Class.*—Mondays and Thursdays, at 11 a.m. The Junior Class is devoted to a general outline of the *theory* of chemistry, illustrated by experiments and demonstrations. In the Senior Class students are taken through the applications of Chemistry to the Arts, Analysis, &c., receiving at the same time practical instruction in the Laboratory. Fees for the Senior Class, £2 2s.; for the Junior, £3 3s. per term. The Laboratory is open daily from 10 till 4, except on Saturdays, when it closes at 1, for instructive and practical work. Fees may be known on application. Evening Classes in theoretical and practical chemistry, are held during the winter session.

CORRESPONDENCE.

ALUM IN BREAD.

To the Editor of the Chemical News.

Sir,—I was surprised the other day on reading the report of a lecture on this subject, delivered by Dr. Carter Moffat before the Chemists' and Druggists' Association, at Glasgow, in January last, to find him stating that alum and logwood gave a *dark red* colour, which is directly at variance with the well-known characteristics of the mixture of those substances, as given in every work on chemistry and dyeing to my knowledge for upwards of 40 years, and until some higher authority can be adduced to support such a statement I must decline to accept it, having invariably found that a deep purple or violet blue is the result.

Dr. Moffat's experiments were made at night time, but I fancy if he examined his specimens in the morning when the colour became fully developed, he must have found that all those which *really contained alum* went blue, as of course they ought to do. Surely there must be a mistake somewhere.—I am, &c.,

John Horsley.

The Laboratory, Cheltenham,
September 9, 1871.

"THE ONENESS OF MATTER."

To the Editor of the Chemical News.

Sir,—Professor William Thomson has given to the world an hypothesis by which he accounts for the origin of life on this earth. On this hypothesis we are to consider the endless variety of plants and animals derived from a few simple forms received meteorically. It is indeed a "prodigious step." I conceive as possible that *all* matter —simple or compound (so called)—is constituted of *one element* under different molecular forces. The step from one simple form of matter to all known and unknown compounds is less prodigious than that assumed by Sir W. Thomson. Yet the two cases are somewhat parallel.

Compounds have, in general, no resemblance in properties to the elements which constitute them. If a force, or forces, can cause the union of two elements, and the compound formed is no likeness of its constituents, may not a force, or forces, act on *one* matter or element, and the resultant bear no likeness to the original matter! See how unlike carbon as charcoal, and carbon as the diamond are, and yet they are one matter. By combustion both give carbonic acid gas.

Thus all the 65 elements, so viewed, would be the same *matter* actually, but each under different forces; the forces engaged so operating as to give to each different properties. And it would be easy to rise from simple to compound matter; a compound being formed by a uniting force between two or more such differently operated upon portions of elemental matter. On this hypothesis, if all forces were withdrawn so as to leave all the ultimate particles in contact, matter would be reduced to simplicity. Finally, in relation to this subject—to use Professor Thomson's words—"All I maintain is, that it is not unscientific."—I am, &c.,

Chas. Thos. Kingzett.

Putney.

THE GUN-COTTON EXPLOSION.

To the Editor of the Chemical News.

Sir,—Having carefully considered the evidence, as reported in the public papers, it appears to me that the most probable cause of the explosion of gun-cotton at Stowmarket has not been suggested by any of the witnesses examined.

I believe it to have arisen from the effect of gradually accumulated heat from the vaporising action of the unusually heated magazine on damp gun-cotton.

When this substance was first introduced I experimented extensively on its manufacture, and soon found the importance of perfect neutralisation of acid, and of peculiar care in drying.

With rapid ventilation, at a high temperature—over 300° —it could be dried without danger, but at a temperature even as low as 100° ignition would take place most

readily if the moisture, as soon as vaporised, were not removed by ventilation.

Evidence has been given of the malicious introduction of sulphuric acid, but it has not been shown that, although it may promote decomposition, it has, in the case of the discs examined, increased their liability to ignition. It is, however, probable that the sulphuric acid may have caused the absorption of moisture, which, on the heating of the magazine during the hot weather, may have been vaporised, and thus the temperature within the gun-cotton may have gone on increasing until the explosive point was attained. In the course of evidence it did appear that the month of August had been recognised as peculiarly liable to explosions.

In the *Chemical Gazette* some time since, I called attention to the fact that I had repeatedly ignited fibrous peat, shredded into small portions, by placing it, while damp, in a partially closed vessel in a position where the bottom of the vessel could not have attained a higher temperature than 120° F.

I could always prevent the ignition by stirring the mass sufficiently to allow of the dissipation of the vapour formed within the mass of fibrous matters.

Having regard to these facts, I applied the principles suggested with great success to several practical purposes; and I took every opportunity of cautioning persons using drying processes on hydro-carbonaceous bodies, whether fibrous or otherwise.

I predicted disastrous explosions which occurred in two gunpowder manufactories in this neighbourhood. Want of attention to the caution given issued in the closing of both of the factories.

If ordinary hydrocarbons, such as peat, sawdust, hemp, starch, &c., be liable to ignition at such low temperatures, what may not be expected of similar substances when associated with other matters greatly increasing their tendency to ignition.

The manufacture of gun-cotton may, no doubt, be safely carried on by carefully ventilating the driers, using every precaution suggested by the knowledge of these facts, such as the employment of only a low temperature, with an amount of ventilation largely in excess of ordinary requirement to prevent danger from changes of atmospheric conditions.

It becomes, however, a very series question whether the use of gun-cotton may be maintained with the knowledge of the extreme danger arising from its becoming accidentally moistened, and its consequent liability to heating up to the point of ignition by the ordinary increase of atmospheric temperature. This difficulty may possibly be overcome by waterproofing the perfectly dried gun-cotton. I have succeeded in waterproofing gunpowder, but I have not had the opportunity of experimenting on gun-cotton. I do not anticipate any great difficulty in so doing, especially as in the form of discs it is greatly facilitated.—I am, &c.,

Robert Oxland, F.C.S.

Compton Gifford, Plymouth,
September 8, 1871,

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 13, 1871.

From the protocol of the meeting of this Society we quote the following:—Prof. A. W. Hofmann exhibited to the members a series of photographic pictures representing views of the new chemical laboratory built at Pesth (Hungary), and sent to the *savant* just named by Dr. von Than. It appears, from the brief explanatory paragraph devoted to this subject, that this new laboratory is in every respect an excellent, yet somewhat improved, copy of the celebrated Berlin laboratory. All members of the Chemical Society above alluded to are politely requested to send in their *carte de visite*, signed with their names, to Dr. C. Scheibler, 24, Alexandrinen Strasse, Berlin, in order to complete the photographic album of the Society. All books, pamphlets, &c., intended to be presented to this Society are requested to be sent to the same address.

The number above mentioned contains the following original papers and memoirs:—

Application of Polarised Light for Determining the value of the Cinchona Barks.—O. Hesse.—This paper is in reality a critical review of a paper published by Dr. J. E. de Vry (*Journ. Pharm. Soc.*, No. 53, p. 1, 1871), "On the Adaptability of the Strong Action most of the Cinchona Alkaloids possess upon Polarised Light for the purpose of Estimating the Value of the Cinchona Barks." The author of this paper points out the great difficulties which, in various respects, stand in the way of such an application, and reminds, among other matters, that, beside quinine and cinchonine, the barks alluded to contain, as first stated by Dr. De Vry's discoveries, other alkaloids, the action of which, as regards polarised light, is almost unknown.

Chemical Studies on the Alkaloids of Opium.—O. Hesse.—This lengthy essay treats, in the first place on the mode of preparation, and next on the properties, of some of the more recently discovered alkaloids of opium, viz.:—Cryptopine, $C_{21}H_{23}NO_5$, fuses at 217°, readily soluble in chloroform, not so in ether, difficultly so in alcohol, has a strongly alkaline reaction, and forms, with acids, salts, most of which crystalise; protopine, $C_{20}H_{19}NO_5$, fuses at 202°, is almost insoluble in ether, but difficultly soluble in alcohol; laudanosine, $C_{21}H_{27}NO_4$, crystalline in prismatic shape, readily soluble in alcohol and ether, fuses at 89°, and forms with HI a very difficultly soluble salt; hydrocotarnine, $C_{12}H_{15}NO_3$, fuses at 50°, is crystalline, readily soluble in ether and alcohol, and exhibits, with strong sulphuric acid, the same reaction as does narcotine. The author calls attention, at length, to the peculiar reactions which these and other (codeine, codamine, and laudanine) opium alkaloids exhibit with pure and impure (that is, containing a trace of oxide of iron) strong sulphuric acid at 20° and at 150°. These reactions are so marked by the peculiar colourations which ensue that these bodies may be thereby readily recognised and detected. While space forbids us to give here the full details, we quote, as instances, the following:—

	Pure acid dissolves—		Acid containing iron dissolves—	
	At 20°.	At 150°.	At 20°.	At 150°.
Codeine	Colourless.	Dirty green.	Blue.	Dirty green.
Codamine	Colourless.	Dirty red to violet.	Deep greenish blue.	Deep violet.
Laudanine	Very faint rose-red.	Dirty violet-red.	Brownish red akin to solution of nitrate of cobalt.	At first green, next deep violet.

Contribution to our knowledge on Benzyl-Ether.—F. Sintenis.—The contents of this paper treat mainly on the behaviour of benzyl-ether with the haloids. By the direct action of chlorine, bromine, &c., upon the ether just named, either at the ordinary temperature or by the aid of heat, no substitution products are formed; while, as regards benzyl-phenyl-ether, substitution products are only formed under peculiar conditions. When benzyl-methyl-ether or benzyl-ethyl-ether are treated with dry chlorine at the ordinary temperature, there is formed oil of bitter almonds, C_6H_5COH, and chlor-methyl, chlor-ethyl, and benzyl-ethyl-ether yields, under these conditions, C_6H_4ClCOH and chlorethyl. The benzyl-phenyl-ether—

$$C_6H_5CH_2OC_6H_5,$$

does not exhibit, with the haloids, any stability in forming substitution products.

Miscellaneous Notices.—L. Henry.—This lengthy paper, filled with a large number of extensive formulæ, is divided into the following sections:—On the isomerism of the glycerine derivatives of the formula $(C_3H_5)X_3$. On various glycerine derivatives—bichloro-iodhydrine, $(C_3H_5)Cl_2I$; chloro-bromo-iodhydrine, $(C_3H_5)Cl.Br.I$; chloro-brom-nitrin, $(C_3H_5)ClBr(NO_3)$; chloro-nitro-sulphuric acid glycerine, $(C_3H_5)Cl(NO_3)(HSO_4)$; bichloracetin, $(C_3H_5)Cl_2(C_2H_3O_2)$; bromo-diethylin of glycerine, $(C_3H_5)Br(C_2H_5O)_2$. Preparation of dichlorhydrine. On glyceric acid-ether, $(C_3H_3O)(HO)_2(C_2H_5O)$; on glycolic acid diethyl-ether.

Brom-Benzo-Nitrile.—C. Engler.—This essay treats on—Brom-benzoic acid ether, $C_6H_4Br.CO.OC_2H_5$, a colourless, highly refractive fluid, boiling at 259°. Brom-benzamide, $C_6H_4Br.CO.NH_3$, a crystalline solid body, readily soluble in alcohol, difficultly so in cold water, and fusing at 150°. Brom-benzo-nitrile, $C_6H_4Br.CN$, a solid substance, exhibiting crystalline structure, fuses at 38°, boils at 225°, and is readily soluble in alcohol and ether.

Action of Sodium Amalgam upon Oxalic Ether.—S. Friedlander.—This paper is mainly a critical review of the statements made by A. Eghis (see Chemical News, vol. xxiv., p. 34) in reference to this subject, especially as regards the question of glycolinic and glycolic acid.

Researches made in the Chemical Laboratory of Lund (Sweden) University.—C. W. Blomstrand.—This memoir is divided into the following sections, of which only the titles are given, because, notwithstanding the intrinsic scientific value of this communication, the large number of formulæ render useful abstraction impossible:—Derivatives from luteo- and roseo-cobaltiac-iodo sulphate.—J. M. Krok. The sulphites of copper and silver and double salts thereof.—N. Svensson. On some of the sulpho-ethers of ethylen.—F. Ewerlöf.

Further Researches on the so-called Fore-Run (First Distillate) of the Spirit Distilleries.—A. Kekulé.—This memoir contains a detailed account of the labours of several chemists, among whom Dr. J. Weinzierl, Dr. Zincke, and others, on the constituents of the fore-run, especially in the case of the distillation of the fermented beet-root molasses. It appears, from what is here communicated, that the aldehyde, paraldehyde, metaldehyde, and acetal found in the fore-run are due to the action of small quantities of nitric, hyponitric, and nitrous acids, which are formed during the fermentation in small quantity.

Oxidation of Ketons.—A. Popoff.—The author describes at length the mode of preparation of methyl-phenyl-keton, boiling at 200°, and the mode of its oxidation. The result of that process is that benzoic and carbonic acids are formed—

$$C_6H_5--CO--CH_3+3O=C_6H_5--CO_2H+CO_2+H_2O.$$

Ethyl-phenyl-keton, boiling at from 208° to 212°, soluble in water, and combinable with bisulphite of soda, yields, by oxidation, benzoic and acetic acids—

$$C_6H_5--CO--C_2H_5+3O=C_6H_5--CO_2H+C_2H_4O_2.$$

Researches on the Uric Acid Group.—M. Nencki.—This paper contains, in the first place, a discussion on the constitution of the uric acid, and on the probability of synthetically preparing uric acid from sulpho-urea. In this direction, the author has experimented by mixing together sulpho-urea along with alloxan and alcoholic solution of sulphurous acid, and exposing that mixture for five hours in a sealed tube to a temperature of 100°. The result is that sulpho-pseudo-uric acid is formed, which, after having been purified, was found to consist of $N_4C_5O_3SH_6$; it is formed according to the following formula:—

$$N_2C_4O_4H_2+N_2CSH_4=N_4C_5O_3SH_6+O.$$

This body is insoluble in water and ammonia, difficultly soluble in hydrochloric, but more readily so in hydrobromic and sulphuric acids, from which solutions it is precipitated by water; also soluble in caustic alkali solutions. The removal of the sulphur from this substance did not succeed. The author treats at considerable length on the products of decomposition of this substance.

Naphthol Compounds.—J. Grabowski.—This paper is divided into the following sections:—Oxalic acid and naphthol; chloride of phthalic acid and naphthol; pyromellitic acid and naphthol.

Products of the Reduction of Silicic Acid Ether and some of its Derivatives.—A. Ladenburg.—This lengthy essay does not admit of useful abstraction.

Monochlor-Crotonic Acid.—C. Sarnow.—The acid alluded to has been prepared by the author by causing zinc-dust to act, along with water, upon trichlor-crotonic acid, allowed to flow drop by drop into the water containing the zinc. The aqueous solution of monochlor-crotonate of zinc thus obtained is readily decomposed by hydrochloric acid, and the monochlor-crotonic acid purified by re-crystallising it from hot water, wherein this acid is readily soluble, as is also the case with alcohol and ether. Monochlor-crotonic acid, $C_4H_5ClO_2$, fuses at 94°, boils at 206°, and acts, when in contact with the skin, as an epispastic. This paper further contains chapters on monochlor-crotonid ($C_4H_4ClO.Cl$), monochlor-crotonamid ($C_4H_4ClO.NH_2$).

The Betain of the Phosphorus Series.—A. H. Meyer.—This valuable scientific paper is not suited for abstraction, owing to the large number of formulæ required.

Some of the Derivatives of Piperidine.—J. W. Brühl.—This memoir is divided into the following sections:—Introduction, containing a review of the labours of Cahours and Hofmann on this subject; action of ethen-bromide upon piperidine; action of ethen-bromide upon ethen-dipiperidyl-diamine.

Methylisation of the Phenyl Group in Aniline.—Drs. A. W. Hofmann and C. A. Martius.—This very lengthy and exhaustive monograph, full of formulæ, contains, besides a lengthy introduction, the following sections:—Dimethyl-aniline; dimethyl-toluidine; dimethyl-xylidine; dimethyl-cumidine; dimethyl-cymidine.

Nature of the Sea-Water along the Coast of Bohuslän (Sweden).—Prof. J. L. Ekman.—From this lengthy memoir we quote the most interesting point—viz., that, as regards the quantity of salt contained in the sea-water on the west coast of Sweden, there is greater difference than for any other now known sea. The coast alluded to is, on the one hand, watered by the North Sea, and on the other by the Baltic. In the more northerly part the water at the surface contains rather less than 2 per cent salt, at 60 feet depth 2·5 per cent, at 90 feet depth 3 per cent; in the more southerly portion the discrepancies are greater, but at 600 feet depth 3·5 per cent salt is met with. The average quantity of salt of the oceans is 3·44 per cent; while in the Atlantic, from the equator to from 55° to 60° N. latitude, the quantity of salt in the surface-water is 3·606 per cent, and at depths of from 500 to 10,000 feet 3·578.

Annalen der Physik und Chemie, von Poggendorff, No. 5, 1871.

The original papers and memoirs of this number relating to chemistry and allied sciences are the following:—

Apparatus for Determining the Resistance which Atmospheric Air Exerts against Moving Bodies.—K. H. Schellbach.—A memoir illustrated by engravings.

Third Instalment of the Essay on the Friction which Particles of Gases exert upon each other.—O. E. Meyer.—An algebraico-physical treatise.

On Fluorescence.—E. Lommel.—An optico-mathematical essay.

Researches on the Electrophor.—W. von Bezold.—This lengthy memoir, illustrated by engravings, is, as regards its contents, strictly an algebraico-physical paper.

Description of a New Thermo-Galvanic Battery of Great Force.—Dr. A. von Waltenhofen.—Illustrated by engravings essentially required for the proper understanding of this apparatus.

Leidenfrost's Phenomenon.—R. Colley.

Experimental Proof of the Existence of Air in Water.—A. Andersohn.—The description of a complicated contrivance for experimentally proving a fact which is readily exhibited by the aid of an air-pump.

Stereoscopic Phenomenon produced by Dispersion.—F. Kohlrausch.—Illustrated by diagrams.

Simple means for Increasing the Deviation or Dispersion of a Ray of Light.—F. Kohlrausch.

Appendix to a Paper published in a former volume of this periodical, "On the Abnormal Dispersion Exhibited by Bodies Coloured on the Surface."—A. Kundt.

Melting of Lead Shot when Fired against an Iron Target.—E. Hagenbach.—After referring to a former paper on this subject, the author mainly states that Dr. A. Socin had exhibited to him balls extracted from wounds caused in the late war, some of which balls exhibited signs of fusion, thereby leading to the inference that, on the impact of the balls with bones, a great deal of heat is generated.

Observations on Thomsen's Experiments on the Specific Heat of Aqueous Solutions.—A. Wüllner.

No. 6, 1871.

This number contains the following original papers relating to chemistry and allied sciences:—

Purity of the Surface of Films of Albumen and Tannin for Photographic Use.—C. Schultz-Sellack.

Studies on the Colouration of the so-called Smoky Quartz.—Dr. A. Forster.—An optico-crystallographical essay; but the main result of chemical investigation leads to the inference that the smoky colour is due to the presence in the quartz of a substance containing organic nitrogen and carbon.

Priority of the Discovery of the Relation existing between the Second Chief Axiom of the Mechanical Theory of Heat and the Principle of Least Action.—L. Boltzmann.

Contribution to our knowledge on Chlorophyl and some of its Derivatives.—E. Gerland and N. W. P. Rauwenhoff.—This paper, a spectroscopico-chemical essay, is illustrated by a series of engravings.

On the Rebound of Elastic Bodies, and the Determination of the Time Elapsing between each Rebound.—H. Schneebeli.

Refraction of Light Exhibited by Fuchsine.—C. Christiansen.—Optico-physical essay illustrated by engravings.

Second Essay on Abnormal Dispersion.—A. Kundt.

Improved Excitation Method for Electrical Machines.—W. Musaeus.

Newly Improved Holtz's Machine Fitted with Double Discs turning in opposite directions, whereby twice as much Electricity can be Generated.—W. Musaeus.—The contents of these two papers, however interesting in a scientific point of view, do not admit of any useful abstraction.

Earthquake of Cosenza, October 4th, 1871.—G. vom Rath.—This essay contains the detailed description of everything which bears, in a geographico-physical and geological aspect, on this catastrophe, which destroyed a portion of Calabria (Sicily).

Chromate of Chrom-Oxychloride.—E. Zettnow.—The author describes at great length the mode of preparation of three specimens, compounds obtained by the action of strong sulphuric acid upon chlorochromate of potassa. The samples designated A and B are compounds the formula of which is $Cr_2Cl_4O+4CrO_3$; in 100 parts—chromic acid, 60·42; chlorine, 21·45; chromium, 15·71; oxygen, 2·42. The sample designated C has the formula $Cr_{12}Cl_{30}O_3+22CrO_3$; in 100 parts—chromic acid, 55·88; chlorine, 27·05; chromium, 15·85; oxygen, 1·22.

La Revue des Scientifique de la France et de l'Etranger, August 19, 1871.

This number does not contain any original papers relating to chemistry, but contains the continuation and end of the very interesting lecture on the—

Influence of Heat upon Animals.—Dr. C. Bernard.

August 26, 1871.

This number does not contain any original papers bearing upon chemistry, but we meet here with a very excellent series of lectures on—

Respiration and the Renewal of Air in the Lungs.—Dr. Gréhant.—Illustrated by woodcuts.

September 2, 1871.

This number does not contain any original papers relating to chemistry or allied sciences.

Bureau Scientifique Central Neêrlandais à Harlem, August 15, 1871.

Under this title, Dr. E. H. von Baumhauer has sent us a circular, the contents of which agree essentially with what has been already communicated to our readers on this subject (see Chemical News, vol. xxiv., p. 97). We only add here that Messrs. Williams and Norgate, of Henrietta Street, Covent Garden, London, have been appointed as agents for the Bureau, which, as regards the United Kingdom, is in communication with all the most important of the scientific institutions and societies existing therein.

Le Moniteur des Produits Chimiques pour l'Industrie, les Sciences et les Arts et du Matériel de ces Industrie Publié par une Société de Chimistes et d'Industriels, August 25, 1871.

In addition to several papers of economico-political and politico-industrial importance, this number contains the following original matter relating to chemistry;—

Pigments and Dyes known to and used by the Ancients.—E. Rousset.—The first portion of an essay on this subject. From the contents it appears that the author's primary object is to prove that the ancients were not so ignorant in industrial matters as is commonly supposed to be the case. Among the white pigments, they were acquainted with white-lead, which, according to Pliny, was prepared especially at Rhodes. As black pigments, various kinds of charcoal and soot were used by the Ancients, the same as nowadays; while they dyed animal skins black with nutgalls and sulphate of iron. By their acquaintance with the use of various kinds of ochre, and by mixing these, either with each other in various proportions, or with black pigments, brown pigments of various shades were obtained. Under the name of Alexandria blue, the Ancients (the author includes in that term the Ancient Egyptians, as well as Greeks and Romans) largely used and prepared a pigment containing oxide of copper, and they also were acquainted with a pigment containing cobalt; while indigo was not unknown to them, but not used for dyeing, their blue-dyed fabrics being obtained by the use of pastel-wood, *Isatis tinctoria*.

Improved Process of Soda Manufacture.—M. Swager.—By the joint aid of highly superheated steam and red-heat, the author decomposes the double chloride of aluminium and sodium, previously fused. The result is the formation of aluminate of soda and hydrochloric acid; the latter is condensed, the former, treated with carbonic acid, yields carbonate of soda and alumina.

Biography.—E. Rousset.—Under this heading the author here publishes another instalment of the life and labours of the late M. Payen.

Les Mondes, August 24, 1871.

This number contains the following original matter relating to chemistry and allied sciences:—

Use of a Screw Propeller fitted to Sailing Vessels.—E. Martin.—The author proposes to fit sailing ships with a screw propeller, to be set into motion by the movement of the ship while sailing, the object being to employ the mechanical power thus obtained for the purpose more especially of imparting movement to a magneto-electrical apparatus, with the view of giving to sailing vessels the advantage of electro-magnetic light on deck at nights, instead of the use of oil lamps now applied, for indicating the ship's course and presence to other vessels.

Elasticity of Caoutchouc.—E. Villari.—An algebraico-physical essay on the elasticity by stretching, and on the change of volume of caoutchouc.

Formation of a New Volcano in Sicily.—Rev. F. Moigno.—The author states that, on a mountain situated near Bivona (district of Girgenti), a crater has been opened.

Very Hard Cement.—Rev. F. Moigno.—Some repairs being required to the stone steps leading to a garden, the mason used Portland cement mixed with finely-divided cast- and wrought-iron filings and broken-up borings, instead of with sand. The result has been that the mass has become so hard as not to admit of being broken either with hammer or pickaxe.

Discovery of Coals in Norway.—Rev. F. Moigno.—In the Island of Andöe, off the coast of the province of Nordland, borings have been executed which have led to the discovery of seven seams of coal, varying in thickness from 0·076 to 0·508 metre.

NOTES AND QUERIES.

Lute for Nitric Acid—Test for Nitric Acid.—Can any of your readers inform me what is the best and cheapest lute for use in the manufacture of nitric acid? I have used plaster of paris, but do not find it to answer very well, and think there must be a better luting material in general use. What is the best and simplest tests for any nitrous compounds in sulphuric acid? Aniline and sulphate of aniline have lately been suggested, but are these found to be the most exact in their test? What is the cheapest method of destroying both colour and smell in palm oils on a large or manufacturing scale?—Chemicus.

Logwood Test for Alum.—(Reply to B. F. Munn.)—This test was first proposed by Mr. Horsely, of Cheltenham, and has been thoroughly tried by Dr. R. Carter Moffat, who came to the conclusion that the best method of applying this test is as follows:—120 grms. of chips of logwood are digested in 8 ozs. of methylated spirits for eighteen hours, then filtered. This solution, when brought into contact with bread or flour free from alum, produced a pale yellow or straw colour, but a dark red when alum is present. The process is, therefore, simply to apply, to bread or flour suspected to contain alum, a portion of the alcoholic solution of logwood prepared as mentioned.

TO CORRESPONDENTS.

*** We cordially thank those gentlemen who so kindly acceded to our request, in sending us the necessary information respecting the Chemical and Medical Schools for our Students' Number.

T. W.—You will find full particulars about Zeiodelite in an English edition of Wagner's "Chemical Technology," which will shortly be published by Messrs. J. and A. Churchill.

R. W.—The pamphlet never arrived; we shall be glad to receive one.

A. E. Tucker.—Your object is unattainable.

J. W. Taylor.—We have often quoted titles of books on the subject. Consult the Index to the Chemical News, or our "Answers to Correspondents."

BOOKS RECEIVED.

Annual Report of the City of New York for the years 1869 and 1870.

Annual Report of the Board of Regents of the Smithsonian Institution for 1869. Washington.

New Remedies, a Quarterly Retrospect of Therapeutics, Pharmacy and allied subjects. Edited by Horatio C. Wood, jun., M.D. New York: William Wood and Co.

Lecture on the Analysis of Coal-Gas. By Henry Letheby, M.B., M.A., &c. Delivered before the British Association of Gas-Managers. London: William B. King.

NOTICE TO AMERICAN SUBSCRIBERS.

In answer to numerous inquiries, the Publisher begs to state that Subscribers in the United States can be supplied with the CHEMICAL NEWS from this Office, post free, for the sum of £1 2s. 4d. per annum payable in advance.

North London School of Chemistry, Pharmacy, &c.—For Instruction in Practical Chemistry and Evening Classes for the Study of Chemistry, Botany, Materia Medica, &c. Conducted by Mr. J. C. BRAITHWAITE, *for thirteen years Principal Instructor* in the Laboratories of the Pharmaceutical Society of Great Britain, and Demonstrator of Practical Pharmacy, Pharmaceutical Latin, &c.

Mr. Braithwaite, having taken the premises adjoining his house, has been enabled *nearly to double the size of his Laboratories*, and, at the same time, procure a large piece of ground which *he has had laid out as a Botanic garden*. Every facility is, therefore, offered to Students desirous of acquiring a practical knowledge of this branch of their education.

The Session 1871—1872 will commence on the 2nd of October, when the Laboratories will re-open at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

THE CHEMICAL and TOXICOLOGICAL CLASS will meet as usual every Monday and Thursday evening, commencing October 2nd, at 8 p.m.

The LATIN CLASS for the reading of Physicians' Prescriptions, Cæsar's Commentaries, &c., every Tuesday and Friday evening, commencing October 3rd, at 8 p.m.

The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday evening, commencing October 4th, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will be continued every Saturday, until further notice, at 10 a.m.

Fee to either of the above Classes Half-a-Guinea per Month. Pupils can enter at any period.

Gentlemen Privately Prepared for the Examinations of the Pharmaceutical Society, and the "Modified Examination for Assistants," &c

All Fees must be paid in advance.

Letters of inquiry should be accompanied with a stamped envelope.

Mr. Braithwaite receives a few Pupils to Board in his house.

Address—54, Kentish Town Road, N.W.

PRACTICAL CHEMISTRY.

Laboratory, 60, Gower Street, Bedford Square, W.C.

Mr. Henry Matthews, F.C.S., is prepared to give Instruction in all branches of PRACTICAL CHEMISTRY, particularly in its application to MEDICINE, AGRICULTURE, and COMMERCE.

The Laboratory is open daily, except Saturday, from ten to five o'clock; on Saturday, from ten till one o'clock.

Mr. Matthews is also prepared to undertake ANALYSES of every description.

For Particulars and Prospectuses, apply to Mr. Henry Matthews, the Laboratory, 60, Gower Street, Bedford Square, W.C.

THE CHEMICAL NEWS.

Vol. XXIV. No. 617.

ANALYSIS OF PITTICITE, FROM REDRUTH, CORNWALL.

By Professor A. H. CHURCH, M.A.

Carefully selected homogeneous portions of a fine specimen of this mineral from Cornwall were submitted to analysis, after having remained a year or more in my cabinet. They evidently still contained a considerable amount of hygroscopic water.

Water lost at 100° C.	8·76
,, lost at 175°	7·53
,, retained at 175°	8·63
Ferric oxide	32·54
Arsenic pentoxide	33·99
Phosphorus pentoxide	1·27
Sulphur trioxide	7·28
	100·00

Regarding the water lost at 100° as non-essential or accidental, we may re-calculate the above numbers as follows:—

Water	17·71
Ferric oxide	35·67
Arsenic pentoxide	37·25
Phosphorus pentoxide	1·39
Sulphur trioxide	7·98
	100·00

I fear that these numbers throw no fresh light upon the constitution of this very variable mineral, and that no satisfactory formula can be deduced from them. Yet there can be little question but that they belong to pitticite, a species which has not, I believe, hitherto been definitely ascertained to be British. One peculiarity of the Cornish specimens consists in the high proportion of arsenic pentoxide which they contain, a proportion which is greater than that in this mineral as derived from any other recorded locality. But, on the other hand, the Cornish pitticite shows a smaller quantity of ferric oxide than the other analysed specimens. It does not appear that phosphorus pentoxide has been previously detected in this mineral. I ought to add that the Cornish mineral was straw to ochre-yellow in colour, subreniform and massive in form, and in great part opaque. The softest, palest, and most homogeneous portions were selected in preparing the sample for analysis. It is not improbable that the darker and less opaque portions would have shown a higher percentage of iron.

CONTRIBUTIONS TO THE HISTORY OF THE PHOSPHORUS CHLORIDES.*

By T. E. THORPE, Ph.D., F.R.S.E.

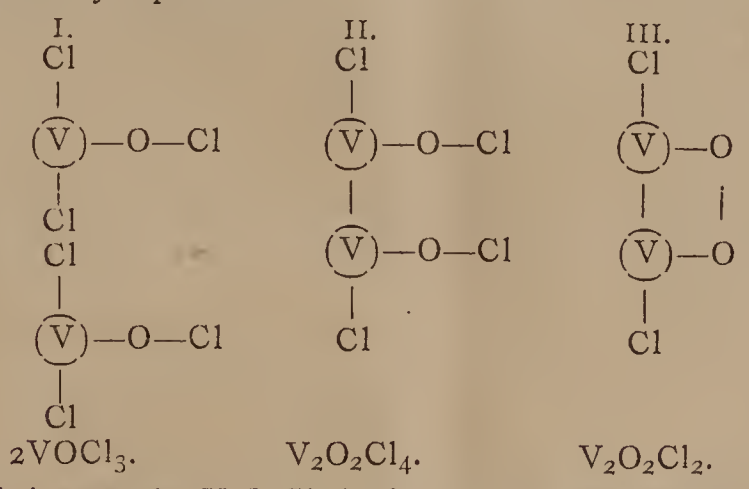
I. *On the Reduction of Phosphoryl Trichloride.*

In his first memoir on vanadium, Dr. Roscoe described a series of oxychlorides obtained from vanadyl trichloride by the action of reducing agents. When the vapour of vanadyl trichloride is passed, together with hydrogen, through a heated tube, a bright grass-green crystalline sublimate of vanadyl dichloride, $VOCl_2$, is produced in the anterior portion of the tube; afterwards, a layer of vanadyl monochloride, VOCl, is deposited as an exceedingly light flocculent brown powder; whilst, at the extreme end of the tube, beautiful bronze-coloured plates of the divanadyl monochloride, V_2O_2Cl, are formed, which have the appearance of mosaic gold. In this memoir, Dr. Roscoe clearly pointed out the intimate analogy which exists between the compounds of vanadium and those of phosphorus, arsenic, antimony, and nitrogen, and, in his subsequent researches on this subject, he has so far elaborated this view of its chemical relationship, that there is no longer room to doubt that vanadium is virtually a member of the trivalent group of elements.

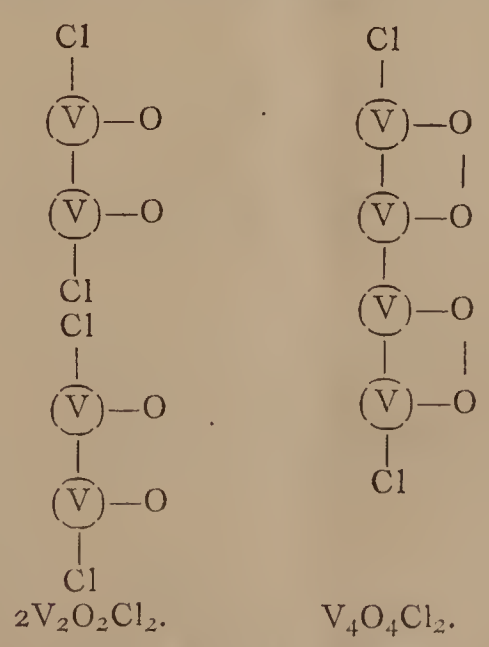
It must be confessed, however, that the triatomic nature of vanadium is not very apparent in the oxychlorides derived from the vanadyl trichloride if the simplest formulæ derived from their analysis be retained; but, if these formulæ be doubled, the difficulty at once vanishes. The supposition, that these oxychlorides possess a greater molecular weight than the vanadyl trichloride, may derive some support from the fact of the change of physical state which accompanies their formation, the lower oxychlorides being all solid. Beyond this, I am not aware that any fact is known to establish such an assumption, unless it be the coincidence between the atomic volume of the vanadyl trichloride and that of the vanadyl dichloride with the formula doubled—

	Specific gravity.	Atomic weight.	Atomic volume.
$VOCl_3$	1·83	173·8	95·0
$V_2O_2Cl_4$	2·88	276·6	96·0

According to this view, the formulæ of these oxychlorides and their relation to the vanadyl trichoride would be thus graphically represented—



And, just as the $V_2O_2Cl_4$ is formed by the juxtaposition of 2 molecules of $VOCl_3$ *minus* 2 atoms of chlorine, so, in like manner, the $V_4O_4Cl_2$ may be represented as derived from 2 molecules of $V_2O_2Cl_2$ *minus* 2 atoms of chlorine, thus—



So far as I am aware, there is nothing to disprove such a method of representation; it has, at least, the merit of preserving the triatomic nature of vanadium in these compounds, and shows in a simple manner their relation to the vanadyl trichloride.

* Read before the British Association, Edinburgh Meeting, Section B.

Assuming, then, that the triatomic nature of vanadium is established, analogy points to the existence of other oxychlorides among the trivalent group than those at present known to us. To fulfil the relationship we ought to have $TOCl_3T_2O_2Cl_4$, $T_2O_2Cl_2$, and $T_4O_4Cl_2$, where T represents a member of the triatomic group of elements. The following table represents these analogies so far as they are complete:—

$VOCl_3$	—	$POCl_3$	—	$SbSCl_3$
$V_2O_2Cl_4$	$N_2O_2Cl_4$	—	—	—
$V_2O_2Cl_2$	$N_2O_2Cl_2$	—	$As_2O_2Cl_2$*	$Sb_2O_2Cl_2$†
$V_4O_4Cl_2$	—	—	—	—

The $V_2O_2Cl_4$ was also prepared by Roscoe by heating $VOCl_3$ in a sealed tube with fragments of metallic zinc to a temperature above the boiling-point of mercury; in this way the compound was obtained in quantity, and it was easily freed from a small quantity of adhering $VOCl_3$ by heating to 130° C. in a current of dry carbon dioxide. I have attempted to repeat this reaction with phosphoryl trichloride. A quantity of the pure liquid was sealed up together with zinc filings in a tube, and heated to about 400°. The zinc was slowly acted upon, and a transparent glassy mass was formed at the bottom of the tube; no evolution of gas occurred on opening the tube. The small quantity of liquid remaining was submitted to distillation; it commenced to boil at about 80°, and the thermometer gradually rose to 105°, by which time the whole of the liquid had passed over. This behaviour appeared to indicate the presence of phosphorus trichloride, PCl_3, and a few drops of the liquid, decomposed by water, yielded the reactions of phosphorous acid. The quantity was too small to admit of fractional distillation, even if the perfect separation of the two liquids had been practicable by this method; accordingly, three portions of the distillate were weighed out for determination of the chlorine, total phosphorus, and amount of phosphorus yielding phosphoric acid on decomposition with water.

1. *Determination of Chlorine.*—The weighed quantity of liquid was decomposed by water in a stoppered bottle, a quantity of nitric acid added, and the chlorine precipitated with silver nitrate.

0·6032 grm. gave 1·7764 AgCl and 0·0075 Ag.

Cl found.	Calculated For $POCl_3$.	Calculated For PCl_3.
73·21 per cent	69·36	77·43

2. *Determination of Total Phosphorus.*—The mixed chlorides were decomposed by water in the manner above described, nitric acid added, and the liquid concentrated. The fluid was then made strongly alkaline by ammonia, and the phosphorus precipitated as the magnesium ammonium compound.

1·3343 grms. gave 1·0077 magnesium pyrophosphate, or 21·09 per cent P.

3. *Determination of the Phosphorus existing as Phosphoryl Chloride yielding Phosphoric Acid on Decomposition with Water.*—The bulb containing the weighed portion was broken under water, and ammonia and "magnesia-mixture" immediately added.

1·3965 grms. gave 0·5174 magnesium pyrophosphate, or 10·58 per cent P; equivalent to 52·35 per cent $POCl_3$.

These numbers almost exactly correspond to a mixture containing equivalent quantities of $POCl_3$ and PCl_3; such a mixture would give—

		Found.
Cl	73·17	73·21
Total P	21·32	21·09
P giving PO_4H_3 ..	10·66	10·58

The vitreous mass remaining in the tube fused on gently heating, and was decomposed; it was probably a combination of one of the above chlorides with zinc chloride, possibly the $ZnCl_2+POCl_3$ already described by Casselmann, mixed with zinc oxide or zinc oxychoride.

The action of zinc at a high temperature on phosphoryl trichloride is therefore sensibly different from the action of this metal on the corresponding vanadium compound; in the former case, the reaction is attended with abstraction of oxygen; in the latter, with abstraction of chlorine.

II. *Note on the Preparation of Phosphorus Sulphochloride.*

This compound was first prepared by Serullas, who obtained it by the action of sulphuretted hydrogen upon the pentachloride of phosphorus—

$$PCl_5+H_2S=2HCl+PSCl_3.$$

This reaction, however, affords only an impure product. Baudrimont states that this compound is more easily prepared by the action of pentachloride of phosphorus on antimony trisulphide—

$$3PCl_5+Sb_2S_3=2SbCl_3+3PSCl_3.$$

It has long been known that phosphoryl trichloride may be easily obtained in a state of complete purity, by the action of pentachloride of phosphorus on phosphoric anhydride—

$$P_2O_5+3PCl_5=5POCl_3.$$

It occurred to me to try whether the sulphochloride might not be produced by the analogous reaction with phosphorus pentasulphide—

$$P_2S_5+3PCl_5=5PSCl_3.$$

The materials, mixed in this proportion, were heated in a sealed tube to about 150°; in a few minutes, combination was quickly effected, and the entire contents of the tube were transformed into colourless phosphorus sulphochloride—a mobile liquid, boiling constantly at 126° at 770 m.m. Bar. Its vapour is extremely irritating, but when diluted with air it has an aromatic odour, reminding one of that of the raspberry.

* Wallace's chlorarsenic acid.
† Schaeffer.

ON RECENT INVESTIGATIONS AND APPLICATIONS OF EXPLOSIVE AGENTS.*

By F. A. ABEL, F.R.S., Treas. C.S.

(Continued from p. 129).

The meeting of the British Association in 1862 marks the period when gun-cotton, which fell into disfavour in England and France within two years of its discovery by Schönbein in 1846, again attracted public attention in this country. A committee was appointed at the Cambridge meeting to report on the system of manufacturing and applying gun-cotton, which had been elaborated in Austria by Baron von Lenk; and, early in the year following Her Majesty's Government received from that of Austria a confidential communication of the full details respecting von Lenk's improvements. I was at once called upon, in the spring of 1863, to investigate practically and scientifically the merits of the several modifications which had been imported into the original process of manufacture, as laid down by Schönbein; and, early in the year following, a committee was appointed by the Secretary of State for War, under the presidency of Sir Edward Sabine (and including several members of the British Association Committee), with instructions "to investigate the properties of gun-cotton as a substitute for gunpowder." The continuance of the chemical and manufacturing portion of these investigations being left in my hands, as a member of that committee, the results arrived at with regard to to the production and composition of gun-cotton, the causes to which the uncertain stability hitherto exhibited by it were to be ascribed, and the extent to which Von Lenk's improvements had removed or reduced these, were communicated by me from time to time to the Committee and the Royal Society. Some very searching experiments were made upon a considerable scale, for the Com-

* A Lecture delivered to the Members of the British Association at Edinburgh, August, 1871.

mittee, with gun-cotton manufactured according to Von Lenk's process, at Waltham Abbey, with a view to ascertain whether the requisite confidence could be placed in its keeping qualities, and the results were so far satisfactory, that the Committee, in the Report which they submitted in 1868, were enabled to state that strong evidence had been afforded of the stability of the material when properly manufactured; though they considered that further experience was required to determine this important point with sufficient certainty to justify a general adoption of gun-cotton for military service. The various samples of gun-cotton upon which the Committee based their conclusions in 1868 have been preserved to the present day, under the same conditions; recent inspection has shown them to be quite unaltered. A further experience of more than three years has, therefore, been acquired, favourable to the stability of the material, most of which was manufactured eight and seven years ago. With regard to the methods of preparing gun-cotton for mining purposes, and for artillery and small-arms, devised by Von Lenk, which have been described in detail to the British Association at former meetings, the results arrived at by the Committee did not sufficiently bear out the expectations which at first were entertained of the practical value of those methods, to warrant any decisive conclusion of a favourable nature being arrived at; and it was obvious that much remained to be done to obtain proper control over the explosive power of gun-cotton, and to render it really susceptible of being safely and beneficially substituted for gunpowder.

In examining the results obtained when gun-cotton was fired under pressure (*i.e.* in confined spaces), and observing the very limited and uncertain extent to which the explosive violence of the material was subjected to regulation, under those circumstances, by the methods of twisting and winding, and other expedients employed by Von Lenk to give compactness to a charge of the fibrous material, I was led to believe that there would be much greater prospect of attaining the desired results if gun-cotton could be converted into a form readily susceptible of treatment by compression, so as to furnish perfectly homogeneous masses of required form and density,—resembling gunpowder, in fact, in their physical character. This object was attained by submitting the gun-cotton fibre to the pulping process applied in the preparations of rags and fibres for paper-making, and afterwards converting the pulp into sheets or moulded masses, to which perfect compactness and a high density could be given without difficulty, by means of well-known mechanical appliances.

This modification of the method of preparing gun-cotton, when applied to the preparation not only of mining charges, but also of cartridges for small-arms and for artillery of small calibre, soon furnished decisive and very promising results. The experiments hitherto instituted with compressed gun-cotton in small arms and artillery have been only of preliminary nature, as already stated; but the substitution of charges of compressed gun-cotton for blasting and mining operations, in place of the gun-cotton rope hitherto employed, was not only at once productive of greatly improved results on account of the considerable reduction effected in the size of the charges of a given weight, but also imparted to the material a character of safety (in its storage, and all manipulations with it) which it did not hitherto possess, as the masses of compressed gun-cotton cannot be made to explode by accidental ignition unless they are very strongly confined. The advantages resulting from the application of the pulping process to gun-cotton were, however, not limited to the improvements effected in its efficiency as an explosive agent, but extended, with a degree of importance scarcely at first anticipated, to the properties of the material, specially in regard to stability, and to its manufacture, which was speedily quite revolutionised thereby. Thus, instead of the raw cotton of high quality and long staple, which it had been necessary to use in carrying out the Austrian system, any description of cotton could be employed, and the waste cuttings from spinning-machines (such as are used for cleaning machinery) proved to be as suitable as cotton in any other form.

The purification of the raw cotton from seed and from other matters foreign to cellulose, which are contained in the hollow fibres, constituted a most important preliminary operation in the Austrian process. Even by a searching treatment with alkali, and careful washing, these impurities were never thoroughly removed; and the products of somewhat indefinite and comparatively unstable nature, produced by the action of the acids upon these traces of organic impurities, and occasionally remaining in the finished gun-cotton, were clearly shown in the investigations which I carried out on the stability of this substance, to be the starting-point in any change which gun-cotton might sustain by long exposure to elevated temperatures. The cotton-waste now used in making gun-cotton has undergone so thorough a purification by the various manufacturing processes through which it has passed, that, while no further preliminary purification is requisite, the finished gun-cotton obtained from it is practically free from the impurities just referred to.

The cotton having been treated with the mixed nitric and sulphuric acids, and the greater portion of the acids afterwards separated, the subsequent processes of purification and preparation differ entirely from those pursued in Von Lenk's system. The purifying processes prescribed by the latter, and demonstrated experimentally to be absolutely essential in dealing with gun-cotton in the form of fibre, consisted in very long-continued washing (extending over several weeks) in running water, and subsequent treatment with alkali. The capillarity of the long fibres constituted the great obstacle to rapid purification, the displacement of the acid from the interior of these being obviously a very slow operation. In the present system of manufacture the gun-cotton is rinsed two or three times in a large volume of water, the latter being extracted as completely as possible between each rinsing by means of centrifugal apparatus; it is then transferred to a rag-engine of the kind ordinarily used in producing pulp for paper-making. Here it is not only reduced to the state of fine division necessary for its subsequent conversion into homogeneous compressed masses, but it also undergoes at the same time a most searching purification, which is continued in a still more complete manner in the next operation, the pulp being transferred to what is technically called a poaching-engine, where it is beaten about so as to remain uniformly suspended in a large volume of warm water, continuously renewed, and rendered slightly alkaline at the close of the operation. This washing is carried on uninterruptedly until samples of the material under treatment have satisfactorily sustained a very severe heat-test, and generally lasts about forty-eight hours. At least 10 cwts. of gun-cotton are washed at one time in the poaching-machine; in this way an exceedingly intimate mixture of the products of many dipping operations is obtained, and any fluctuations in the composition of the gun-cotton are thus made to counterbalance each other, much greater uniformity in the explosive power of the product being obviously secured than was previously attainable. When the gun-cotton pulp is completely purified it is converted into compact masses of the desired forms and density by a preliminary moulding process, and subsequent application of hydraulic pressure ranging from 4 to 6 tons upon the square inch. During the whole of these manufacturing operations the gun-cotton is wet, and therefore absolutely uninflammable. Even when it leaves the presses it still contains about 20 per cent of water. and is so perfectly safe in this condition that slabs of it may be cut up by means of circular or band saws, revolving very rapidly, and holes drilled in it by drilling machines, or even by means of a red-hot iron. In this damp and incombustible condition the compressed gun-cotton may be stored in water-tight cases for any length of time; the final drying of the masses is carried on ver

rapidly and safely upon hot plates, which are freely open to the air at the sides.

Numerous experiments, on a considerable scale, have been made with a view to thoroughly test the safety of compressed gun-cotton. Deal boxes, filled with the material in the ordinary way in which it is stored, and securely closed, have been arranged in piles, and the contents of a box in the centre of the pile have been ignited by means of a fuse. In another experiment one of the inner boxes of a pile has been surrounded by highly combustible material, aud the latter inflamed, so as to envelope the box in fire. In all instances the contents of the one box have ultimately burnt, but without even shattering the latter, and the large volume of flame produced for a few moments sometimes penetrated to the interior of another box in the heap, causing its contents to inflame in like manner but in no instance was an explosion produced. Those boxes the contents of which were intact were removed from the pile without incurring any danger, although the inflamed boxes were still burning. Closed boxes, filled with compressed gun-cotton, have been fired at with a Martini-Henry rifle from a distance of 100 yards; in some instances the box and contents were perforated by the bullet without igniting the gun-cotton; in other instances the contents were inflamed, but no explosion occurred. Numerous other practical proofs have been obtained of the safety of compressed gun-cotton as compared with gunpowder, and with gun-cotton in the comparatively loose and open condition.

When the Austrian improvements in the preparation of gun-cotton were communicated to the British Association in 1864, great stress was laid upon the fact that the proper development of its explosive force could only be effected by confining the material in receptacles of considerable strength, as in shells, in firmly tamped boreholes, or very strong cases of wood and metal. In attempts made by our Royal Engineers in the autumn of 1863 to apply gun-cotton to the demolition of the works at Corfu, the operations failed, in the majority of instances, to furnish any satisfactory results, evidently on account of deficiency in strength of the cases, specially constructed for this purpose, in which the charges of gun-cotton were supplied by the Austrian Government. These, and other unfavourable results, warranted the conclusion that gun-cotton could not be advantageously applied as a substitute for gunpowder in connection with military operations of mining and demolition which it is desirable to be able to accomplish hastily, and for which consequently few men and appliances, and little preparation, should be needed.

(To be continued).

ON THE

ACTION OF HEAT ON PROTOPLASMIC LIFE DRIED ON IN COTTON FABRICS.

By F. CRACE CALVERT, F.R.S.

The papers which I have previously published on the action of heat on animalcule life having been almost entirely of a purely scientific character, I propose in this to give a series of experiments which have a direct bearing on the question of the disinfection of fabrics and wearing apparel by the application of heated stoves, with the object of destroying contagion or animalcule life.

To carry out these views, a piece of ordinary grey calico was treated chemically, and washed until free from any sizing material, and dried; this prepared cloth was then steeped in a solution of putrid albumen containing abundance of animalcule life, wrung out, and dried at the natural temperature; it was then cut into small pieces, 5 centimetres square. Each of the pieces was then folded in two, rolled up, and introduced into a small strong glass tube of 6 centimetres in length and 9 millimetres in diameter; each tube was then hermetically sealed at the blowpipe.

These specimens of calico were prepared on the 8th of August, and on the 9th thirty-five small pieces were sealed in tubes. On the 10th, five of the tubes were set aside, and the remaining thirty were placed in an oil-bath and gradually heated up to 100° F., and kept at that temperature for half an hour. Five of the tubes were then taken out, and the temperature raised successively to 200°, 300°, 400°, 500°, and 600° F., kept at each temperature half an hour—five tubes being taken out at the end of each half-hour, or at each of the above points of temperature.

On the following day, one of the tubes which had been heated at each determined temperature was opened, the cloth moistened with water, and a quarter of an hour afterwards examined under the microscope, giving the results specified on Table I.

On the 14th of August, one of the small tubes from each series was broken, and the heated cloth introduced into seven tubes, each containing 400 grains of pure distilled water free from life, and left for three days to ascertain if the life which had resisted 200° and 300° F. was still capable of reproduction, and if the germs, as well as the animalcule, had been destroyed by a temperature of 400°, 500°, and 600°.

A second series was made by introducing similar pieces of cloth, which had been also heated to the different temperatures, into tubes containing an albumen solution, made by mixing one part of white of egg with four of absolutely pure distilled water free from any trace of life, and these set aside for the same length of time to corroborate the above results.

The different fluids from both series were then microscopically examined on the 17th inst., and Tables II. and III. show the result.

From an examination of Table I., it will be seen that life was *not* destroyed in the fabric at a temperature of 300° F., whilst *it is* destroyed at 400°, and that these results coincide with those obtained when microscopic life were submitted to heat in the fluids in which they had generated, but differ from those observed in the experiments described in my last paper where a fluid full of microscopic life was placed on slips of glass dried carefully, either at natural temperatures or in an air-bath at 212° previously to being heated in the oil-bath at higher temperatures—and no doubt it will have been noticed that life disappeared after 300° in the former, whilst it was only destroyed after 400° in the latter; these results are no doubt due to the albuminous nature of the protoplasmic life existing under these circumstances. These facts are in accordance with results obtained by my learned master, M. Chevreul, forty years since,—namely, that it requires a much higher temperature to render albumen insoluble when once deprived of its water than when it is in its natural state,—and all chemists know that the coagulating-point of an albuminous solution bears a certain ratio to its point of concentration. The only explanation I can offer for the destruction of life at 300° in dried calico, is that the fabric (having been, as will be seen further on, softened at 300°) proves that it has undergone a decomposition, and, therefore, that part of its elements have united together to form water, which would become high-pressure steam at the temperature at which I operated, and, to use a common expression, cook the albumen.

It will also be remarked that the amount of life in the cloth heated to 300° is similar to that on the plates of glass—viz., that in both instances it is much more abundant than when such animalcules were heated in the fluids in which they had generated, which illustrates the fact that the greater the amount of fluid in which animal life exists, or the larger the proportion in which it exists in the animal itself, the lower is the temperature at which life is destroyed.

As it was interesting to know what changes the calico had undergone at the various temperatures above cited,

Table I.—Examination of the fabrics after having been heated as follows :—

Water used for Experiment.	Cloth. Not heated.	Heated to 100° F.	Heated to 200° F.	Heated to 300° F.	Heated to 400° F.	Heated to 500° F.	Heated to 600° F.
1.	2.	3.	4.	5.	6.	7.	8.
No vibrios nor *bacteria*.	A considerable quantity of vibrios are present moving to and fro. No swimming vibrios are present.	About the same quantity of life is present here as in 2, and with about the same amount of vitality.	A little less amount of vibrios is present here than in 2 or 3, but a large quantity is still present, and they possess about the same vitality as 2 or 3.	Considerably less life here than in 4, but several distinct vibrios are present under each field moving to and fro.	No life.	No life.	No life.

Table II.—*Water Series.*—Examinations of the fluids in which some of the heated fabrics had been introduced. This series commenced on August 14, 1871; examined microscopically on August 17.

Water alone for comparison.	Cloth. Not heated.	Heated to 100° F.	Heated to 200° F.	Heated to 300° F.	Heated to 400° F.	Heated to 500° F.	Heated to 600° F.
1.	2.	3.	4.	5.	6.	7.	8.
No vibrios nor *bacteria*.	The whole bottom part of each of the fields of the microscope is covered with long, ordinary, and small-sized *bacteria*. Three or four ordinary, long, and small vibrios are swimming about under each field.	Thirty to forty long *bacteria*, and three or four long swimming vibrios are present under each field.	Forty or fifty long, ordinary, and small *bacteria* are present under some of the fields, and very large shoals of these *bacteria* under others. One or two long vibrios are swimming about under each field.	The bottom parts of each field is covered with ordinary, long, and small *bacteria*. And a considerable number of long vibrios are present throughout the drop.	No *bacteria*, and no vibrios present.	No *bacteria*, and no vibrios present.	No *bacteria*, and no vibrios present.

Table III.—*Albumen Series.*—Examination of the albuminous solutions in which had been introduced heated fabrics. Commenced on August 14, 1871; examined on August 17.

Albumen solution alone for comparison.	Cloth. Not heated.	Heated to 100° F.	Heated to 200° F.	Heated to 300° F.	Heated to 400° F.	Heated to 500° F.	Heated to 600° F.
1.	2.	3.	4.	5.	6.	7.	8.
No vibrios present.	Twenty to thirty ordinary vibrios and microzyma, and a small number of long and very long vibrios are present, swimming about in all directions under each field.	Nine or ten long and very long swimming vibrios, and four or five long vibrios, merely moving to and fro under each field.	About the same amount and kind of life is present here as was observed in 3, or that heated to 100° F.	Four or five long and and very long swimming vibrios and one or two small lots of vibrios joined together.	No vibrio present.	No vibrio present.	No vibrio present.

one of each of the small tubes which had been heated to the different temperatures was broken, and its contents carefully examined. The piece of fabric which had not been heated at all and those heated to 100° and 200° F. were quite sound; whilst that heated to 300° was of a slightly brown colour, much injured, and for practical purposes completely spoiled. At 400° F. the cloth was very much charred, almost black, and crumbled easily into powder when rubbed between the fingers; the tubes contained a large volume of gases, owing to the decomposition of the cloth. At 500° F. the cloth had been completely carbonised, and the tube contained also much gas. At 600° F. the cloth was completely decomposed into charcoal, and various hydrocarbon gases generated.

The above results clearly show that germ life placed under the above circumstances is not completely destroyed at 300° F., whilst it is at 400°. These facts not only confirm my previous results, but demonstrate, at the same time, that the temperature which will not destroy germ life is quite sufficient to materially injure cotton fabric. From these carefully conducted experiments, I am led to the conclusion that no beneficial results can be obtained by the employment of public stoves as a means of destroying germ life and contagion.

ON THE

ESTIMATION OF SULPHUR BY BARIUM.

By NICHOLAS GLENDINNING and ALFRED EDGER,
Newcastle-on-Tyne.

Our experience in the estimation of sulphur in pyrites by the gravimetric method has not led us to the same conclusion as that arrived at by Messrs. Teschemacher and Smith.

We have often had occasion to make duplicate determinations of sulphur in the same sample of pyrites, and the results have been such as to prove to our satisfaction that the method is capable of giving at least concordant results.

We are of opinion that Messrs. Teschemacher and Smith attribute too much of the differences between results obtained by this method to the solubility of sulphate of barytes in hydrochloric acid. The fact that sulphate of barytes is gradually deposited when the clear filtrate and washings are allowed to stand for some time, will admit of a different explanation than that offered by them, that "sulphate of barytes is noticeably soluble in hot and but moderately diluted hydrochloric acid." We attribute this to sulphate of iron, which is invariably carried down with the sulphate of barytes, and which appears on treatment with hydrochloric acid, after the precipitate has been freed from chloride of barium. That this is a correct interpretation may be proved by the following experiment. Oxidise about 50 grs. of pyrites, evaporate to dryness, add hydrochloric acid, and again evaporate to dryness; then take up with about 100 fluid grains of hydrochloric acid, add water and filter, and to the filtrate, at the boiling-point, add chloride of barium gradually and in excess; allow to stand for two or three hours, then filter and wash the precipitate of sulphate of barytes with hot water, until sulphuric acid fails to indicate barium in the washings; at this point treat the precipitate with hot, moderately dilute hydrochloric acid and filter; repeat this operation two or three times, then evaporate the acid washings to dryness, take up with a few drops of hydrochloric acid and water, filter to remove any trace of sulphate of barytes, and to the filtrate add chloride of barium, which will at once produce a precipitate of sulphate of barytes. In making this experiment care must be taken to use hydrochloric acid, which leaves no sulphuric acid on evaporation.

In the actual determination of sulphur, it is of great importance to obtain the precipitates as free as possible from sulphate of iron, and more especially when they are to be treated with hydrochloric acid after ignition, otherwise a loss is unavoidable.

It is our experience that the longer the precipitated liquor is allowed to stand, the freer the sulphate of barytes is found to be from sulphate of iron.

We have found in many instances on treating ignited sulphate of barytes with hydrochloric acid, that small quantities of sulphuric acid might be detected in the washings, but when precipitates have been subjected to an intense heat for a considerable length of time, such will probably not be the case.

We have since the publication of Messrs. Teschemacher and Smith's paper made experiments on a sample of pyrites, the results of which we beg to lay before our readers after first describing the *modus operandi*, which is as follows:—

Four portions of pyrites, 25 grs. each, were oxidised by red fuming nitric acid, evaporated to dryness in a water-bath, re-dissolved by a little hydrochloric acid, and again evaporated to dryness, again re-dissolved in hydrochloric acid, water added and filtered; the filtrates, measuring about ten ounces each were then heated to about 180° F., and the sulphuric acid precipitated by gradual addition of chloride of barium. It sometimes occurs on heating the filtrates before precipitation, that they assume a deep reddish colour: we consider this an unfavourable condition of the solution, and we add a little hydrochloric acid, which restores the light amber colour.

The precipitated liquors were allowed to stand in a warm place for about eight hours, and then filtered. We intended to have examined the strong filtrates for sulphate of barytes, but were prevented by want of time; but we can say from previous experience that only traces would have been found.

The sulphate of barytes precipitates were washed repeatedly by decantation with small quantities of hydrochloric acid and boiling water, until the addition of a little strong hydrochloric acid to the precipitate failed to give a colouration indicative of the presence of iron. They were then transferred to the filters, and thoroughly washed with boiling water. The whole of the washings, after the addition of a little chloride of barium, were evaporated to dryness, and the quantities of sulphate of barytes obtained, amounting generally to about 0·5 grs., added to the original precipitates, three of which after ignition and weighing, were treated with about 500 grs. strong hydrochloric acid, and allowed to stand for twelve hours in a warm place; the small quantities of sulphate of barytes dissolved by the acid were recovered and added to their respective precipitates.

The following are the results:—

	Before treatment with HCl.			After treatment with HCl.		
	Grs. $BaOSO_3$.		Grs. S.	Grs. $BaOSO_3$.		Grs. S.
No. 1	= 83·12	=	11·415	83·08	=	11·411
,, 2	= 83·18	=	11·423	83·12	=	11·415
,, 3	= 83·30	=	11·440	83·23	=	11·430
,, 4	= 83·23	=	11·430	——		——

It will be seen from the above figures that the greatest loss on treating the precipitates with HCl amounts to only 0·07 grs. $BaOSO_3$, probably attributable to the precipitate having retained a small quantity of sulphate of iron. We think the above experiments are sufficient to prove that constant results and precipitates of reliable purity are obtainable by the gravimetric method.

We have not had an opportunity of experimenting on protosulphate of iron, but we are of opinion that the estimation of sulphuric acid in the oxidised substance presents greater difficulty than is offered in the case of pyrites, inasmuch that the proportion of oxide of iron to the sulphuric acid is much greater in the case of protosulphate of iron than in that of oxidised pyrites.

We have shown that sulphate of iron is carried down with sulphate of barytes, and are of opinion that this

property, which offers the greatest drawback to the gravimetric method, will also affect the results obtained by the volumetric method recommended by Messrs. Teschemacher and Smith.

NOTES FROM THE INTERNATIONAL EXHIBITION OF 1871.

The chemical contributions to the exhibition of this year are very few, but of the highest technical importance. And here arises a difficulty as to the order in which they shall be considered, the dispersion in various parts of the building precluding the following of the numbers of the catalogue; while it would be impossible to make an arrangement according to merit. It is perhaps the best plan to walk through the building, and observe which chemical product exhibited most attracts the attention of the visitors. Entering the exhibition at the south-east gate, where most of the visitors arrive, and, being bent upon a scientific exploration, allowing but a few minutes to the seductive curiosities of the Indian Court, we pass by the collection of British and foreign paintings, the valuable Meyrick collection of armour, down and up the steps where the Whitworth ordnance stood when these galleries formed part of the South Kensington Museum, to the ground floor of the West Gallery, chiefly devoted to scientific invention. Bearing our object in mind, the case most eulogised by the visitors in the exclamation "Those beautiful colours," is that (7609) belonging jointly to Messrs. E. C. Nicholson and D. S. Price, in which are exhibited the coal-tar products, rosaniline-base, acetate of rosaniline, and chloride of rosaniline. Fourteen years ago, aniline-violet, or "mauve," the first colour from coal-tar, was prepared on a practical scale by Mr. W. H. Perkin; next, in 1859, followed aniline-red or magenta, and then a series of brilliant colours. The present exhibit is illustrative of the system of manufacturing the magenta dyes. In 1859, when Messrs. Verguin and Renard Frères first manufactured aniline-red by the action of tetrachloride of tin upon aniline, there was little idea of the extension of the industry that would ensue from the discovery of Messrs. Nicholson and Price that this colour is the salt of a colourless base, rosaniline. (7609) includes two blue dyes derived from aniline, exhibited by Mr. E. C. Nicholson on his own account; they were first prepared in 1862 and 1863, and both are of considerable technical importance. The first is known as "soluble blue," and is produced by the action of strong sulphuric acid upon Girard's blue, also a product of aniline. For wool it has little affinity, even with a mordant, consequently its use is limited to the dyeing of silk and feathers. It is the salt of a new acid, the constitution of which is as yet unknown; but it will probably prove to be a conjugate sulpho-acid, bearing a similar relation to Girard's dye as sulphindigotic acid does to indigo. The salts with the alkaline bases are very soluble in water, but with difficulty in alcohol; the aqueous solution, if neutral, has a light blue tint, nearly disappearing on the addition of an alkali. The blue colour is developed, but not precipitated, by acids. The export of this dye in the dry state to China and the East is very large, on account of the ease with which it may be applied, and the excellence of the result. Mr. Nicholson's second dye, known as "Nicholson's blue," or "fast blue," is intended for woollen fabrics, to which it is peculiarly suited by its property of dyeing in an alkaline solution, and to its entire insolubility when precipitated by a mineral acid. The process of dyeing with this colour is also due to Mr. Nicholson, and is extremely simple. The goods are first boiled in an alkaline bath, to which the quantity of dye required to produce the desired tint has been added; the whole of the die in the bath is soon absorbed; the goods are then washed and passed into a bath of boiling water, containing a small quantity of a mineral acid, in which the blue colour is developed. As the dye exists in *solution* in the first bath instead of in *suspension*, the fibres of the material are completely penetrated by it; and when the second bath is employed, precipitation of the blue colour instantly takes place among the fibres; thus a fast colour is obtained, slightly affected, however, by washing with soap.

Messrs. Perkin and Sons have a most interesting case (7516) illustrating the conversion of anthracene into alizarine. The series includes the two extremes, crude anthracene and the pure colouring matter; and also specimens of fabrics dyed and printed with artificial alizarine. Messrs. Southwall and Briggs (7550) exhibit anthracene purified by pressure and sublimation according to Mr. Wavey's process, as well as the several stages of conversion into alizarine.

Allied to aniline, as a constituent of coal-tar, is phenol, or carbolic acid, first manufactured in this country by Dr. F. Crace Calvert, who exhibits (7433) a magnificent specimen prepared for medical purposes, and which fuses at 42·2° C. (108° F.) There is also a complete collection of the various forms of carbolic acid applied to curative and sanitary purposes. Messrs. Calvert state that the monthly sale by them of carbolic acid for medical purposes amounts to about seven thousand 8-oz. bottles, while there is a correspondingly large consumption of the preparations which contain from 10 to 20 per cent of the substance, especially the "carbolic acid soaps," and the convenient and efficient disinfectant known as "carbolic acid powder." A medal was awarded to this firm in 1867 for their monohydrate of phenol, the purity of which greatly enhanced the beauty of the colours obtained from carbolic acid, such as picric acid, rosalic acid, aurine, &c.

Actuated by a desire to see what such a destructive agent is really like, many of the visitors throng to the stand (7520) of specimens illustrating the manufacture and application of compressed gun-cotton exhibited by the Patent Safety Gun-Cotton Factory, formerly Messrs. Prentice and Co., of Stowmarket, Suffolk. This variety of gun-cotton is manufactured on Professor Abel's system; and as this eminent chemist is Official Reporter to the *Chemical Section*, it may not be uninteresting to quote the particulars of the system from the Report:—

"The starting point in the production of this gun-cotton is not cotton-wool, as was the case in Schönbein's original process, nor cotton of long staple spun into loose strands or threads, as employed in Von Lenk's system of manufacture. Any form of cotton refuse (*e.g.*, the so-called "machinery waste") may be employed, provided it be quite clean, and in a loose condition, so as to admit of its rapid impregnation by the acids with which it is treated. The process of converting the cotton into the most explosive form of gun-cotton or trinitro-cellulose, does not differ in any fundamental point from that first applied in 1846. The cotton, after being very carefully dried, is immersed, in small quantities at a time, in a perfectly cold mixture of one part of nitric (sp. gr. 1·5) and three parts of sulphuric acid (sp. gr. 1·85) and is afterwards allowed to remain for twenty-four hours in contact with about ten times its weight of the mixed acids, to ensure as complete a conversion as possible into gun-cotton. The vessels containing the cotton and acids are kept closed, and as cool as practicable; and, at the expiration of the proper period, their contents are transferred to a centrifugal extracting apparatus, by which the gun-cotton is separated to a very great extent from the excess of acid. It is then suddenly plunged, by means of simple mechanical arrangements, in very small quantities at a time, into a large volume of water. The object aimed at is to dilute the acid which remains in the gun-cotton with water so quickly as to avoid the development of heat, and the consequent establishment thereby of a second violently oxidising action of the nitric acid upon the gun cotton—an action which, though only of the briefest

duration, would affect prejudicially the quality and perhaps also the stability of the product. The adoption of this precautionary measure, and the long-continued digestion of the gun-cotton with considerable excess of acids, constitute the prominent improvements which Baron Von Lenk effected in Schönbein's process for *producing* gun-cotton. After this preliminary washing, the gun-cotton is drained of water by means of the centrifugal extractor; it is then rinsed twice in a large volume of water, and passed through the centrifugal machine after each rinsing. It is now transferred to a rag engine of the kind ordinarily used in producing pulp for paper making. By this operation the gun-cotton is reduced to the state of fine division necessary for its subsequent conversion into homogeneous compressed masses; it is subjected, at the same time, to a most searching purification, which is continued in the next operation, the pulp being transferred to "poaching" engines, in which it is beaten about in a very large volume of slightly warm water, which is renewed from time to time. This final washing operation is carried on continuously until the gun-cotton has passed satisfactorily through a very searching test for purity, and generally lasts about 48 hours. This method of washing constitutes one of the great advantages of the present system of manufacture. The chief obstacle to the complete purification of the gun-cotton consisted formerly in the obstinate retention of impurities within the hollow fibres. With a view to their removal, Von Lenk prescribed continuous washing during many weeks in running water, and subsequent boiling with very dilute alkali. But by the application of the pulping and poaching processes, the capillary action of the fibre is greatly reduced, and the washing operation is rendered so searching that a decidedly more complete and uniform purification of the material is accomplished in three days, at the outside, than was previously attained by processes which extend over six or eight weeks. At the conclusion of the washing process, the gun-cotton pulp is converted, by a preliminary moulding process, and subsequently by hydraulic pressure, into compact masses of cylindrical and other forms of about the same density as water, and of dimensions suited to the particular applications required of them. During the whole of these manufacturiug operations, the gun-cotton is wet, and therefore absolutely uninflammable. After compression, the finished material is dried upon hot plates, which are freely open to the air at the sides, and is then packed in light wooden boxes for storage or transport. Compressed gun-cotton, prepared from the pulp as above described, possesses decided advantages over the forms of that explosive agent which have been previously manufactured, as regards compactness, uniformity, stability, and safety. It requires very strong confinement for the development of its explosive force by the ordinary modes of applying flame or heat; if inflamed in open air, or when confined in ordinary packing cases, it does not flash into a flame with explosive violence, like gun-cotton wool or yarn, but simply burns. It may, however, be made to explode with great violence in open air, and to exert a most powerfully destructive action, if fired through the agency of a detonation, such as is produced by the explosion of a small quantity of fulminate of mercury strongly confined. In this respect it resembles nitro-glycerine, and this property obviously renders it applicable, simple and expeditiously, to many important military, mining, and engineering operations. Unless gun-cotton be in the highly compressed form in which it is now produced, it is not susceptible of explosion *unless very strongly confined*. From the Patent Safety Co.'s works eight to ten tons of gun-cotton were sent out weekly. Government works are also in the course of completion for the extensive manufacture of compressed gun-cotton, which has been introduced into the Service for several military purposes, and as the explosive agent to be used in submarine mines.

Near at hand is an exhibit of Messrs. Rose and Gibson (7522) of specimens of oil and paper prepared from cotton seed. The crop of American cotton gathered during the last season amounted to some 800,000 tons, and the weight of the seed to 1,958,620 tons, a quantity of cotton fibre, however, amounting to one-third the weight of the seed not being separated in the ginning. This has hitherto been waste, but is now utilised by Messrs Rose and Gibson by passing the seed-husk with its fibrous coating between peculiarly constructed rollers to separate the kernel. A treatment with alkali is next effected, by which the fibre is loosened from the shell; it is afterwards washed and bleached. It is estimated that the seed of last year's cotton crop is capable of yielding 274,206 tons of fibre worth £30 per ton, besides 311,420 tons of crude oil worth £27 per ton, and 726,648 tons of oil-cake, worth £9 per ton as food for cattle. A case containing specimens of paper-pulp produced from wood (7551) is exhibited by Messrs. Smith and Granville; but no information is afforded as to the mode of treatment. The fibre is long and of fine colour.

Mr Walter Weldon (7561) exhibits specimens illustrative of his process for the manufacture of chlorine. The *rationale* having been before the readers of this paper in previous numbers (see Chemical News, vol. xxii., No. 565, p. 145), it is unnecessary to enter upon details here. By the Weldon process of re-oxidising manganese, nearly 500 tons per week are being made. The cost of recovering the quantity of manganese required for the liberation of a given quantity of chlorine is less than one-fourth the average cost for the last five years of the native manganese required to do the same work. It will have been seen that the chemical exhibitors, although not numerous, present the result of much thought and labour; and all those in the least interested in technical production should at once visit the Exhibition who have not already done so. It closes with this month.

(To be continued).

CORRESPONDENCE.

NEW FORMS OF GALVANIC BATTERIES.

To the Editor of the Chemical News.

Sir,—I send you a brief account of the results of my experiments on galvanic batteries. I tried some thousands of experiments, and kept batteries at work, watching them night and day for several months.

I soon found that the great point to secure constancy was a good negative. The positive is of minor importance, as the oxidation or other similar chemical change which takes place there produces a change of specific gravity in the liquid, securing a circulation and consequently a continuation of the action. This is much assisted by the action of heat, which itself, if applied at the bottom of the vessel, produces a circulation, and at the same time increases the conductibility of the fluid.

But the substances conveyed to the negative ordinarily cling there, and both by their chemical reaction and by forming a film on the surface soon immensely reduce the potential. This difficulty has been overcome in several ways, which I will proceed to discuss.

(1.) By a solution of copper, which absorbs hydrogen and produces metallic copper. Hitherto, this, on the whole, has been found the most convenient method for ordinary purposes, as in the Daniell battery. But to this there are many objections:—

1. Copper is not a very powerful negative, and to get a good potential requires an expensive positive, such as zinc, magnesium, &c., in order to secure much power. Copper and iron, for instance, are so near in their potential as not to give more than half the potential of copper and zinc, and consequently, when the expense of the negative is taken into consideration, the use of iron effects but little economy.

2. There is so much water of crystallisation in sulphate of copper, that it requires very nearly four pounds to sulphoxidise one pound of zinc.

3. Sulphate of copper is not only rather insoluble, but is a nasty creeping salt, which is sure to find its way wherever you want to keep it out, and by getting to the zinc sets up a local action, wasteful and injurious. Every one who has used a Daniell battery for long knows how troublesome it is to keep in order.

The last difficulty may be obviated by using a neutral salt and silicate of soda with the zinc. The silicate precipitates the salts both of copper and zinc as silicates, and adds much to the steadiness and efficiency of the battery. With a mixture of nitrate and silicate of soda, magnesium may be used as a very powerful positive, and without any local action, which usually destroys it almost immediately. It is an expensive but most convenient and powerful positive.

(2.) By nitric acid with the negative to oxidise the hydrogen. This is very good for a short time, but the acid losing part of its oxygen soon becomes gaseous and fumes, both weakening the potential and proving very injurious to the health and comfort of any one subject to its influence.

(3.) Chromic acid. This, as chromic acid, though an excellent negative, is very expensive, being sold ordinarily at one shilling an ounce. Chromate of potassium, which is commonly used with sulphuric acid, is both expensive (being now I believe £90 per ton, wholesale) and very insoluble. Bichromate of soda is both much better and much cheaper (about £45 a ton now), but is difficult to procure, being sold only in lots of four tons. The potential of chromic acid is great—considerably greater than nitric acid—but soon becomes weaker, as it passes through the stages of chromoso-chromic, chromous oxide, &c.; mixed with nitric acid, it helps to stop the fumes, as chromous acid absorbs nitric oxide gas.

(4.) As far as I know, I have been the first to use the permanganates with acid; they are very powerful—more so than even chromic acid—but require adding gradually in order to supply oxygen, otherwise the oxygen flies off and the effect is lost. The action is so powerful that I have seen the wet coke electrode actually burst out into a flame on the first application of a permanganate with sulphuric acid. The permanganate of soda may be had at about £40 a ton, and therefore is not a very expensive source of oxygen.

(5.) As far as I know, too, I have been the first to use the chlorates, or chloride of lime (so called) with an acid; they are powerful negatives, but not so powerful as chromic or permanganic acid, and the evolution of chlorine in a gaseous form is objectionable.

(6.) Sulphate of mercury is expensive and very slowly soluble. Marie-Davy introduced it in France, but I hear it is now abandoned for sulphate of copper.

(7.) Peroxide of manganese. In some cases this is useful where a battery is very little used; but without acid it parts with its oxygen very slowly, and the Leclanché battery in which it is used very soon exhausts itself when put to do any hard work. At the Post Office after an hour's work, it has to be removed and a fresh one substituted till it has recovered itself.

(8.) My experiments at last led me to the conclusion that by far the best and cheapest negative is the air itself, which of course is practically used always in oxidising coal for producing power. For this purpose I pack the negative, carbon or platinum, in a high porous cell with cinders or similar material broken so as to be freely pervious to the atmosphere, and forming a damp porous bed, on the surface and pores and cavities of which the deoxidised materials may recover their oxygen. Thus the nitric oxide fumes are oxidised and flow back as nitroso-nitric acid; hydrogen is oxidised into water, especially if a little platinum black be sifted on the surface of the cinders and made to cling to it by dipping the cinders in a little soap and water. A battery thus, if not overworked, becomes perfectly constant. If very hard work be required, the dimensions of the porous jar must be enlarged, and holes pierced above the level of the liquid to secure a good draught of air through the coke. The porous cell should of course only partially be filled with the liquid. I find the best plan is to put the zinc or iron in a neutral solution, which prevents the necessity of amalgamation, and to place in the porous cell with the carbon sulphuric and nitric acid in proportions proper for sulphoxidising the zinc. If sulphur be put in the cell with the zinc or iron, the oxidising of the sulphur will furnish the sulphuric acid, and save the necessity of sulphuric acid in the negative cell. With this negative iron may be advantageously used as a positive, as the potential of iron with a powerful negative is about $\frac{7}{8}$ of zinc, thus effecting a very considerable saving.

A very convenient battery is formed by using a solution of sulphate or muriate of ammonia for both parts of the cell. The acid unites with the zinc, and the ammonia and the hydrogen are oxidised on the coke, or partly oxidised, so as to form a solution of nitrate of ammonia, which itself acts over again.

Having obtained this excellent negative, I amused myself with trying almost every conceivable oxidisable substance as a positive. Of course a metal is quite unnecessary, any oxidisable liquid with carbon to collect the electricity being as effectual as a metal. Sulphur, a mixture of sulphur and carbonaceous matter (as in gunpowder), sugar, sawdust (especially with peroxide of manganese and sulphuric acid to decompose it), brandy and water, gruel, tea, broth, all gave good currents; the positive part of the cell acting the part of the stomach in the human body, and the porous cell with its cinders playing the part of the lungs. Again, all solutions of salts only partially oxidised, such as the hyposulphites, the cyanides, the sulphates, ferrous salts, gave exceedingly good currents, many of them fully as strong as a Daniell battery. The most powerful are of course the soluble sulphides, which in their first stages of oxidation are 60 or 70 per cent stronger than a Daniell, getting weaker as they go through the process of becoming sulphites and thionates. But as a hyposulphite is more valuable than a sulphide, the product after the first stage of oxidation is more valuable than the substance used, so that the electricity is got for less than nothing. Waste sulphide of calcium may thus become an important source of electrical and mechanical power. Heat, as it greatly increases the affinity of sulphur for oxygen, very much assists the action of these batteries. Again, ferrous sulphate gives an excellent current, and if we keep it in the condition of a ferrous salt by placing in it a sulphide of iron, forms a very cheap, indeed costless, source of electricity, because sulphate of iron is more valuable than a sulphide.

I will only add that I found that any common battery as the Wollaston, the Smee, and the Walker, if placed over a source of heat, so as to evolve steam from the negative, is made very powerful, and perfectly constant; the steam sweeping away the hydrogen from its surface. The common Walker battery is thus made equal to a Grove, and a Wollaston to a Daniell.

Now this production of cheap electricity opens a wide field for the substitution of magnetism for steam power. Even if Joule's theory were true, magnetic power could be produced as cheap as steam power. But I repeat, what I have written and explained privately to Dr. Joule, that his original experiments in 1843, when carefully and minutely examined, overthrow his own theory. Men like Sir W. Thomson and Tait doubtless do not like to be told that their elaborate science, built up mathematically with so much care and trouble, is based on a quicksand, and is inconsistent with facts. You know yourself how much odium and what violent attacks you have incurred by inserting my articles, which, though no doubt they contain mistakes, are in the main true. The British

Association absolutely refused to hear me, or even to admit a description of my batteries, lest, I presume, heresy should lurk even in them; but I noticed notwithstanding a considerable change in the tone in which both Sir W. Thomson and Tait spoke on the subject; though the latter took for granted the absurd supposition that $-272°$ is the absolute zero of temperature, which idea I find good judges consider I conclusively disproved in an article some months since in the Chemical News; and where is the report of the committee appointed to determine the mechanical equivalent of heat? £50 was paid to them in 1870 for their expenses. What have they found to be the mechanical equivalent? They maintain a judicious silence themselves, though they are determined, as far as in them lies, to silence me too.

I urged a friend of mine, Mr. Slater, the optician, of 136, Euston Road, who has the apparatus required and well-constructed magnets, to try how much power he could get by electricity. He writes to me to say that, by accurate measurements and weighings, he has got 300 foot-pounds out of a grain of iron, and he is persuaded that by improved mechanism he could get at least six times as much. Now, even 300 foot-pounds to a grain of iron is only nine pounds of iron per day of ten hours for a horse-power, a cost which may vie with steam in economy. And taking sulphide of calcium or of iron instead of iron, we can reduce the cost per horse-power to a mere trifle. The only question is the cost and convenience of the machinery. Even if the American statements are an exaggeration, this question must soon be the question of the day for all mechanists and engineers.—I am, &c.,

H. Highton.

2, The Cedars, Putney,
Sept. 18, 1871.

PS.—Since writing my letter, my ingenious friend Mr. Slater, by a larger battery, has obtained 1,371,088 foot-pounds of work from 7 ounces of iron, or 388 per grain; this with two electro-magnets rotating before a fixed electro-magnet.—H. H.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, August 14, 1871.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

New Volatile and Sweet Principle found in the Caoutchouc of Bornéo.—A. Girard.—After briefly referring to his researches (in 1862) on dambonite, $C_8H_8O_6$, a sweet saccharine substance found in the caoutchouc of Gabon, and on dambose, $C_6H_6O_6$, a derivative from dambonite by the action thereupon of hydriodic acid, the author communicates the results of his researches on the caoutchoucs obtained from climbing plants belonging to the genus *Urceola*, and grown in Madagascar as well as in Bornéo. These kinds of caoutchouc contain, enclosed among the real caoutchouc substance, a body, very soluble in water, which the author has named *Bornesite*, which in pure state is a crystalline solid body difficultly soluble in strong alcohol, which fuses at 175° without decomposition, and sublimes at 205° with but partial decomposition. Bornesite is not capable of undergoing fermentation, and does not reduce the cupro-potassic tartrate solution unless it has been first acted upon by very dilute sulphuric acid. Treated with nitro-sulphuric acid, bornesite is converted into a nitrated crystalline body, insoluble in water, soluble in alcohol, fusing at about 35°, and detonating by a blow. The formula of bornesite is $C_{14}H_{14}O_{12}$; treated with an excess of hydriodic acid, at 120° in a sealed tube, it yields, as does dambonite, ether methyl-iodhydric and dambose. While neither dambonite nor dambose act at all upon polarised light, bornesite was found to be dextogyrate.

Influence Exercised by the Difference of Size of the Polar Electrodes of a Galvanic Battery.—T. Du Moncel.—The contents of this paper and of the following are not suited for useful abstraction.

Molecular Properties of Saline Solutions considered according to the Densities thereof.—C. A. Valson.

Apparent Volatilisation of Silicium and Boron.—L. Troost and P. Hautefeuille.—The authors describe in this lengthy memoir a series of experiments made with pure silicium and boron, each by itself, placed in porcelain tubes, kept at a very high temperature (in a slow current of dry and pure hydrogen gas), and the reaction which ensues by the admission, into the tube, of fluoride of silicium, chloride of silicium, and fluoride of boron. Silicium is under these conditions apparently volatilised, forming a brown-coloured smoke, which, in a cooler part of the tube, is condensed sometimes as amorphous silicium, sometimes deposited in crystalline state. The same obtains with boron, but this apparent volatilisation is due to a simple mechanical effect, conjointly with the existence of compounds of silicium with chlorine and fluorine which are only formed at a very high temperature and dissociated at red heat.

Thermo-Chemical Researches on the Cyanogen Series.—Dr. Berthelot.—This essay contains the following sections:—Cyanhydric acid; potassium cyanide; cyanhydrate of ammonia; cyanide of mercury; cyanate of potassa; chloride of cyanogen; iodide of cyanogen; bromide of cyanogen.

Production of Ammonia by the Alcoholic Fermentation.—M. Dubrunfaut.

Presence of Milk Sugar in a Juice of Vegetable Origin.—Dr. G. Bouchardat.—The author relates at length a series of experiments made with a specimen of sugar obtained (1837) from the juice of the *Achras sapota*, at Martinique, the specimen being preserved among the objects known as belonging to the *Matière Médicale de Mérat*. By treating a portion of the sample of the sugar alluded to with boiling alcohol at 90 per cent, there was left undissolved a substance which, on further investigation, was found to possess all the physical and chemical properties of milk sugar. A careful quantitative analysis of the sample established the fact that it contains 55 per cent of cane sugar and 45 per cent of milk sugar, which latter was also found to exist in the ripe fruit of the same tree recently brought from Egypt and analysed by the author.

This number also contains several important papers relating to meteorology.

August 21, 1871.

This number contains the following papers and memoirs relating to chemistry and collateral sciences:—

Quantitative Estimation of Nitrous and Nitric Acids in Rain-water.—M. Chabrier.—This essay contains, in tabulated form, the results of a series of experiments made chiefly at Saint-Chamas (Bouches du Rhône). It appears that, contrary to what is generally supposed to be the case, nitrous acid is far more generally present in rain-water than nitric acid, while nitrite of ammonia has also been found by the author; the quantity of nitrous acid in the litre of rain-water amounts to from 0·7 to 0·8 milligramme, the quantity of ammonia to from 0·30 to 0·35 milligramme, while of nitric acid only traces are found. Curiously, the quantity of rain which falls in the part of France above alluded to is the same as the quantity which falls in Paris, but in the former instance there are only fifty rainy days, to at least three times as many in the latter.

Petroleum and Paraffin Oils.—M. d'Abbadie de Barrau.—A letter addressed by the gentleman just named to the Academy, with the view of receiving the opinion of that scientific body on a process of fractional distillation executable on the large scale, and so contrived as to render the oils used for burning in lamps uninflammable without wicks at a temperature above 65° (156° to 158° F.), while the heavy oils are rendered suitable to be burnt in *moderateur* lamps without producing smoke and emitting an unpleasant smell.

Experiments on the Conversion of Mechanical Force into Heat.—P. Volpicelli.

New Contribution to the History of Carbon.—Dr. Berthelot.—In the first part of this very lengthy essay the author treats on the properties of the carbon met with in the Cranbourne (near Melbourne, Australia) meteorite; this carbon must be considered as having been first in state of solution in molten iron, and to have separated therefrom on cooling. Next, the carbon obtained from oxide of carbon, by the decomposition of that gas by iron at a relatively low temperature, is considered. From the reactions of these substances, the author comes to the conclusion that native graphite, about the origin of which very little is known, is certainly not, at least as far as experiments can throw light on this point, derived from either anthracite or from decomposed masses of meteoric iron which contained carbon.

Reagent for Alcohol.—Dr. Berthelot.—When benzoic chloride, $C_{14}H_5ClO_2$, is put into contact with water it is only very slowly decomposed, but if the water contains any alcohol (even as little as 1 in 1000 parts of water) benzoic ether is at once formed; this ether is set free by a single drop of aqueous solution of caustic potassa, the odour of the ether being very peculiar and prominent.

Note on a Subchloride of Silicium.—C. Friedel.—After referring to formed researches on the silicium compounds, and to the researches of Troost and Hautefeuille, the author states that when hexiodide of silicium, S_2I_6, is heated along with bichloride of mercury, there is formed, along with tetrachloride of silicium, another less volatile silicium chloride, S_2Cl_6, and an oxychloride of silicium, S_2OCl_6. By

passing chloride of silicium vapours over solid silicium, placed in a porcelain tube, heated to a very high temperature, beside acicular silicium crystals, very hard solid agglomerated silicium was obtained in sufficient quantity to serve instead of carbon (graphite) as conductors for electricity and the production of electric light.

Petroleum Oils of the Bas Rhin.—M. Le Bel.—The contents of this paper contain an account of the various hydrocarbons obtainable from bituminous shale, which is submitted to dry distillation for the purpose of manufacturing what is, in this country, generally termed paraffin oil. The author has obtained hydride of amyl, hydride of hexyl, and compounds of these bodies from the oil alluded to after having been treated with sulphuric acid.

Some Metallic Trichloracetates.—A. Clermont.—This paper treats on:—Trichloracetate of baryta, $C_4Cl_3O_3,BaO+6HO$, a crystalline, but very deliquescent, salt; trichloracetate of strontia—

$$C_4Cl_3O_3,SrO+6HO,$$

also a crystalline salt, less deliquescent than the preceding, but readily soluble in water; trichloracetate of lime; and trichloracetate of soda.

This number also contains several papers on astronomy, meteorology, and geology.

Polytechnisches Journal von Dingler, first number for August, 1871.

The following papers and essays relating to chemistry and collateral sciences are contained in this number:—

Studies on Blast-Furnaces for Iron-Works.—C. Schinz.—The first portion of a lengthy monograph on this subject containing the following sections:—Introduction; statics of temperature in blast-furnaces; utility and purpose of the statics of temperature.

Method of Removing and Utilising Phosphoric Acid from Iron Ores.—J. Jacobi.—The author proposes to convert the phosphoric acid present in many ores into a soluble state, by treating the same with sulphurous acid and water, to be forced into the previously ground up ores by means of properly constructed machinery. The ore is next washed with water, and the phosphoric acid solution applied for agricultural manure.

Description of an Apparatus for Determining the Melting-Point of Organic Substances.—J. Löwe.—Illustrated with engravings. It appears that, for accuracy of results and nicety of means of observation, this contrivance deserves special notice. The description requires the aid of engravings.

Extraction of Animal Fats to be used either as Food or for Cosmetic Purposes.—Dr. H. Vohl.—The fresh fat is first as much as possible freed from membranes and flesh, next cut up either into small discs or cubes, and then thoroughly washed with cold water (which should contain the least possible quantity of lime, therefore fresh river-, or, better, good rain-water, should be used) until all blood is entirely removed. The fat is next put into a cylindrical stoneware vessel, 1·25 metres high and 0·5 metre inside diameter, this vessel being placed in a water-bath and provided with a tap at the bottom, so placed that the vessel may be emptied without removing it from the water-bath. The vessel having been filled for three-fourths of its capacity with fat, there is placed on the top of it a stoneware perforated disc, and next poured over it (the fat) very dilute pure hydrochloric acid—10 per cent of the weight of the fat of an acid made up of 3 lbs. of chemically pure HCl at 1·12 sp. gr. to 100 lbs. of water (sulphuric acid is not to be substituted, because its solvent power for membranes is very slight). This having been done, the stoneware vessel is closed with a well-fitting cover, and the water-bath heated. From the fat, while melting, the perforated cover carries, by slowly sinking downwards, all the impurities, as far as they are not dissolved by the acid, which at the end of the operation is run off by aid of the tap. The fat is then, while yet molten, washed several times with warm water, to which, for the last washing, some carbonate of magnesia is added. The acid liquid yields, along with phosphorite or other native phosphate of lime, an excellent manure. The fat is next treated with Canada oil (a refined petroleum spirit), and the solution separated by decantation from any yet present nitrogenous organic matter (membranes, &c.). The solution of the fat is freed by distillation (in a water-bath) from the Canada oil, and the result is the production of a very superior fat, which, being absolutely free from water and other organic, especially nitrogenous, matter, is not liable to become rancid, and may be preserved for many years. Although the process here briefly described may appear complicated, it yields not only a better, but also far larger quantity of product.

Description of a Diffusion Apparatus for the Purpose of Exhausting the Active Principles from Vegetable Matter, and especially for Extracting, by means of Cold Water, Sugar from Beet-Root Pulp.—J. Robert.—With engravings.

Preparation of Fruit Juices.—U. Gräger.—A lengthy paper treating on the preparation of syrups from various kinds of fruit.

Prize Essay for the Estimation of the Value of Raw Beet-Root Sugar.—The directors of the Association for the beet-root sugar industry in the German Custom's Union (*Zollverein*) considering that the co-efficient 5, adopted by the French trade as measure for the melassimetric value of the salts contained in raw beet-root sugar, is not founded on scientific basis, have resolved to grant a sum of £150 for the best essay to the following query:—Since the quantity of crystallised white sugar contained in various samples of raw beet-root sugar does not stand in direct relation to the polarisation, what research (analysis) and calculations are to be made to estimate theoretically beforehand the yield (*rendement*) of white crystalline sugar contained in a sample of a raw beet-root sugar? If it happen that a complete and, in all respects, satisfactory answer to this question be not sent in, the nearest approaching solution of the problem will be paid for in a proportionate manner. The essays, to be written in German, to be sent, postage or carriage paid, on or before the 31st of January next, to Dr. Riedel, Privy Councillor, &c., 76, Klosterstrasse, Berlin. The decision and award of the directors will be made at their general meeting, May, 1872.

Annalen der Chemie und Pharmacie, August, 1871.

This number contains the following original papers and essays:—

Researches on the Constitution of Piperine and of the Products of its Dissociation—viz., Piperinic Acid and Piperidine.—R. Fittig and T. Remsen.—The second instalment of the lengthy monograph on this subject, containing the following sections:—Action of nascent hydrogen upon piperonal; hydro-piperoine, $C_{16}H_{14}O_6$; action of chloracetyl and of nitric acid upon hydro-piperoine; isohydro-piperoine; piperonyl-alcohol, $C_8H_8O_3$; action of nascent hydrogen upon piperonylic acid; action of hydrate of baryta, dilute hydrochloric acid, and water upon piperonylic acid; action of chloride of phosphorus upon piperonal; action of hot water upon dichlor-piperonal; action of chloride of phosphorus upon piperonylic acid; constitutional formulæ of the bodies treated of.

Volumetrical Estimation of the Typical Hydrogen in the Ammonia Bases, and on the Reactions Exhibited by Free Phenol-Hydroxyles.—H. Schiff.—The first portion of this paper is not suited for abstraction. From the second portion we quote the following:—The non-nitrogenous aromatic substances which are coloured by chloride of iron contain free phenyl-hydroxyles: this reaction ceases when, for the hydrogen of the hydroxyle, are substituted other groups. Nitro-derivatives either do not exhibit this reaction at all, or only in a very limited manner; the intensity of this coloured reaction appears to depend upon the number of the free hydroxyles present in the substances.

Researches on Glycerine and Allyl Compounds and their Behaviour towards each other.—H. Hübner and K. Müller.—This memoir, treating on the position of the constituent atoms of allyl-alcohol and derivatives obtained therefrom, contains the following sections:—Dichlorhydrine; decomposition of dichlorhydrine by sodium; conversion of dichlorhydrine into an isomeric dichlorhydrine; decomposition of epichlorhydrine by sodium.

Potassium Amalgam—Sodium Amalgam.—K. Kraut and O. Popp.—The authors describe a series of experiments made with solutions of carbonate of potassa of different strength, into which sodium amalgam was placed and left for longer or shorter time, the result being the formation of a crystalline potassium amalgam, mixed, however, with a very small quantity of sodium, which the authors consider to have been left in combination with the mercury. The percentage composition of several of the amalgams thus obtained is quoted; as instances, we mention the following:—Hg, 98·370; K, 1·560; Na, 0·036. Hg, 98·420; K, 1·31; Na, 0·119. Hg, 98·044; K, 0·934; Na, 0·641. Potassium amalgam—formula, K_2Hg_{24}; in percentages—Hg, 98·41; K, 1·59. Sodium amalgam, Na_2Hg_{12}, with 1·88 per cent sodium.

Phenylic Ether and Diphenylen-Oxide.—W. Hoffmeister.—This lengthy and very exhaustive monograph contains the following chapters:—Preparation of phenyl-ether by means of sulphate of diazobenzol and phenol; preparation of phenyl-ether from benzoate of copper; properties of phenyl-ether, and its behaviour with pentachloride of phosphorus, zinc-dust, chromic, sulphuric, and hydriodic acids; phenyl-oxide-bisulpho acid; binitro-phenyl-ether; biamido-phenyl-ether; bibrom-phenyl-ether; diphenyl-oxide; diphenyl-oxide-bisulpho acid; binitro-diphenylen-oxide; bibrom-diphenylen-oxide.

Disulphobenzoic and a New Dioxybenzoic Acid.—L. Barth and K. Senhofer.—This essay contains a complete description of the mode of preparation and the salts of the two acids alluded to. The disulphobenzoic barium compound has the formula—

$$C_7H_4S_2BaO_8+2H_2O=C_6H_3\left\{\begin{matrix}COOH\\SO_3\\Ba\\SO_3\end{matrix}\right\}+2H_2O.$$

The formula of the new dioxybenzoic acid is $C_7H_6O_4+1\frac{1}{2}H_2O$.

Conversion of Oxybenzoic into Protocatechutic Acid, and on the Constitution of the latter.—L. Barth.

Bimethyl- and Biethyl-Protocatechutic Acid.—R. Koelle.—Bimethyl-protocatechutic acid is a solid crystalline substance, not yielding with chloride of iron the reaction protocatechutic acid yields with that compound. It is a strong acid; formula—

$$C_9H_{10}O_4=C_6H_3\left\{\begin{matrix}COOH\\OCH_3\\OCH_3\end{matrix}\right.$$

Some of the salts of this acid are described. The biethyl-protocatechutic acid—

$$C_6H_3\left\{\begin{matrix}OC_2H_5\\OC_2H_5\\COOH\end{matrix}\right.$$

is also a solid body, crystalline, and fusing at 149°.

Conversion of Dichloraceton into Lactic Acid.—E. Linneman and V. von Zotta.—When dichloraceton is submitted in sealed tubes to a temperature of 200° along with water (20 volumes), it is converted into lactic acid. 24 grms. of dichloraceton yielded 5 grms. of pure lactate of zinc.

Stannum Triethyl-Phenyl.—A. Ladenburg.—This substance is a colourless liquid, which is readily oxidised by exposure to air, insoluble in water, readily soluble in ether and absolute alcohol, and boils at 254°; sp. gr. at 0°, 1·2639. Formula, $Sn(C_2H_5)3C_6H_5$.

Silico-Propionic Acid and its Ether.—C. Friedel and A. Ladenburg.—Notwithstanding the high scientific merits of this paper, its contents are not suited for any useful abstraction.

Preparation of Hydrochlorate of Creatinin from Urine.—R. Maly.—Several litres of urine are first concentrated to one-fourth of its bulk by evaporation, decanted from the sediment of salts, the fluid treated with acetate of lead, filtered, and the excess of lead contained in the filtrate removed by sulphuretted hydrogen, and the filtered liquid nearly neutralised with soda. After this, a concentrated solution of corrosive sublimate is added, whereby a compound of creatinin and mercury is thrown down, which, having been decomposed by sulphuretted hydrogen, is next treated with animal charcoal, and after that evaporated to dryness. The resulting crystalline mass is treated with alcohol, and leaves, on evaporation, creatinin in pure crystalline state.

The American Journal of Science and Arts, August, 1871.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Historical Notes on the Systems of Weather Telegraphy and Especially their Development in the United States.—Dr. C. Abbe.—A very excellent account of what has been done in this respect by Americans, to whom, jointly with Europeans, the honour is due of having initiated weather telegraphy, and brought it into practice.

Tornadoes in the Southern States.—H. S. Whitfield.—This essay contains an excellent and clearly-written account of this phenomenon and the causes which produce it.

New Difference Engine.—G. B. Grant.—Illustrated by woodcuts. It treats on the subject of calculating machines.

New Form of Galvanometer.—J. Trowbridge.—Illustrated by an engraving required for the proper understanding of this subject.

Notice of the Meteoric Stone of Searsmont, Maine.—C. U. Shepard.—Account of the phenomena which were observed at the fall, accompanied by a loud report, as of the firing of heavy ordnance, on May 21 last at the locality above named, and exhaustive description of the external physical appearance of a small fragment of the meteorite, the fragments of which, scattered far and wide, are now difficult to find.

This number also contains a number of papers bearing upon natural history.

NOTES AND QUERIES.

Palm Oil.—(Reply to "Chemicus")—As regards the bleaching and deodorising of palm oil, bichromate of potassa and dilute sulphuric acid are used. A work now in the press, viz., Wagner's "Technology" (Churchill), will give you full details on this subject.

Lute for Nitric Acid.—(Reply to "Chemicus.")—Use fire-clay, or, better still, kaoline as lute after having thoroughly mixed it with a tolerably strong solution of silicate of soda. Consult the former volumes of the Chemical News, since many lutes and cements are mentioned therein.

Soda from Cryolite.—There appeared in the Chemical News, vol. xxiii., p. 270, an account of the "Manufacture of Soda and Carbonate of Soda from Cryolite," by Mr. J. L. Smith. I have conducted some experiments with a view to making caustic soda liquor from cryolite, observing the directions given in the above process, as described by Mr. Smith. I treated the crushed cryolite with 15 parts of lime, and after boiling for three hours, I found that decomposition had been effected, although I failed to obtain certain results that ought to remain, according to Mr. Smith's calculations. I obtained caustic soda liquor at 22° T., but it was contaminated with alumina in some form. I estimated the alumina, and I found in the gallon of liquor, which consisted of strong caustic soda washings, 585 grs. of alumina. I would feel much obliged if either Mr. J. L. Smith or any other chemist would inform me how to separate the alumina without destroying the causticity of the soda solution. I would like to be informed, also, of the price per ton of cryolite, delivered, say, in London. I have written to Copenhagen for this last particular, but have not had any reply.—W. F. Catcheside, F.C.S.

PRACTICAL CHEMISTRY.

Laboratory, 60, Gower Street, Bedford Square, W.C.

Mr. Henry Matthews, F.C.S., is prepared to give Instruction in all branches of PRACTICAL CHEMISTRY, particularly in its application to MEDICINE, AGRICULTURE, and COMMERCE.

The Laboratory is open daily, except Saturday, from ten to five o'clock; on Saturday, from ten till one o'clock.

Mr. Matthews is also prepared to undertake ANALYSES of every description.

For Particulars and Prospectuses, apply to Mr. Henry Matthews, the Laboratory, 60, Gower Street, Bedford Square, W.C.

Silicates of Soda and Potash in the state of Soluble glass, or in CONCENTRATED SOLUTION of first quality, suited for the manufacture of Soap and other purposes, supplied on best terms by W. GOSSAGE and Sons, Widnes Soapery, Warrington.

London Agents, CLARKE and COSTE, 19 and 20, Water Lane, Tower Street, E.C. who hold stock ready for delivery.

Chemical Technology, or Chemistry in its Applications to the Arts and Manufactures. By Thomas Richardson and Henry Watts. Second Edition, illustrated with numerous Wood Engravings.

Vol. I., Parts 1 and 2, price 36s., with more than 400 Illustrations.

Nature and Properties of Fuel: Secondary Products obtained from Fuel: Production of Light: Secondary Products of the Gas Manufacture.

Vol. I., Part 3, price 33s., with more than 300 Illustrations.

Sulphur and its Compounds: Acidimetry: Chlorine and its Bleaching Compounds: Soda, Potash: Alkalimetry: Grease.

Vol. I., Part 4, price 21s., 300 Illustrations.

Aluminium and Sodium: Stannates, Tungstates, Chromates, and Silicates of Potash and Soda: Phosphorus, Borax: Nitre: Gun-Powder: Gun Cotton.

Vol. I., Part 5, price 36s.

Prussiate of Potash: Oxalic, Tartaric, and Citric Acids, and Appendices containing the latest information and specifications relating to the materials described in Parts 3 and 4.

Bailliere and Co., 20, King William Street, Strand.

North London School of Chemistry, Pharmacy, &c.—For Instruction in Practical Chemistry and Evening Classes for the Study of Chemistry, Botany, Materia Medica, &c. Conducted by Mr. J. C. BRAITHWAITE, *for thirteen years Principal Instructor* in the Laboratories of the Pharmaceutical Society of Great Britain, and Demonstrator of Practical Pharmacy, Pharmaceutical Latin, &c.

Mr. Braithwaite, having taken the premises adjoining his house, has been enabled *nearly to double the size of his Laboratories*, and, at the same time, procure a large piece of ground which *he has had laid out as a Botanic garden.* Every facility is, therefore, offered to Students desirous of acquiring a practical knowledge of this branch of their education.

The Session 1871—1872 will commence on the 2nd of October, when the Laboratories will re-open at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

THE CHEMICAL and TOXICOLOGICAL CLASS will meet as usual every Monday and Thursday evening, commencing October 2nd, at 8 p.m.

The LATIN CLASS for the reading of Physicians' Prescriptions, Cæsar's Commentaries, &c., every Tuesday and Friday evening, commencing October 3rd, at 8 p.m.

The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday evening, commencing October 4th, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will be continued every Saturday, until further notice, at 10 a.m.

Fee to either of the above Classes Half-a-Guinea per Month. Pupils can enter at any period.

Gentlemen Privately Prepared for the Examinations of the Pharmaceutical Society, and the "Modified Examination for Assistants," &c

All Fees must be paid in advance.

Letters of inquiry should be accompanied with a stamped envelope.

Mr. Braithwaite receives a few Pupils to Board in his house.

Address—54, Kentish Town Road, N.W.

ANALYTICAL LABORATORY AND SCHOOL OF TECHNICAL CHEMISTRY.

7 and 9, HACKIN'S HEY, LIVERPOOL.

Conducted by A. NORMAN TATE, Analytical and Consulting Chemist, and Chemical Engineer.

Established for Educational Purposes connected with Chemistry in its practical Applications to Manufactures, Commerce, &c.; for the performance of Analyses, Assays, and Chemical Investigations; and for affording information respecting the construction, &c., of Chemical Manufactories, and the conduct o Chemical Manufacturing Processes.

The Course of Instruction, in addition to the ordinary Chemical studies, comprises, as far as possible, all such other subjects as are necessary to give the scientific and practical information required in the Arrangement, Construction, and Management of Chemical Manufactories, and in the Application of Chemistry to Industrial Pursuits.

Students' Fees may be known on Application.

Plans, &c., for Chemical Apparatus and Manufactories are supplied, and the Erection of Plant and Buildings is superintended when required.

Chloride of Calcium (Purified Muriate of Lime), total insoluble impurities under ¼ per cent.

CHLORIDE OF BARIUM (Muriate of Baryta), free from Iron and Lead, total impurities, water excepted, under ¼ per cent.

GASKELL, DEACON, & CO.,
Alkali Manufacturers, Widnes, Lancashire.

THE CHEMICAL NEWS.

Vol. XXIV. No. 618.

ON THE

OXIDATION PRODUCTS OF ESSENTIAL OIL OF ORANGE-PEEL (EAU DE PORTUGAL).*

By C. R. A. WRIGHT, D.Sc., and CHARLES H. PIESSE.

Preliminary Notice.

The researches of Soubeiran and Capitaine, and those of Dr. Gladstone, have shown that there is contained in oil of orange-peel a hydrocarbon, hesperidene, boiling at 174°, and of formula $C_{10}H_{16}$; the oil employed in these experiments (which was kindly furnished for this purpose by Messrs. Piesse and Lubin, and was believed to be a perfectly pure and genuine article) began to boil at 175°, and almost entirely distilled below 180°; a small amount of non-volatile resinous yellow substance was left in the retort; this was almost insoluble in alcohol when cold, and but slightly so when boiling. After complete expulsion of hesperidene it furnished a soft resin not hardening on standing, perfectly inodorous, of a bitter aromatic taste, and yielding the following numbers on combustion:—

0·3595 grm. gave 0·997 CO_2, and 0·314 H_2O.

	Calculated.		Found.
C_{20}	240	75·47	75·63
H_{30}	30	9·43	9·70
O_3	48	15·10	—
$C_{20}H_{30}O_3$	318	100·00	

No nitrogen was contained in this body, which appears to be related in composition to the hydrocarbon hesperidene; the amount of this resin in the specimen of oil examined was 2·8 per cent.

On re-distilling the hydrocarbon over sodium, scarcely any action ensued; the whole came over between 175° and 177° (uncorrected). Treated with nitric acid and warmed, a powerful action ensues. By employing acid diluted with its own bulk of water, this action is moderated, and may be safely performed in a capacious flask furnished with an inverted condenser, red fumes and CO_2 being copiously evolved. By employing about 1 volume of hydrocarbon, 3 of nitric acid, and 3 of water, and boiling for 1½ hours, a brown resinous non-volatile substance is obtained, which may be obtained pure by boiling several times with water, and drying at 100°, at which temperature it becomes soft; this resin contains nitrogen, and on combustion gave—

Carbon	57·0 per cent
Hydrogen	5·9 ,,

By the further action of diluted nitric acid on this resin, a yellow resin is produced which does not soften at 100°. A specimen obtained by the action of 1 volume of hydrocarbon, 3 of nitric acid, and 3 of water, for 1½ hours, another volume of nitric acid being then added (red fumes having almost ceased to come off), and the whole boiled 1 hour longer, gave these numbers—

Carbon	47·4 per cent
Hydrogen	5·1 ,,

Both this resin and the former brown one appear to contain less hydrogen in proportion to the carbon than the original hydrocarbon, the ratios being—

	Carbon.	Hydrogen.
Hesperidene	100	13·3
Brown resin	100	10·3
Yellow resin	100	10·9

As both contain nitrogen it is possible that they may be derived from $C_{10}H_{16}$ by addition of oxygen and replacement of H by NO_2.

The aqueous acid from which these resins have separated contains much oxalic acid (recognised by combustion, and the behaviour of its calcium and manganese salts, and the explosibility of its silver salt), and apparently also another acid containing nitrogen; for the snow-white oxalic acid prepared by precipitation as lead salt, treatment with H_2S, and several recrystallisations from water, did not give perfectly sharp numbers on analysis, and was found to contain nitrogen by the sodium test.

When hesperidene is boiled *per ascensum* for several hours with dilute potassium dichromate solution, and about as much SO_4H_2 as will saturate the metals of that salt, CO_2 is slowly given off and the chromate is reduced. On distilling the product of five hours' action of 1 part hydrocarbon, 3 of chromate, 1 of SO_4H_2, and 30 of water, an acid distillate was obtained, as well as an oily substance, consisting for the most part of unaltered hesperidene; this oily body, however, although volatile with steam of water, does not wholly volatilise at the temperature at which the original hydrocarbon distils (175° to 177°), a portion being found to boil at a temperature higher than 200°.

The acid distillate, converted into barium salt, gave a product that reduced silver nitrate on boiling, gave a red colouration with ferric chloride, a strong smell of acetic acid on warming with SO_4H_2, and of acetic ether with alcohol and SO_4H_2; the barium salt gave these numbers—

0·2765 gave 0·245 $BaSO_4$ Ba = 52·1 per cent.
Barium acetate requires .. .. 53·7 ,,

From these numbers it appears as though a trace of some acid of higher molecular weight than acetic were produced, especially as probably a little formic acid is also present (from the reduction of the silver nitrate); still the main portion of the product is acetic acid, as is shown by the following analysis of the silver salt obtained by double decomposition of the barium salt by $AgNO_3$, and three re-crystallisations from boiling water.

0·309 gave 0·200 Ag Ag = 64·7 per cent
Silver acetate requires 64·7 ,,

This production of acetic acid does not arise from admixtures of any other body with the hydrocarbons, as might possibly be imagined; in the first place, the high commencing boiling-point of the oil, and its constancy indicates that, at any rate, only traces of any other substance could be present; and, again, the hydrocarbon regained from the oily substance arising from the reaction of the chromate, &c., on hesperidene, furnished more acetic acid on again subjecting it to this treatment.

From the production of acetic acid it appears that the group CH_3 must be present in hesperidene; the following formula—

$$\begin{array}{c} CH{\cdot}CH_3 \\ | \quad | \\ (C_8H_{12}) \end{array}$$

possibly may express its composition. It is proposed to follow up these experiments so as to gain some clue to the functions of the other eight carbon atoms, and also to submit other similar substances to examination in the hope of throwing some light on the question of "physical isomerism" in the turpentine group of hydrocarbons.

Manganese dioxide and sulphuric acid do not seem to produce any promising results with hesperidene. The action of potassium chlorate and SO_4H_2 is very marked, a thick resinous substance being formed.

* Read before the British Association, Edinburgh Meeting, Section B.

ON A NEW METHOD OF ESTIMATING ZINC.

By HUGO TAMM.

Of all the metallic precipitates which abound in chemistry there is none which can be compared to hydrated sulphide of zinc. In forming it nature seems to have made a gross mistake which she carefully avoided in the creation of the congener metal *magnesium*, for this abominable compound possesses all the bad or negative properties of all the others, without almost a single good one as a compensation. It settles too slowly in liquors, and when once settled, rises up too quickly if an attempt is made to decant the liquid. It clogs the filters; it passes through the filters; it washes only when it chooses; it oxidises at pleasure, but invariably at the wrong moment; it refuses to oxidise when required to do so; or, when it oxidises, it retains both sulphur and oxygen, seemingly, for the very purpose of leading to wrong results. And yet chemists have, for ages past, submitted to this intractable substance, and all the modes of estimating zinc are founded on the use of sulphide of zinc.

After some efforts, I have succeeded in shaking off the yoke of this capricious mineral tyrant. I am far from saying that this new method is perfect. I shall carefully point out its defects; but, in most cases, where zinc is specially looked for, it is by far the easiest and safest method, and its general convenience is an ample compensation for its defects, which, on the whole, are but slight. After endeavouring, but in vain, to discover some volatile substance which would precipitate zinc completely in acid solutions, or some substance not difficult of separation from any of the elements likely to co-exist with zinc, and precipitating zinc in acid or neutral liquors, according to the rules which I have laid down elsewhere, I was led by analogy to apply the method which answers so well—in default of a better one—for the estimation of magnesia, and I studied the action of phosphates and ammoniacal salts on zinc solutions, and I found that phosphate of soda, for instance, precipitates completely a neutral or slightly acid solution of chloride of zinc, mixed with an excess of chloride of ammonium, in the state of phosphate of zinc and ammonia.

It is this reaction which I have applied with the greatest success to the estimation and separation of zinc in most cases where the estimation of this metal is of any importance.

Preparation of Ammoniaco-Zincic Phosphate—Behaviour and Composition of this Salt—Value of this Mode of Estimating Zinc.

When a solution of zinc in any mineral or volatile organic acid is supersaturated by ammonia, until all the oxide of zinc is dissolved, and when this solution is re-saturated by hydrochloric acid until litmus paper indicates a feeble acid reaction, a double chloride of zinc and ammonium exists in the liquor. If a solution of ordinary crystallised phosphate of soda is added, a voluminous white precipitate of phosphate of zinc is formed, which, if left for a few minutes at a temperature near that of boiling-point of the liquor, soon combines with phosphate of ammonia, and suddenly comes down in the shape of a dense white precipitate, which settles very rapidly.

This precipitate of ammoniaco-zincic phosphate, collected on a filter, can be washed with the utmost facility, in fact, as fast as water can be poured upon it, and it never passes through filters, a most important property. It retains the phosphate of soda and chloride of ammonium in the midst of which it has been precipitated with some strength, and several successive washings are absolutely required to free it from these salts, but eventually the washing is complete. To ascertain this, nitrate of silver acidulated with nitric acid must be used, because the double phosphate retains chlorides with more strength than phosphates. After drying at 100° C., the ammoniaco-zincic phosphate has the constant formula—

$$(ZnO)_2NH_4OPhO_5,$$

and it contains exactly 36·49 per cent of metallic zinc.

From a careful examination of this salt, I arrived at the conclusion that the equivalent of zinc is 32·75. On this point I agree with some analysts, and differ from others. I will not, however, discuss this question, suffice it to say that in complete analyses I have arrived at more exact results in taking the equivalent of zinc at 32·75 than in taking it at 32.

Calcined over a gas-lamp, the double phosphate leaves a residue of pyrophosphate of zinc, $(ZnO)_2PhO_5$.

It might be supposed that zinc could be estimated with accuracy in this salt; but this is not the case, as a loss of zinc is always incurred during the calcination of the ammoniaco-zincic phosphate. On the contrary, the composition of the phosphate of zinc and ammonia, well washed and dried at 100° C., can always be relied upon, and it is from the weight of this salt that the amount of zinc must be calculated.

The precipitation of zinc is complete when the supernatant liquid, mixed with a little excess of phosphate of soda, does not show any bulky precipitate of zinc phosphate; but it is advisable to add at once to the zinc solution a quantity of phosphate of soda, sufficient to turn red litmus paper blue. The liquor is only momentarily alkaline, and it re-assumes its slightly acid or neutral reaction as soon as the double phosphate has come down, so that the precipitation actually takes place in a slightly acid or neutral liquor, a gratifying result.

Should a very accurate estimation of zinc be required, the liquor should be left in a warm place for some ten or twelve hours, when the precipitation of the zinc will be very complete, as might be proved by adding sulphide of ammonium to the filtrated liquor, or sulphuretted hydrogen to the filtrate previously saturated by ammonia, and re-acidulated by acetic acid. In general a trace of zinc is precipitated, for the double phosphate is not absolutely insoluble. For most practical purposes, it is quite sufficient to allow the precipitated double phosphate to rest for about an hour; a very small quantity of zinc will remain in the liquor, from which it can be separated by sulphide of ammonium, but this quantity of zinc never amounts to more than 1-300th of the quantity of zinc precipitated by phosphate of soda, so that it can be neglected, especially if a simple assay of zinc is all that is required.

One of the chief defects of the double phosphate is its propensity to adhering firmly to the side of the flask in which the precipitation takes place. A thin film of this salt coats the glass, and it can be removed only with some difficulty. A glass stirrer, covered at one end with 1 inch or 1½ inches of india-rubber tubing, can be advantageously employed for this purpose. But it is best, after the bulk of the precipitate has been removed on the filter, to dissolve the adhering film in dilute hydrochloric acid, to neutralise by ammonia, to add a few drops of phosphate of soda, to boil, and to add the slight precipitate thus obtained to the main portion already placed on the double filter.

It is sometimes possible to avoid the coating of the glass with ammoniaco-zincic phosphate, by heating the solution almost to boiling-point before adding phosphate of soda; the precipitation in this case is very rapid, and, by taking this precaution, further trouble is avoided. But the chief defect of this mode of estimating zinc is undoubtedly the use of phosphate of soda, a fixed salt, difficult of separation from most substances. Unfortunately, with zinc, there is no choice of precipitating reagents, and phosphate of soda, which must be considered as a very perfect assay reagent, is, from its very nature, a defective one in analytical researches.

If, in similar conditions, carbonate of ammonia is substituted for phosphate of soda, most of the zinc is precipitated as ammoniaco-zincic carbonate, but, even when the operation is conducted with the utmost care, too large a proportion of zinc remains in the liquor. On the other

hand, if carbonate of soda is used, no precipitation of zinc takes place. However, in such cases as this one, the only remedy is a complete knowledge of the behaviour of the reagent employed in given instances, and I shall, accordingly, expose the result of my observations.

Estimation of Zinc in Spelter, and in Salts and Compounds chiefly formed of Zinc and of Oxide of Zinc.

Fifty grains of spelter, and from 50 to 100 grains of the zinc salts or compounds, are dissolved in dilute hydrochloric acid. The solution is supersaturated by ammonia, and a little carbonate of ammonia is added to precipitate any lead which might be present. The addition of carbonate of ammonia, which is essential in the case of spelter, may be useless with other zinc solutions, and, as its effervescence with acids is a source of trouble, it ought to be used only for a purpose. If lime exists in the solution, it is, of course, just as well to get rid of it at once by using a little carbonate of ammonia.

The liquor, separated from any precipitate produced by ammonia or carbonate of ammonia, is re-saturated by hydrochloric acid, until blue litmus paper indicates a feeble acid reaction. The liquor is brought to almost boiling point, phosphate of soda is added until red litmus paper turns blue; the liquor is kept at about the same temperature until the double phosphate has come down; it is then tested for zinc with phosphate of soda, and when the precipitation is complete, the whole is left for some time in a warm place. After filtering, washing, and drying the precipitate, with the precautions already indicated, the amount of zinc is calculated from its weight.

Estimation of Zinc in Blendes.

There are two classes of blendes: those which contain large proportions of iron and small proportions of lead, and those which contain large proportions of lead and small proportions of iron.

Blendes of the first description are attacked by strong nitric acid, and, when the action is over, a large excess of hydrochloric acid is added, then hot water in sufficient quantity to give a clear liquor.

After cooling, the mixture is supersaturated by ammonia. The whole is then boiled and filtered, the precipitated oxide of iron is well washed with dilute ammonia, then re-dissolved on the filter in hydrochloric acid in excess, re-precipitated by ammonia, re-filtered, and well washed.

This second treatment of the oxide of iron is absolutely necessary, but it is most efficient. I have assured myself, by the most careful investigation, that, after this double treatment, the oxide of iron *does not contain a trace of zinc.* This result must be attributed to the large excess of chloride of ammonium formed during both operations.

In this result, I differ from that admirable chemist, H. Rose, who condemns this method of separating zinc from iron. But I suspect that he had not observed the excellent influence of an excess of chloride of ammonium, for if this salt does not exist in the liquor, or if it exists only in small proportion, it is quite true that the separation of zinc from iron by ammonia is impossible.

With the second class of blendes, addition of a large excess of hydrochloric acid is not required. The blende is attacked by strong nitric acid, a little hydrochloric acid is added, then water, then an excess of ammonia, and, lastly, a quantity of carbonate of ammonia sufficient to precipitate thoroughly all the lead. The whole is boiled and filtered, and the precipitate is well washed with water containing a little ammonia and carbonate of ammonia. The precipitate is re-dissolved on the filter in nitric acid, and submitted once more to a treatment similar to the first.

In analyses, the more complicated modes of separation of zinc from iron and lead would have to be resorted to, and, in general, it is best to obtain a solution of zinc as free as possible from impurities. But a solution of zinc which has gone through the usual course of analysis is perfectly fit to be precipitated by phosphate of soda.

The ammoniacal solutions of zinc obtained with either class of blendes, after being carefully neutralised by hydrochloric acid, are precipitated by phosphate of soda, and zinc is estimated as before.

Sometimes either class of blendes contain small quantities of copper, but no notice should be taken of the presence of this metal, which, in this circumstance, is not precipitated with the zinc. However, if it existed in any quantity, it would be best to separate it first, by means of the copper reagent.* Now it just happens, and this is very fortunate, that nickel, cobalt, and manganese, which would trouble the estimation of zinc by this process, seldom, if ever, accompany zinc in blendes; but, should they exist in small quantities, their presence could be neglected, as they would remain in the solution. But this process must not be used in cases in which nickel, cobalt, and manganese, exist in any quantity, unless these three metals are first separated from the zinc.

Estimation of Zinc in Calamines.

Calamines are attacked by hydrochloric acid, and the mixture of gelatinous silica and of chlorides thus obtained being evaporated to dryness, re-acidulated by hydrochloric acid, diluted with water, and filtered, the filtrate can be submitted to two successive treatments with hydrochloric acid and ammonia, as in the case of blendes of the first class, and zinc estimated as in blendes. But, however carefully the operation is conducted, it is not possible to obtain a silica free from oxide of zinc, and it is by far the best to have recourse to the following process:—

Fifty grs. of the calamine are attacked in a platinum vessel, conveniently large, by a mixture of equal parts of hydrofluoric and hydrochloric acids. When the solution is completed, dilute sulphuric acid (half water and half sulphuric acid) is added in slight excess, and the mixture is slowly evaporated, until white fumes of sulphuric acid begin to come off. After cooling, water is added, and also a large excess of hydrochloric acid. The solution, which ought to be quite clear, is transferred to a flask, and there submitted to the two successive treatments described in the case of blendes of the first class, and zinc is estimated exactly as in that instance. Or the solution may be submitted to a regular analytical process.

When lime is present, it is advisable to separate it first by means of a little carbonate of ammonia. But, if magnesia exists, even in pretty large quantity, this substance is nicely separated from the zinc. It remains in the solution, in which it can be estimated as phosphate of magnesia and ammonia by addition of ammonia. However, if it existed in large proportion, it would be best to separate it, first by adding phosphate of soda to the ammoniacal solution of zinc; after the separation, zinc could be easily precipitated by neutralising the filtrate by hydrochloric acid.

These notes, however, apply much more to what might happen than to what actually occurs in most cases.

Estimation of Zinc in Brass.

The liquor from which copper has been separated by the copper reagent,† and resulting from the solution of 20 or 50 grs. of brass, is saturated at once, and without any previous preparation, by ammonia in excess, and this mixture neutralised by hydrochloric acid is precipitated by phosphate of soda and zinc estimated as stated. Or, better still, the liquor from which copper has been precipitated by the copper reagent, and resulting from the solution of 100 grs. of brass, is boiled to get rid of sulphurous acid, then submitted to sulphuretted hydrogen, whereby lead, arsenic, antimony, &c., are precipitated, then filtered, boiled once more to get rid of sulphuretted hydrogen, oxidised by nitric acid, saturated by ammonia, which precipitates small quantities of iron, filtered, and the filtrate neutralised by hydrochloric acid is precipitated by phosphate of soda.

* Chemical News, vol. xxiv., p. 91.
† *Ibid.*, p. 92.

As it is quite as easy to estimate large quantities of zinc as small ones by this method, the more zinc there is in a liquor the more accurate is the estimation of this metal.

Estimation of Zinc in German Silver.

This method cannot be applied to the estimation of zinc in this alloy unless nickel is separated immediately after copper, and zinc left alone in solution.

General Observations.

In the course of an estimation of zinc by this method, the chemist can depend on the result, whenever he can obtain the dense precipitate in the circumstances previously described; for whenever the substances which follow zinc in an ammoniacal solution exist in large proportions, the precipitate of phosphates remains bulky, and the dense precipitate cannot be obtained.

Cobalt, it is true, is precipitated freely along with the zinc, but, in this case, cobalt imparts a beautiful blue colour to the double phosphate, and reveals itself at once.

In the same circumstances, nickel would impart a greenish tinge to the precipitate.

I need scarcely remark that it is just as well to examine qualitatively the double phosphate with which zinc has been estimated. It should be free from lime, magnesia, nickel, cobalt, and manganese.

But all these observations will seldom find applications, and are introduced here only to meet possible but not actual cases.

When zinc forms only a small fraction of the substance analysed, the ordinary methods of separations ought to be, and generally must be, resorted to, but, when once isolated, zinc can be with advantage estimated as ammoniaco-zincic phosphate.

Such is, with all its advantages and all its imperfections, the method which I propose for the estimation of zinc. I hope that a happier hand will soon find a reagent volatile, if possible, or easy of separation with most substances, precipitating completely zinc in acidulated solutions of zinc and ammoniacal salts. Here is the problem; may the solution soon be discovered.

Analytical and Chemical Notes, Derived from the use of Phosphate of Soda in the above Process.

Estimation of Manganese.—If there was any difficulty about the estimation of manganese, or if excellent methods for the estimation of this metal were not as numerous as they are, I should publish a lengthy article on the following process, which can be safely recommended especially for the assays of manganese ores.

The hydrochloric solutions of manganese, freed from oxide of iron generally existing in them, by means of succinate of ammonia, are mixed with an excess of chloride of ammonium. An excess of phosphate of soda is added, and the mixture is heated to almost boiling-point. Manganese is precipitated completely in the state of phosphate of manganese and ammonia. This precipitate is well washed (it washes very easily) and dried at 100° C. Its formula is then $(MnO)_2NH_4O,PhO_5 + 2HO$, and it contains exactly 29·78 per cent of manganese.

The chief advantage of this mode of estimating manganese over the usual method is that it is estimated in one series of operations, while by the ordinary process it requires two.

This process is as nearly as possible identical with the above process proposed for the estimation of zinc, and nearly all I have said in the former pages I could repeat here.

Ammonio-Phosphates.—Most of the neutral solution of oxides soluble in ammonia, mixed with an excess of chloride of ammonium, are precipitated by phosphate of soda, and when the mixture is boiled most of the ammonio-phosphates crystallise. Some of them are very remarkable. The phosphate of manganese and ammonia thus prepared (the double phosphate of the above process of estimating manganese) forms crystalline scales, of a silky appearance, soft to the touch, and of a beautiful flesh-colour.

The phosphate of ammonia and cobalt forms beautiful crystals of an indifferent pink colour, but when this substance is calcined at a low temperature, phosphate of cobalt of an admirable deep blue colour is obtained; it preserves the shape of the original crystals, and forms a beautiful substance pseudo-crystallised.

A beautiful series of blues can be obtained by precipitating, by phosphate of soda, chloride of zinc mixed with chloride of ammonium, and containing variable quantities of chloride of cobalt.

The phosphate of ammonia and protoxide of iron is precipitated in the same general conditions, in the form of silky crystalline scales, very soft to the touch, and which possess a most remarkable appearance. Their colour, which I cannot very well describe, is analogous to that of certain greenish micas, and altogether very strange.

Chloride of ammonium is the crystallising agent in the preparation of these salts, remarkable in so many respects.

ON RECENT INVESTIGATIONS AND APPLICATIONS OF EXPLOSIVE AGENTS.*

By F. A. ABEL, F.R.S., Treas. C.S.

(Concluded from p. 138).

The discovery made in 1864, by Mr. Alfred Nobel, that the explosive force of nitro-glycerine can be fully developed without any strong confinement of the charge, through the agency of a detonation, appeared to give that substance so great and well-founded a claim to superiority over gun-cotton and other explosive agents, in connection with some of their applications, that the pre-eminence which this liquid enjoyed for a time as an explosive substance of quite exceptional properties almost equalled the dread of its dangerous character inspired by the succession of fearful accidents which inaugurated its employment on an extensive scale. Not long afterwards, however, it occurred to my assistant, Mr. E. O. Brown, to try whether compressed gun-cotton could not also be violently exploded in the open air, through the agency of a detonation, and a result was obtained quite similar to that furnished by nitro-glycerine. I was led by this observation to institute a systematic experimental inquiry, with a view of throwing light upon the nature and cause of the remarkable phenomena exhibited by these two bodies, and I soon found that *all* explosive compounds and mixtures, even down to gunpowder, are susceptible of violent explosion by means of a detonation, though the nature and force of the required detonation vary very considerably with different explosive substances. The results arrived at by a careful inquiry into the conditions to be fulfilled in determining the detonation in open air of these compounds and mixtures, and of the operating causes, physical and mechanical, which tend to modify the character of the phenomena produced upon their exposure to heat, concussion, &c., are detailed in the *Transactions of the Royal Society*—their present discussion is precluded by the great length which this lecture has attained. It may, however, be stated in general terms, that although the amount of mechanical force developed by the initiative detonation, and the suddenness of its operation, play most important parts in determining the violently sudden metamorphosis of the substance submitted to their influence, neither the severity nor suddenness of the blow or concussion, nor the heat developed by it, nor the peculiar nature or comparative instability of the particular explosive body operated upon, suffice individually or collectively to account for all the several phenomena of detonation; but

* A Lecture delivered to the Members of the British Association at Edinburgh, August, 1871.

that some yet unexplained peculiarity in the initiative concussion employed, and probably some physical relation or antagonism between it and the particular concussion produced by explosion of the substance operated upon must, in many instances, contribute to produce results, positive and negative, which can be satisfactorily explained by simple reference to the operation of mechanical force, and consequently of heat. In illustration of this it may be instructive to give two examples. The detonation of compressed gun-cotton is accomplished by the explosion of 0·32 grm. (5 grains) of confined mercuric fulminate, placed in contact with the mass, but it requires ten times that quantity of the violent explosive agent, chloride of nitrogen, also confined, to produce the same result. Again, the mechanical force exerted by the explosion of nitro-glycerine is fully equal to that developed by the mercuric fulminate, yet a quantity of nitro-glycerine, about seventy times greater than the minimum of the fulminate required to detonate compressed gun-cotton, fails, when exploded in contact with the latter, to produce any other result than the complete mechanical disintegration of the mass.

With regard to the general manner in which a detonation action determines the violent explosion or sudden chemical disintegration of such a substance as gun-cotton, the similarity of its operation to that of a blow is readily demonstrated by many and simple experiments, for a description of which I must refer to my paper presented to the Royal Society in 1869; one or two may, however, be mentioned which have been made with gun-cotton, and which probably illustrate the subject sufficiently for present purposes. The heat developed in a mass, when submitted to a blow, depends upon the resistance which its particles oppose (by reason of its rigidity or solidity) to the motion of the body striking it. Repeated blows may be required to explode a detonating substance placed in the form of loose powder upon an anvil; the force being, at first, in part expended in compressing the particles into a compact mass. When no longer free to move, the resistance they oppose to the force applied determines the sudden transformation of the latter into heat to a sufficient extent to bring about the detonation of the substance struck. If, in the case of gun-cotton, the force developed by a detonation, even of a powerful character, is allowed to operate upon the material in a loose flocculent condition, the latter is simply dispersed; again, if the gun-cotton be only lightly compressed, a much more powerful detonation is required for its explosion than if it be in a very compact condition; and if the mass of the highly compressed material be only very small, it cannot be detonated by the means which are successful with larger masses, unless special precautions be taken, by fixing it rigidly to the detonating fuse, to prevent its being dispersed by the force which the explosion of the latter exerts. These facts, when compared with the following experiments, demonstrate that the action of a detonation in developing the violent explosion of the substance upon which it is allowed to operate, is that of a very sudden blow given to some portion of a mass, the particles of which are in a condition to resist the motive or dispersive power of the mechanical force applied. A bullet from a Martini-Henry rifle was fired at a distance of about 50 yards, against a slab of compressed gun-cotton, 0·75 inch thick, and 3·75 inches in diameter (weighing 4 ounces), freely suspended in air by a string; the gun-cotton was simply perforated by the bullet. A similar result was several times obtained with slabs of gun-cotton of the same dimensions, and with others double the thickness. On making the experiment with a slab of three times the thickness, the gun-cotton was inflamed but not detonated by the impact of the bullet. The mass was, in this instance, of sufficient thickness to offer considerable resistance to the penetrative power of the bullet; the passage of the latter was, therefore, retarded to such an extent as to give rise to the heating of the opposing gun-cotton particles up to their inflaming point. This experiment was repeated with the same result, but when a bullet was fired against a piece of compressed gun-cotton four times the thickness of that first employed, and weighing one pound, the result was detonation of the mass.

It need scarcely be stated that the detonation of a large quantity of an explosive body is accomplished by the initiative detonation of a very small portion of the mass; this is the case even if the material is arranged in the form of a train of considerable length, the detonating fuse being applied at one extremity. Rows of gun-cotton disks from 3 to 5 feet in length, with intervals of 0·5 inch and 1 inch between the individual masses, have been detonated in this way. There is, however, a limit to the distance to which a detonation will be transmitted along a row of spaced disks, the limit being determined by the particular weight of the masses employed; if it be exceeded, those masses which are at the farther extremity will be inflamed and scattered, instead of being detonated. A few preliminary experiments have been made with the view of determining, by means of the chronoscope, the rapidity with which detonation progresses along a row of gun-cotton disks. This will no doubt vary with the sizes of the masses; in an experiment with disks weighing 2 ounces each, placed in a row without intervals, it was found that the detonation extended to 3 feet in about 1-5000th part of a second.

Time will not permit of the discussion of many other points of scientific interest connected with the detonation of compressed gun-cotton and of other explosive agents, but it will probably prove interesting if a few illustrations are furnished, in conclusion, of the practical value of this mode of developing the force of explosive agents.

The necessity for confining gunpowder and other explosive materials in strong receptacles, for the purpose of developing their explosive force, is greatly reduced, and is, indeed, entirely dispensed with in the case of charges fired under water, when detonating fuses are used as the exploding agents. Thus, if a quantity of gunpowder which, when enclosed in a strong iron receptacle, will be completely exploded, producing a particular destructive effect when fired in the ordinary way, is confined in a thin glass vessel, or in a bag of waterproof material, the receptacle will be burst open upon the first ignition of the charge, and a large amount of the powder will be dispersed in the water; but if a detonating fuse be employed to fire the charge contained in the thin envelope, the powder will be completely exploded, the destructive effect produced being at least as great as that of the charge fired in the strong vessel by the ordinary method. This result is of very great importance, because, in employing submerged charges of gunpowder or other explosive agents for purposes of demolition, or as submarine mines for war-purposes, it is no longer necessary to use very strong and cumbrous receptacles for the purpose of obtaining the desired result; their strength need only be sufficient to insure the perfect exclusion by them of water from the charge at the depth of immersion at which it has been employed. In the recent demolition of the wreck of the "Golden Fleece," off Cardiff, by the Royal Engineers, large charges (500 lbs.) of gunpowder were simply enclosed in waterproof bags and exploded with detonating fuses. The results produced with these were quite equal to those obtained with similar charges enclosed in strong iron cases.

Masses of hard material, of great size or strength, such as blocks of hard rock, large iron castings, or thick bars of wrought-iron, may be broken up by simply placing upon one of their surfaces a comparatively small charge, quite unconfined, of compressed gun-cotton, or of a nitro-glycerine preparation, and exploding it by means of a detonating fuse. In such operations it is obvious that the destructive effect of the detonation will be increased by covering the charge to be exploded by sand or other material, which will act as tamping; but, in hurried operations, results may be obtained with either of the materials specified, by detonating them when freely exposed to air, which could not

have been produced by previously known modes of using explosive materials. The demolition of stockades, bridges, and other structures, which it may be desirable to destroy or render useless as expeditiously as possible, in the course of military operations, may also be effected with much greater ease, rapidity, and certainty, by the aid of detonation, than by the old method of operation; and the ease and safety with which compressed gun-cotton may be applied to these purposes has been demonstrated by numerous experiments instituted by the Royal Engineers. In mining and quarrying operations, the process of hard tamping which is indispensable in connection with the ordinary method of blasting, may be dispensed with by application of gun-cotton and of nitro-glycerine preparations, which are more readily exploded, with full destructive effect, by detonation, than other explosive materials at present known. A laborious and often very hazardous operation may thus be dispensed with.

For the hasty demolition of buildings, and of military work, such as casemates, magazines, or forts, the explosion by detonation affords most important facilities, reducing the difficulties, danger, and cost of such operation to a minimum. Some results obtained in this direction by the Royal Engineers with compressed gun-cotton may be quoted in illustration of this. It was desired to destroy a counterscarp gallery (forming part of the old works at Portsmouth), which was 250 feet long, and 7 feet wide. Its front wall was from 5 feet to 5 feet 9 inches thick, and was pierced with nineteen loopholes. It was roofed over by an arch 18 inches thick (from over which the earth had been removed), and its total internal height was 7 feet 4 inches. At either end there was an opening, closed by a wooden door, which was protected by an iron grating composed of one-inch bars, 4 inches apart. It was proposed to submit this counterscarp to a succession of small experiments, and, in the absence of any experience of the effects of gun-cotton applied in the interior of a building, it was decided to suspend 60 lbs. against the wall, under the haunch of the arch, placing them in three charges near one extremity of the gallery. The simultaneous detonation of these charges accomplished the destruction of about 140 feet of the gallery—about 114 feet being actually demolished. But this was only part of the damage produced. The violent concussion at the other end of the gallery, where the column of gas was checked in its escape, occasioned the destruction of about 80 feet of this part of the counterscarp, and the bars of the iron grating, by which the exit was closed, were bent and twisted into fantastic shapes, and hurled to a distance of about 60 yards. This long gallery was thus rendered entirely useless, and the greater part of it destroyed, by the detonation of 60 lbs. of compressed gun-cotton; and there is little doubt that, had the same quantity been lodged in the centre instead of at one end, the gallery would have been completely demolished.

Another illustration of the simple, rapid, and effectual manner in which the demolition of structures of great strength may be accomplished by the detonation of compressed gun-cotton, was furnished by the destruction of a Martello tower near Rye. This structure, of circular form, was built of brick, the wall being 12 feet thick on the sea side, and tapering to 7 feet 6 inches on the land side. It had two window openings, and one door opening, and its cubical contents were 7600 cubic feet. On the basement of this tower 200 lbs. of compressed gun-cotton were placed in three piles, freely exposed, which were arranged to be fired simultaneously. Their explosion caused the upper portion of the tower, with the roof, to rise gently a few feet in the air; the walls turned over, outwards, and the upper part subsided to the ground; the demolition of the tower being most complete, while not a brick was projected 50 yards from the spot. The entire operation was accomplished by two or three persons, within one hour of their appearing upon the ground. A second tower was subsequently demolished with 184 lbs. of gun-cotton, with similar results. It was calculated, from existing data, that at least 1200 lbs. of gunpowder must have been employed to produce similar results.

In this sketch of the recent progress which has been made in the application of explosive substances, many points of interest and importance have unavoidably been passed over; sufficient, however, will have been said to show not only that the production and utilisation of these powerful agents of destruction, and these indispensable auxiliaries in the development of industrial resources, have been advanced in an unprecedented manner within the last few years, but also that very much remains to be learned regarding their nature and operation and the conditions to be fulfilled in their most efficient application in many important directions.

NOTES FROM THE INTERNATIONAL EXHIBITION OF 1871.

(Concluded from p. 142).

Who has not asked the question—What is ozokerit? Written on the knife-board of omnibuses—staring from street corners and hoardings, even on the back of one's programme at concert or the theatre, was ever present the one word—ozokerit. But the mystery has this some time been cleared up satisfactorily; the more so as the production of ozokerit appears to open an extensive industry in the view, that for India and other hot climates, a candle having a high melting-point, and manufactured at a lower price than wax, is an absolute necessity. Ozokerit in candle manufacture seems to be offering formidable competition to paraffin. It exists in considerable deposits in Galicia, Hungary, and in Russia. In the latter country crude candles were manufactured out of the native material for the use of the miners; but it is only within the last year that it has been successfully dealt with by Messrs. J. C. and J. Field, who exhibit a series of specimens (7465-67) of native ozokerit, of the refined material, of candles, and other products obtained from this remarkable mineral. Native ozokerit is of a waxy consistency and foliated structure, varying in colour from pale yellow to dark brown, with sometimes a green tinge, and containing 85·75 per cent of carbon, and 15·15 per cent of hydrogen. It also contains a natural oil (7465) applicable to illuminating purposes. For the manufacture of candles the mineral is first carefully distilled, the product being mixed with an oil and formed into cakes under powerful pressure. These cakes are treated with sulphuric acid to remove the last traces of oil, and the melted material washed and filtered through animal charcoal. Candles made from this pure ozokerit have a melting-point between 59° to 61° C., and greater illuminating power than any other candle known. Professor T. C. A. Brock, of Denmark (7626), exhibits some stearic acid, the result of a new process of manufacture; but no details are given.

We now come to the consideration of the metals and metallic preparations exhibited. Messrs. Winsor and Newton contribute (7562) a series of pigments of extraordinary beauty prepared from thallium. The specimens include several shades of yellow and orange-red prepared from thallium chromates by the wet way; and green colours, also constituted of thallium and chromium, with a dark brown, a sulphide of thallium. Mr. J. Johnson (7496) exhibits black, grey, brown, and yellow colours prepared by calcining shales at different degrees of heat. These pigments are intended for cheaply coating iron. Messrs. Johnson and Matthey (7495) contribute specimens of magnesium illustrative of the process of manufacture. Magnesium, though classed with the alkaline earths, more closely resembles zinc in its principal properties. Its chief use is as an illuminating agent for photographic or signalling purposes; for the former it is well adapted, the

light being rich in chemical rays. Messrs. Walker, Campbell, and Co. (7428) exhibit specimens of block-tin pipes encased in lead, intended for the conveyance of soft water, which acts corrosively upon lead pipes. This mode of protection is the invention of Mr. Haines. There are also exhibited specimens of lead pipes (7429) coated externally with tin to afford protection from corrosion when laid in damp earth. Mr. J. F. Allen exhibits (7414) a series of alloys of copper with different proportions of manganese, manufactured under his direction at the works of Messrs. Newton, Keats, and Co., of St. Helens. Bergmann appears to have been the first to produce alloys of copper and manganese in 1774, and he describes them as being extremely malleable and ductile. In 1823 numerous experiments were made in Berlin, and in 1826 there were sold, under the general name of "*Weisskupfer*" alloys of copper and zinc containing manganese. Erdmann analysed a teaspoon composed of this alloy, and obtained it from a firm who kept their process secret; it was found to consist of 57·1 per cent of copper, 23·2 of zinc, and 19·7 of manganese. Messrs. Evans and Askin appear to have been the first in this country to manufacture alloys of copper, zinc, and nickel with manganese; and in 1850 Dr. Percy and Mr. Higgin gave much attention to the subject. The difficulty of manufacture laid in the remelting of the alloys, in consequence of the tendency of the manganese to oxidise out; but Mr. J. F. Allen has succeeded in the production on a large scale with greater uniformity than hitherto, and, by dispensing with the use of plumbago crucibles, at a considerably reduced expense. The alloys are produced by heating mixtures of charcoal, cupric oxide, and manganese carbonate in a reverberatory furnace with small coal as fuel. A non-oxidising flame is obtained by employing Siemens's arrangement. The alloys exhibited contain 5 to 25 per cent of manganese. A copper-zinc alloy with 15 per cent of manganese, termed "manganoid," is proposed as a substitute for German silver. Spoons, &c., of this alloy are exhibited, as well as some very tough wire drawn from an alloy containing 23 to 25 per cent of manganese. Alloys of copper and tin with manganese are proposed by Mr. Allen as a gun-metal.

The British Seaweed Company exhibit a complete series (7425) of the products obtained by the distillation of seaweed at their two extensive works in the Hebrides. These works are lighted by the gas obtained from the seaweed. Mr. Stanford's method is of course that employed, and as illustrative of the extent to which it is now worked it may be stated that the following numbers represent the annual production of potassium-salts at the Company's factories:—Carbonate, 600 tons; bicarbonate, 30 tons; chlorate, 50 tons; iodide, 23 tons; and bromide, 12 tons. Besides these products and the illuminating gas, there remains the charcoal, in some instances an excellent substitute for animal charcoal. The cheapness of seaweed charcoal is much in favour of its employment as a deodoriser of offal of all kinds; and Mr. Stanford shows that it can be used in the place of earth in the dry-closet system with great advantage, especially in dealing profitably with the *excreta* of towns. Employing seaweed charcoal as the starting point, he submits the product of the dry closets to distillation, and re-applies the residual charcoal to deodorising purposes. Mr. Stanford exhibits (7547) tar, calcium acetate, ammonia, and ammonium salts, as the marketable products resulting from the distillation. Glasgow is the first to take up the system which has been worked out by Mr. Stanford with such great labour. Crease's "Patent Cleansable Tank Filter," exhibited by Messrs. Burney and Co. (7479), designed for use on board ship, embodies another efficient sanitary application of charcoal.

M. Ludwig Mond exhibits specimens (7513 and 7628) of the products of the utilisation of alkali waste. M. Mond brought his present process into practice in 1863, and it is now that adopted for recovering the sulphate in most of the German and in two of the largest French works. The process consists in at once submitting the waste, in the same tanks in which the separation of alkali by lixiviation has been accomplished, to successive treatments with air, and lixiviations for the removal of the resulting soluble sulphur-compounds. After the soda-liquor has been drawn off from the residuum, air is made to penetrate the latter by being forced through perforations in the false bottom of the tank. The residue is then lixiviated, the extract or sulphur liquor containing principally calcium hyposulphite, bisulphide, sulphydrate. When sufficiently concentrated, the liquor is mixed with chlorhydric acid to precipitate the sulphur, no sulphuretted hydrogen being evolved, because the liquor contains an excess of calcium hyposulphite. The precipitated sulphur is then transferred to iron vessels, in which it is melted by injected steam. M. Mond exhibits a diagram of the arrangement in actual use for extracting sulphur from 300 tons of alkali waste weekly. This exhibitor also contributes a model (7602) of a simple form of furnace, devised by MM. Helbig and Horsenclever, for effecting the roasting of ores by a continuous operation, which is accomplished through the agency of an inclined plane, or of several such planes, inclosed in the furnace. These planes are fixed at the natural angle presented by the sides of a heap of ore, which descends gradually and regularly as the material is removed from the bottom of the furnace. These furnaces are especially adapted for the roasting of small ore, and are now advantageously employed for this purpose in many German works. In some cases they are connected with the roasting furnaces for pyrites and blende, so that the heated gases from these are passed into the sloping furnaces, assisting in the heating.

Few of the inventions are of greater practical importance than the "selenitic mortar" (7519) exhibited by Col. H. Y. D. Scott, C.B., R.E. Some sixteen years ago Col. Scott first noticed the influence of a small proportion of calcium sulphate, or the sulphuric acid it contained, upon the setting qualities of inferior limes. It was found that by intimately mixing as little as 5 per cent of plaster-of-paris with freshly-burned fat lime, the heating upon the addition of water was presented, and the product hardened after a time. The sulphuric acid or calcium sulphate is first mixed with the water to be used in making the plaster or mortar; the lime is then added, and the whole ground to a creamy paste, which is mixed with the requisite proportion of sand for the production of a mortar or plaster. Five or six parts of sand may be used to one of lime for producing rough plaster or mortar, being being nearly double the proportion employed in the ordinary method of mortar-making, when the lime is allowed to slake. The saving is therefore very considerable. Mr. G. R. Redgrave (7520) exhibits a form of mill adapted to the rapid preparation of selenitic mortar. The only other cement exhibited is a specimen of Portland by Mr. Wedekind (7559) obtained by a new process from Hofmann's kiln; but there are no details afforded.

In the Chemical Stoneware Department Mr. Bailey and Messrs. Doulton and Co. are the only contributors of any importance. Mr. Bailey exhibits some large acid tanks, receivers, condensing worms, and other vessels. Messrs. Doulton and Co. have the finest collection of chemical ware, among which are two acid force-pumps of very superior finish. This firm also excels in the fire-clay department, to which they contribute an enormous plumbago crucible, free from flaws, nearly 6 feet in height, and 4 feet in diameter at the mouth; it is asserted to be capable of melting more than 13,000 lbs. of metal. There is also shown a fine collection of muffles for glass-staining and other purposes. The Patent Plumbago Crucible Company also exhibit a most valuable and interesting assortment of crucibles, assay pots, &c.

The conclusion must now be drawn, for we have considered nearly all the chemical products exhibited, and it will be seen that certainly the results of this year's exhibition must be judged not by the number, but by the intrinsic worth of the inventions.

CORRESPONDENCE.

ALUM IN BREAD.

To the Editor of the Chemical News.

Sir,—I had occasion some few months since to determine the purity of a number of samples of bread, and among other experiments was used the test mentioned by Dr. Moffat in his Glasgow Lecture, and referred to by Mr. Horsley in your last issue.

Some of the specimens gave a purple colour very quickly, but the majority gave a fine blue, several of them within a little time after application of the solution, whilst in others the colour only became developed after an interval of several hours, or on standing over night.

Experimental specimens of flour and of bread, to which alum had been purposely added, gave in each case a purple colour.

I am quite unable to assign any practical value at present to these results, for I have not further examined them. It may, however, be as well to note that all the blue specimens contained potatoes, and that a drop or two of logwood solution gave a blue colour to the ordinary water of the town, which contains a trace of iron, and to this also, possibly to the earthy salts, I presume the change of colour in the water is due; whether any similar influence is exercised by the test over water and salts in the loaf I am unable to state.

So far as my personal knowledge goes, these logwood tests for determining the presence or absence of alum in bread and flour are by no means quite satisfactory.—I am, &c.

Richard Weaver.

Leicester, Sept. 20, 1871.

RING VORTICES IN WATER.

To the Editor of the Chemical News.

Sir,—In the note I addressed to you on the 5th of August last, as a postscript to my paper on the above subject, which was published in your issue of the 4th of August last, I referred to the previous labours of Mr. Charles Tomlinson, as described by him in the *Philosophical Magazine* for 1864. Mr. Tomlinson in those papers refers to the still earlier labours of Professor W. B. Rogers, of Boston, U.S., as described by him in the *American Journal of Science* for September, 1858. After some trouble, I have procured a copy of this journal, and it is now before me. Professor Rogers has done so much, and that so well, as regards these rings themselves, that I venture to ask you to reproduce some of his remarks and figures.

He does not allude to the secondary rings or discs, nor to the currents caused by the passage of the rings through the fluid, and as these secondary phenomena, *i.e.*, the "tendency to form from merely straight currents structures at intervals in planes at right angles to the currents," have been suggested by me as probably throwing light on the formation of clouds in strata, I have also to ask you to reproduce a communication from a friend, with whom I have often discussed the question as to why clouds floated in strata, who is conversant with many of the effects of cloud perspective, and who saw, I think, in actual progress, the phenomenon of a stratum of cloud giving out a column or currrent, and the conversion of that current into another stratum. My friend's communication was written to me before he had heard of any of the experiments now noticed. At our last disscusion on cloud strata he had related this circumstance to me, and when I saw the rings and their sequels, his account at once came to my remembrance, and, without telling him for what purpose I required it, I asked him to put in writing his recollection of the facts. Professor Rogers' most characteristic sketches are, I think, the following:—Fig. 1, the commencement of a smoke ring, and Fig. 2 the section of "a continuous and moderate blast." He gives no drawings of liquid rings, but describes very suitable apparatus for their production, and traces most clearly the resemblance between the two classes of phenomena. The remarks of his to which I attach most force are perhaps the following, but it is not an easy task to avoid much fuller quotations. Speaking of smoke rings, "we observe the ring to be made up of a coil of cloudy air—between the folds of which is rolled up a similar coil of transparent atmosphere," Fig. 1. Referring to his figure reproduced in Fig. 2, "They (the regular alternations) at least furnish conclusive proof that even a large stream of gas discharged under steady pressure does not flow with continuous uniformity, but becomes the seat of periodical movements at equally recurring intervals." Speaking of a liquid ring, "It is thus identical with the rotation of a gas ring impelled in a descending direction." "The liquid ring, moreover, resembles that of gas in being composed of a coil of coloured fluid enfolding a parallel uncoloured coil." Too long for extract is the account of Professor Rogers's experiments in producing smoke rings from soap bubbles filled with smoke by piercing the bubble in various positions, and expelling its contents through this opening by means of the contraction of the bubble film. In fine, simply regarding the experimental formation of the rings, Professor Rogers has left little undone. Mr. Charles Tomlinson has shown that various effects result when dissimilar liquids are used. I have tried to show the alliance of this kind of phenomena to all cases of fluids in motion, when one part of the mass moves with a different velocity to the rest. To this mode of motion I attribute many chemical results now attributed to "diffusion." If chemists will repeat these experiments and consider what must happen when fluids are acting on each other, I think (at all events amongst technical chemists, the body to which I belong), "diffusion" will diminish in importance and mechanical action, *i.e.*, mode of motion will take its place.

Fig. 1.

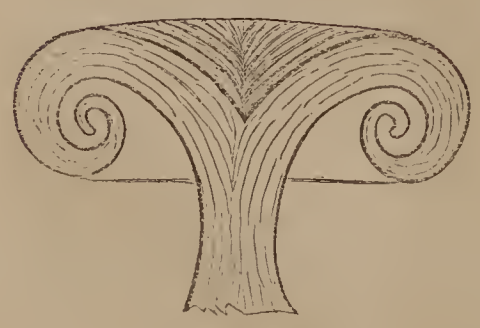


Fig. 2.

I annex my friend's letter.—I am, &c.,

Henry Deacon.

Widnes, September 4, 1871.

Copy of Letter from Mr. Samuel Hall to Mr. Henry Deacon.

"41, Barnsbury Street, London, N.
"August 1, 1871.

"It was about this time of year 1869 that I saw the cloud in the act of transferring itself from one strata of

the air to a higher one. The centre of the cloud was about two or three miles north of Lausanne, on the Lake of Geneva, no mountains sufficiently near to interfere with the process. Time about 11 a.m., a fine day, with a few clouds, which eventually disappeared. The cloud particularly noticed was a cumulo-stratus, say, two or three miles long, and floating from 3000 to 4000 feet above the surface of the ground. When first seen there was a kind of pillar of cloud rising rapidly from the centre of the mass. This took my attention, and I observed it for a few minutes. The pillar seemed to stop rising almost immediately after I commenced looking, and there accumulated a denser head, which began spreading itself out horizontally.

"Unfortunately, owing to the direction of our walk, our backs were turned to the cloud, and my companion was not particularly interested in it. However, from time to time I turned and watched it till in about half an hour I should think, but am uncertain with regard to this, it had assumed the shape of a dumb-bell with very flattened heads, at least half the cloud having attained the higher level, which I should very roughly estimate at another 4000 feet.

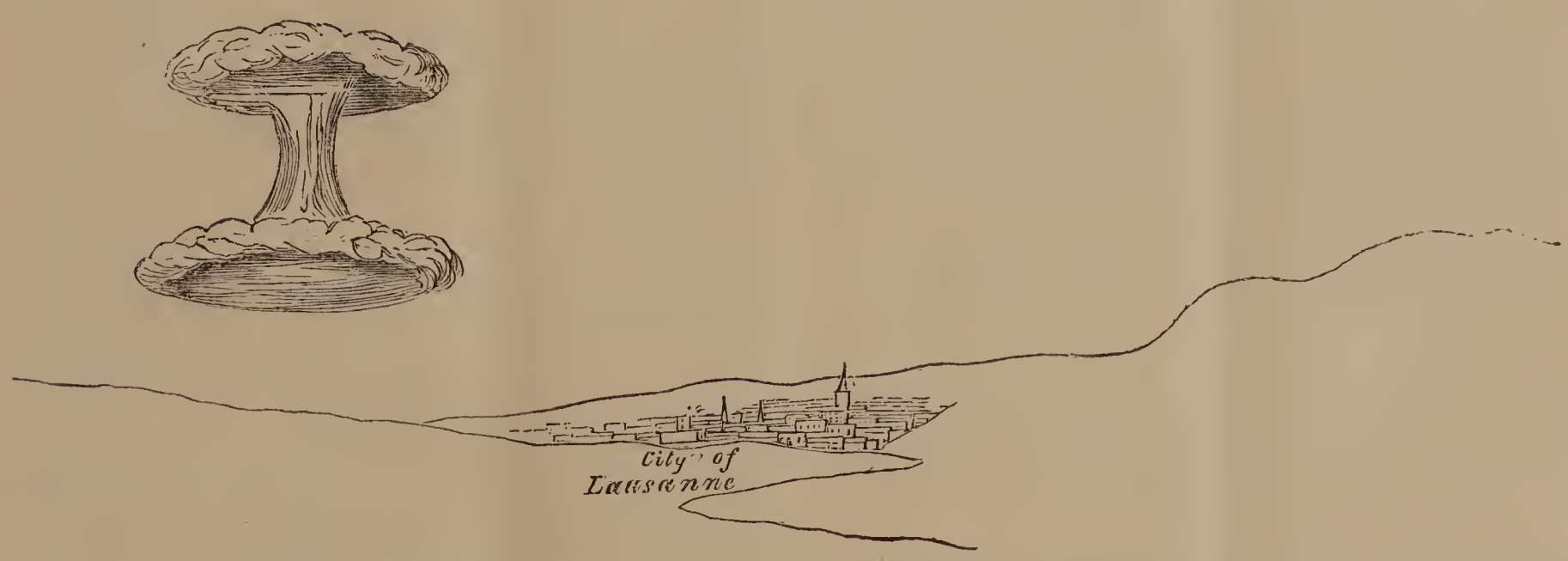
"I will just add that, although there was no mem. taken at the time, I have no doubt of the general accuracy of this description; also that perspective could not have deceived me very much. Though looked for, I could not detect any twisting motion in the ascending pillar."

"(Signed) Samuel Hall.

"The accompanying are rough sketches of first and last appearance.

Fig. 3. (As first seen).

Fig. 4. (As last seen).



MAGNETIC MOTIVE POWER.

To the Editor of the Chemical News.

Sir,—In the postcript to my letter last week, by some clerical or other error, the numbers were given incorrectly. I intended to write that 1,199,700 foot-pounds of work were produced by 7 ounces (avoirdupois) of iron.

It may be satisfactory to describe how the figures were obtained. Two electro-magnets fixed on an axle were made by commutators to rotate in front of a fixed electro-magnet. Revolving fans were placed on the axis, which, by the resistance of the air, reduced the speed to an average of 93 revolutions a minute. When the electrical current was cut off, it was found that a weight of 86 pounds fastened by a cord to an axle one inch in diameter, produced and sustained the same rate of revolution; in ten hours, seven ounces of iron were consumed, so that my calculations were purposely kept below the mark in order to be on the safe side.

The result was verified and confirmed by making the negative power, when the fans were removed, raise at the same rate of revolution six pounds fastened by a cord to an axle of one foot diameter, in addition to the friction.

The potential of the battery was about $\frac{7}{8}$ths that of a Grove. Joule calculates the utmost *possible* force of a grain of zinc in a Grove battery at 267 foot-pounds, and the utmost *practicable*, half that, or 134 *foot-pounds*. *Here* the work of a grain of iron was at least 388 *foot-pounds*, and any one acquainted with the subject must see that with this primitive apparatus only a small part of the power of the current could be utilised.

Mr. Slater encouraged and convinced by the result, is now engaged in the construction of a larger engine, fitted for practical work, and made in a more workmanlike and scientific manner, with numerous magnets instead of only three. Having spent a large part of his life, and hundreds, or even thousands, of pounds in experimenting on the best construction of magnets and best methods of

utilising electric power, he has at last attained a result which is practically most important. His practical acumen and experience always convinced him of the error of Joule's views, and proved to him that there was sufficient power resident in electro-magnets to make an economical motive power, if he could but devise a means of getting it out.—I am, &c.,

H. Highton.

2, The Cedars, Putney,
Sept. 25, 1871.

VALENCY OR ATOMICITY.

To the Editor of the Chemical News.

Sir,—There is perhaps no doctrine of modern chemistry that has been more fully examined or discussed than "Valency" or "Atomicity," and yet it must be admitted that the proper rank of several important elements in the scale of equivalency is still undetermined.

If we take, for example, nitrogen, N, we find that in ammonia, H_3N, it is trivalent, although in nitric oxide, NO, it is divalent, corresponding to O, which is usually regarded as a dyad.

Then again, carbon, C, in carbonic acid, CO_2, is tetravalent, although in carbonic oxide, CO, it is divalent, assuming, as before, that O has invariably the same valency.

My chief object, however, in this brief communication, is to draw attention to iron, Fe, which is ranked, I believe, by all chemical writers as a divalent element. And if the protoxide, FeO, be taken, the Fe must certainly be viewed as divalent, provided the oxygen with which it is combined be O''. But if instead of FeO, we select the sesquioxide, Fe_2O_3, we find that the Fe ought to be trivalent to correspond to O_3.

If we glance, too, at the simple chemical equation—

$$Fe_2O_3+6HCl=Fe_2Cl6+3(H_2O),$$

we find the Fe_2 taking the place of 6H, and consequently the Fe appears, as in the instance of Fe_2O_3, to be a triad rather than a dyad.

As another anomalous example, I would just refer to the bisulphide, FeS_2, for in this compound we have to regard the metal as tetravalent, if S be divalent or S''.

What, then, is the true quantivalence of Fe, and how can it be definitely determined?

This important enquiry I beg to submit to your numerous scientific readers.—I am &c.,

W. H. O.

Mildmay Road, Stoke Newington,
Sept. 20, 1871.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

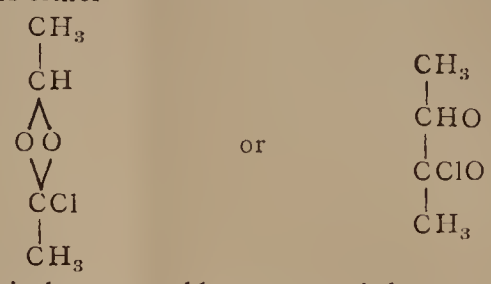
Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, August 28, 1871.

This number contains the following original papers relating to chemistry and collateral sciences:—

Action of Chlorine upon Aldehyde.—A. Wurtz.—Since MM. Krämer and Pinner (*Deutsche Chem. Gesellsch. Berlin*, 1870, p. 383) had contested the accuracy of the author's experiments on the above-named subject (published in the *Annales de Chimie et de Physique*, 3rd series, vol. xlix., p. 58), the author has repeated his former experiments. As before, he has found that there is formed chloride of acetyl and a product, $C_4H_7ClO_2$, boiling at 120°, being the same as that which Maxwell Simpson has found by directly combining aldehyde with chloride of acetyl; although there is no doubt whatever concerning the formation of chloride of acetyl as a product of the action of chlorine upon aldehyde—mixed, however, with perchloride of carbon, in order to lessen the violence of the reaction—there are other by-products formed, of a high boiling-point, which, excepting the compound $C_4H_7ClO_2$, have not been further studied; the constitutional formula of that compound is either—



This compound is decomposed by water, and the manner of its decomposition proves that the formula assigned to this body, by the German *savants* above-named, is not correct—viz., $CH_2ClCOH+CH_3COH$.

Essay on the Use of Divers Alloys, and more especially of Phosphorus-Bronze, for the Casting of Pieces of Ordnance and other Purposes.—Montéfiore-Lévi and Künzel.—This paper is a lengthy abstract from a work published by the authors, and containing the detailed account of an extensive series of experiments made on the large scale on the preparation of various alloys of copper and tin, and the effect produced thereon by the addition of phosphorus in small quantity. It appears, on the whole, that the addition of the element just named is of great value in producing alloys possessed of excellent properties, especially for the manufacture of bronze guns. The Academy has appointed a committee of six of its members, among them MM. Dumas and Frémy, to study this important matter, and report thereon.

Although not belonging to the subjects usually treated of in this periodical, we quote the following paper:—

Note on Geographical Researches Made in the Island of Madagascar during the Years 1865-70.—A. Grandidier.—A very important contribution to the physical geography of an island which appears to have been thoroughly surveyed by the author.

Aëronautic Journey of the Volta Air-Balloon, undertaken on December 2, 1870, for the purpose of a Scientific Mission.—J. Janssen.—This paper contains the very minutely-described account of the author's balloon journey from Paris to Briche-Blanc, Commune de Beuvron, Loire Inférieure, not far from Saint-Nazaire, whence the traveller proceeded by rail to Tours and, *viâ* Bordeaux, to Marseilles, and, farther, by steamer, to Oran, for observation of the last eclipse of the sun. It appears that during this journey several photographs of places and localities over which the balloon passed were taken with great success, so that this mode of obtaining maps of towns and country is at present being experimented on by M. Nadar.

Spectrum Exhibited by Sulphur.—G. Salet.—Notwithstanding the high scientific value of this paper, its contents, including a series of tabulated results, are not suited for abstraction.

Subchloride and Oxychlorides of Silicium.—L. Troost and P. Hautefeuille.—This very lengthy memoir treats, in the first place, on the preparation of the subchloride of silicium, by passing a rapid and continuous current of chlorine gas over silicium at a very high temperature—up to the point of rendering porcelain tubes as soft as wax, a heat at which malleable iron fuses readily,—care being taken to arrange the apparatus in such a manner as to cause the vapours to pass repeatedly over the silicium. The crude product, having been purified, yields the sesqui- or subchloride of silicium in the shape of a very mobile colourless liquid; sp. gr., at 0°=1·58; at −14°, this liquid freezes, and is then very similar to boracic acid; at 146°, the liquid boils; its vapour density at 239°=9·7; heated in contact with air, the vapour of this body inflames spontaneously. This substance is curiously enough, only stable at temperatures below 350° or above 1000°, but is dissociated very rapidly, especially at temperatures between 440° and 800°; the formula of this body is Si_4Cl_6. Protochloride of silicium is also a liquid, of which the boiling-point, density, and vapour density are difficultly ascertained, on account of its retaining oxychlorides of silicium. Of these last-named bodies, the authors have found no less than five, having all a different composition:—The first is a liquid, boiling at from 152° to 154°; formula, $Si_4O_3Cl_5$. The second, also a liquid, boils at 200°; vapour density, 15·9; formula, $Si_8O_8Cl_8$. The third, a liquid, boiling at 300°; centesimal formula, $Si_4O_6Cl_2$; formula, deducted from vapour density =28·2, $Si_{15}O_{20}Cl_{12}$. The fourth, an oily liquid, which becomes pasty at below 0°, and boils at 400°; formula, $Si_4O_6Cl_2$. The fifth, a solid body, not fused at 440°, soluble in the preceding bodies; formula, Si_4O_7Cl. The last portion of this memoir treats on the oxychlorides of boron, titanium, and zirconium.

On Nitro-Ethal, Nitro-Glycol, and the General Method of Converting Alcohols into Corresponding Nitric Ethers.—P. Champion.—Nitro-ethal is formed by the action of nitro-sulphuric acids upon previously-pulverised ethal gradually introduced into the acid liquid; the product is purified by dissolving it in ether, and washing this solution with water. Nitro-ethal is a liquid, soluble in ether, but hardly so in alcohol and water; at between 10° and 12°, it becomes solid and crystalline; the sp. gr. of the liquid=0·91; its formula is $C_{32}H_{33}(NO_4)$. A high temperature decomposes this substance, a carbonaceous residue being left. When put upon a piece of very hot sheet-iron, nitro-ethal takes fire, assumes at the same time the spheroidal state, and burns off with a sooty flame. Nitro-glycol is prepared by the action of nitro-sulphuric acids upon glycol in the same manner as nitro-glycerine. The former-named body is a fluid, sp. gr. =1·48, insoluble in water, very soluble in alcohol and ether, and detonating violently by percussion but not by the action of a high

temperature. Nitro-glycol is poisonous, and exhibits, when taken internally, symptoms akin to those produced by nitro-glycerine. By careful manipulation, and especially by applying lower temperatures to the acid mixture alluded to, the author has been enabled to prepare, rom a series of alcohols, nitric ethers.

Journal für Praktische Chemie, Nos. 11 and 12 (double number), 1871.

The following original papers are contained in this number:—

Contribution to our Knowledge of Hyponitric Acid and Nitrous Acid.—Dr. C. W. Hasenbach.—The leading points of this exhaustive essay, illustrated by woodcuts, may be summarised as follows:—Nylander's idea, that a peculiar and isomeric hyponitric acid is formed when arsenious acid is oxidised by the aid of nitric acid (sp. gr., 1·33), is not correct, the fact being that either a mixture of nitrous and hyponitric acids, or the latter only, is formed, this being dependent upon the degree of concentration of the nitric acid employed. Hyponitric acid and deutoxide of nitrogen combine together at a high temperature, forming chemically-pure nitric acid; hyponitric acid and chlorine yield, under similar conditions, the chloride of nitric acid; bromide of nitric acid cannot thus be obtained in pure state, since the combination is destroyed by boiling; iodine and hyponitric acid do not combine at a high temperature; cyanogen and hyponitric acid form at a high temperature a most violently-explosive compound, probably the cyanide of nitric acid; the compounds of hyponitric acid with chlorine, bromine, and cyanogen are not formed at all, or only to a very limited extent, at a lower temperature: nitrous acid and oxygen combine even at the ordinary temperature of the atmosphere, forming hyponitric acid; carbonic oxide and sulphurous acid combine at a comparatively low temperature, forming compounds which have not been further investigated; benzol is not directly nitrated by hyponitric acid unless aided by sulphuric acid, in which case nitrobenzol is formed. The author prepares hyponitric acid in large quantity by treating nitric acid (sp. gr., from 1·38 to 1·40) with small lumps of arsenious acid of the size of peas, heat being applied and a good condenser. Through the dark green coloured liquid collected in the receiver (a mixture of nitrous and hyponitric acids) a current of oxygen or atmospheric air is passed, in order to convert the nitrous acid into hyponitric acid, after which the liquid is rectified by carefully conducted distillation. The molecular formula of liquid hyponitric acid is—

$$\left\{\begin{matrix} NO_2 \\ NO_2 \end{matrix}\right.,$$

but that of the vapour above 100° is NO_2.

On Sulphur Compounds.—Dr. E. Drechsel.—Owing to the large number and complexity of the formulæ required for the due understanding of the contents of this valuable essay, it is not well suited for abstraction.

Conversion of Formic Acid into Methylic Alcohol.—A. Lieben and A. Rossi.—From formiate of lime, formylic aldehyde was obtained by distillation; the crude product of this operation was rectified, and treated with sodium amalgam, and then again submitted to fractional distillation. The liquid resulting from that operation, being treated with caustic potassa, yielded a fluid which was by further rectification found to be identical in every respect with methylic alcohol; 250 grms. of formiate of lime yielded about 4 grms. of the alcohol.

On Monobenzyl-Urea.—S. Canizzaro.—Among the products of the reaction between benzylic chloride and cyanide of potassium, the author found, in addition to dibenzyl-urea (a solid body), also another compound, which is rather soluble in water and alcohol, but best in ether. This substance is, in the pure state, a solid crystalline body, fusing at 147°; heated to 200°, ammonia is given off, and dibenzyl-urea. The formula of the monobenzyl-urea is—

$$CO\left\{\begin{matrix} NH_2 \\ NH.C_7H_7 \end{matrix}\right.$$

Preliminary Notice on a New Method for Forming Hydrocarbons.—F. Pfankuch.

On Sulpho- and Cyanoform.—F. Pfankuch.—By causing sulphur to act upon iodoform contained in a sealed tube, the author has obtained a compound, $C_2H_2S_3$. By experimenting with iodoform and mercuric cyanide, the author obtained a body which is to be considered as the double salt of cyanoform with iodide of mercury; formula—

$$[CH(CN)_3]_2[HgI_2]_3.$$

On Sulphur Ethyls.—M. Müller.—Preliminary notice.

Gases Occluded in Coal.—E. Meyer.—Preliminary notice; reserved for full translation.

Action of the Hydracids upon the Alkaloids of the Cinchona Group.—W. Zorn.—Preliminary notice.

Products Obtained by the Electrolysis of Acetate of Potassa.—Drs. T. Kempf and H. Kolbe.—Twenty-two years ago, Dr. Kolbe proved that the chief products of the electrolysis of a concentrated solution of acetate of potassa were carbonic acid and methyl-gas; resuming these experiments, the authors now find that, by the process alluded to, also ethylen, acetate, formiate, and carbonate of methyl are formed, and a substance which as yet has not been further investigated.

Action of Ethylen Iodide upon Acetylide of Copper.—E. Carstanjen and A. Schertel.—Prelimary notice; a remark which also applies to the following, as well as to some of the foregoing, papers, all of which are published only in a fragmentary form, the researches they communicate being temporarily discontinued on account of the holidays.

Experiments Made with the View to Prepare a Carbonic Oxide Cyanide, $CO(CN)_2$.—E. Carstanjen and A. Schertel.

Oxidation of the α Naphtyl-Carbonic Acid, $C_{10}H_7.COOH$.—E. Carstanjen and A. Schertel.

Synthesis by Nascent Formic Acid.—E. Carstanjen and A. Schertel.

On Chloraceton and Cyanaceton.—L. Glutz and E. Fischer.

On Simple Chlorinated Chlorethyl.—W. Wolters.

On some Chromium Compounds.—J. Heintze.

Action of Potassium Sulphydrate upon Chlorbenzoyl.—A. Weddige.

New Derivatives from Chloride of Carbon.—K. Hoch and H. Kolbe.

Decomposition of Grape Sugar by Oxide of Copper in Alkaline Solution.—A. Claus.—We regret that the length of this highly valuable monograph prevents any other quotation than the title.

Zeitschrift für Chemie von Beilstein, No. 9, 1871.

This number contains the following original papers and memoirs:—

Contribution to our Knowledge on the Quintanes (Quintane).—M. Lwow.—This paper records some experiments made with the view of obtaining by synthesis a normal quintane—

$$CH_3—CH_2—CH_2—CH_2—CH_3.$$

Normal iodbutyl and zinc methyl were found not to react upon each other even at a high temperature, but the tertiary iodbutyl, $C(CH_3)_3I$, acts upon zinc methyl at the ordinary temperature; the main result of this reaction was found to be a fluid lighter than water, and of a high boiling-point (polybutylen). The result of the reaction of iodmethylen and zinc ethyl was—$2Zn(C_2H_5)_2+2CH_2I_2=2(C_2H_5)_2+C_2H_4+2ZnI_2$.

Preparation of Methylen Iodide.—J. Bljudcho.—This paper treats on the most advantageous method, and the best proportions, of preparing methylen iodide by the reaction of HI upon chloroform. The result obtained is that the best proportion corresponds to the formula $CHCl_3+4HI$—5 grms. of chloroform to 40 grms. of hydriodic acid, the mixture being heated for twenty-four hours to 130° in a sealed tube.

Miscellaneous Researches.—A. Engelhardt and P. Latschinow.—This lengthy essay is divided into the following sections:—Diphenyl bodies; preparation of diphenyl; diphenyl-sulpho-acid; diphenyl-disulpho-acid; bromated α thymol-sulpho-acid; binitro-thymol from α thymol-sulpho-acid; oxidation of thymol; bromated para-cressol-sulpho-acid; chrysanissic acid; binitro-phthalic acid.

Structure of Chlor-Iod-Propylen.—W. Sorokin.—This paper is not suited for useful abstraction, as it requires a large number of complex formulæ; an observation which also applies to the two following papers:—

Structure of Ethylen.—W. Kriwaxin.

So-Called Dichloraceton.—W. Kriwaxin.

Decomposition of Ethylen Bromide by Water.—W. Kriwaxin.—This paper contains the results of some experiments made with the view to prove that Carius's experiments (*Ann. Chem. Pharm.*, cxxx., 172), according to which $C_2H_4Br_2$ and H_2O yield, at from 150° to 160°, aldehyde and HBr, are wrong, since the substance taken by him for aldehyde-ammonia is only bromide of ammonium.

Hydrocarbon, C_7H_{14}, and its Derivatives.—W. Markownikow.—The hydrocarbon alluded to has at 14° a sp. gr. of 0·6985; vapour density, 3·387; colourless, very mobile fluid. Pseudo-heptylen (C_7H_{14}) combines readily with iodine and bromine, but the bromide ($C_7H_{14}.HBr$) is decomposed by water at 100°, yielding some pseudo-heptyl-alcohol, a fluid which exhibits a camphor-like smell, is not solidified at −20°, and by many of its reactions is split up into C_7H_{14} and H_2O.

Preliminary Communication on the Products of Oxidation of Dichlorhydrine.—W. Markownikow.—By treating a pure dichlorhydrine, boiling at a fixed temperature, with an oxidising mixture ($K_2Cr_2O_7$ and H_2SO_4), the author obtained a substance which formed with bisulphite of soda a solid crystalline compound—

$$C_3H_4Cl_2O.SO_3HNa.$$

Dichloraceton has been consequently formed, and the formula of dichlorhydrin is, therefore, $CH_3Cl—CH(OH)—CH_2Cl$.

On some of the Derivatives of Ortho-Toluidine.—E. Wroblevsky.—This essay contains the following sections:—Tribrom-ortho-toluidine; tribrom-toluol; dibrom-aceto-ortho-toluidine; dibrom-toluidine; dibrom-toluol; nitro-dibrom-toluol.

Properties of Trimethyl-Carbinol.—A. Butlerow.—Perfectly anhydrous trimethyl-carbinol is a solid body, rhombo-prismatic crystalline, fuses at 25°, attracts water and dissolves therein, boils at 82·5°; sp. gr., at 30°=0·7788, at 0°=0·8075. Trimethyl-carbinol hydrate, $2C_4H_{10}O+H_2O$, is fluid at 0°, boils at 80°; sp. gr., at 0°=0·827.

Triethyl-Carbinol.—A. Nahapetian.—The substance just named, prepared from propionic acid chloride and zinc ethyl, is fluid even at −20°, has a camphor-like smell, and is almost insoluble in water; sp. gr., at 0°=0·8593.

Dimethyl-Pseudo-Propyl-Carbinol.—J. Prianichnikow.—The body just mentioned is a fluid boiling at 112° to 113°, soluble in water, freezes at −35°; sp. gr., at 0°=0·8364; by oxidation, it yields aceton and some acetic acid.

On a New Amylen.—M. Ermolaien.—The iodide of dimethyl-ethyl-carbinol yields, when decomposed with alcoholic solution of caustic potassa, the amylen here alluded to, according to the following formula, the reaction requiring no heat and separation of a fluid:—

$$C_5H_{10}=C(\overset{II}{CH}.\overset{I}{CH_3}).\overset{I}{CH_3}.CH_3,\text{ or } C.\overset{II}{CH_2}.\overset{I}{CH_3}(CH_2.CH_3).$$

The amylen combines with bromine.

Platin Cyanide and Tartrates of Glucinum.—F. Toczynski.—This exhaustive memoir is divided into the following sections:—On glucina and its reactions; cyanogen compounds of glucinum; tartrates of glucinum.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, June, 1871.

This number contains no original papers relating to chemistry or allied sciences.

Les Mondes, August 31, 1871.

Among the original matter contained in this number we notice the following:—

Sand and Clay.—Dr. Choyer.—A lengthy but interesting geological essay.

Conduction of Heat.—Rev. Laborde.—This paper treats on some phenomena observed by the author while directing a blowpipe flame on the surface, as well as on jets, of water; and on some practically useful conclusions to be deduced from his experiments.

Pressure Exerted by the Gases Generated by the Explosion of Gunpowder.—Captain Noble.—A very important essay on this subject; also containing a good account of the various labours of different authors who, since De la Hire (1702) first sought to explain the action of gunpowder, have treated on this subject up to the present day.

American Journal of Pharmacy, September, 1871.

The original papers contained in this number only bear upon subjects specially relating to pharmacy and pharmacognosy.

La Revue des Scientifique de la France et de l'Etranger, September 9, 1871.

This number does not contain any original papers relating to chemistry or allied sciences.

NOTES AND QUERIES.

Soda from Cryolite.—(Reply to W. F. Catcheside.")—The process is very completely and accurately described, and if you work carefully you will certainly be able to obtain the results precisely as stated; supposing any cryolite to be imported, it is more likely to find its way to either Liverpool, Glasgow, or Newcastle-upon-Tyne than to London.

Test for Nitric Acid.—(Reply to "Chemicus.")—Take a freshly-made cold saturated solution of pure sulphate of iron in distilled water, and pour some of this solution into a test-glass, and add slowly an equal bulk of the sulphuric acid to be tested for nitrous compounds, taking care to let the acid flow slowly and gradually along the side of the glass into the sulphate of iron solution. After having been left standing for some time (a few hours at least) there ought not to appear between the two layers of the fluids a brownish coloured film; if such appears, the sulphuric acid is contaminated with nitrous compounds. Sulphate of aniline—made *extempore* by adding five drops of aniline to 25 c.c. of pure dilute sulphuric acid (sp. gr. $=1{\cdot}113$ to $1{\cdot}117=$ $=13$ per cent strong acid), and stirring the two liquids until the solution is complete—is cautiously added in a quantity of $\frac{1}{2}$ c.c. to 1 c.c. of the sulphuric acid to be tested; if the latter contains even a slight trace of nitric acid, a rose red-coloured layer will make its appearance between the fluids

TO CORRESPONDENTS.

M. P. S.—Gesner's work on "Coal-Tar Products" will probably answer your purpose.

R.—Consult Watts's "Dictionary of Chemistry."

T. W.—This correspondent wishes to know—(1) Extent and price of Dr. Gladstone's lecture on "Theology and Natural Science." (2) Where Dr. Moffat's lecture on "Alum in Bread" is published. (3) If Dr. Frankland's "Lecture Notes" vol. ii. (Organic Chemistry), is published yet.

A. Keiffenheim and Co.—We will supply the information next week.

PRACTICAL CHEMISTRY.

Laboratory, 60, Gower Street, Bedford Square, W.C.

Mr. Henry Matthews, F.C.S., is prepared to give Instruction in all branches of PRACTICAL CHEMISTRY, particularly in its application to MEDICINE, AGRICULTURE, and COMMERCE.

The Laboratory is open daily, except Saturday, from ten to five o'clock; on Saturday, from ten till one o'clock.

Mr. Matthews is also prepared to undertake ANALYSES of every description.

For Particulars and Prospectuses, apply to Mr. Henry Matthews, the Laboratory, 60, Gower Street, Bedford Square, W.C.

Methylated Spirits.—David Smith Kidd, Licensed Maker, Commercial Street, Shoreditch, N.E. Also FINISH, FUSEL OIL, and RECT. NAPHTHA.

BERNERS COLLEGE of CHEMISTRY.—EXPERIMENTAL MILITARY and NAVAL SCIENCES, under the direction of Professor E. V. GARDNER, F.E.S., &c.: of the late Royal Polytechnic Institution and the Royal Naval College.

The Laboratory and Class Rooms are open daily.

Especial facilities for persons preparing for Government and other examinations.

Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

For particulars, &c., apply to Prof. E. V. G., 44, Berners-street, W.

ANALYTICAL LABORATORY AND SCHOOL OF TECHNICAL CHEMISTRY.

7 and 9, HACKIN'S HEY, LIVERPOOL.

Conducted by A. NORMAN TATE, Analytical and Consulting Chemist, and Chemical Engineer.

Established for Educational Purposes connected with Chemistry in its practical Applications to Manufactures, Commerce, &c.; for the performance of Analyses, Assays, and Chemical Investigations; and for affording information respecting the construction, &c., of Chemical Manufactories, and the conduct of Chemical Manufacturing Processes.

The Course of Instruction, in addition to the ordinary Chemical studies, comprises, as far as possible, all such other subjects as are necessary to give the scientific and practical information required in the Arrangement, Construction, and Management of Chemical Manufactories, and in the Application of Chemistry to Industrial Pursuits.

Students' Fees may be known on Application.

Plans, &c., for Chemical Apparatus and Manufactories are supplied, and the Erection of Plant and Buildings is superintended when required.

TECHNICAL EDUCATION.

SCIENCE AND ART DEPARTMENT.

Royal College of Science for Ireland,

STEPHEN'S GREEN, DUBLIN.

SESSION—1871-72.

THIS College supplies, as far as practicable, a complete Course of Instruction in Science applicable to the Industrial Arts, especially those which may be classed broadly under the heads of CHEMICAL MANUFACTURES, MINING, ENGINEERING, and AGRICULTURE.

A Diploma of Associate of the College is granted at the end of the Three Years' Course.

There are Four Royal Scholarships, of the value of £50 each yearly, with Free Education, including Laboratory Instruction, tenable for two years. Two become vacant each year. They are given to Students who have been a year in College. There are also Nine Exhibitions attached to the College, of £50 each, with Free Education and Laboratory Instruction, tenable for three years. Three become vacant each year. These are awarded at the Annual May Examinations of the Science and Art Department.

The Fees are £2 for each Course, or £10 for all the Courses of each year, with the exception of Laboratory.

The Laboratory Fee is £12 for the full Course of nine months, or £2 per month.

SUBJECTS OF INSTRUCTION.

Applied Mathematics, Mechanism and Machinery, Descriptive Geometry, Geometrical, Mechanical, and Engineering Drawing, Experimental Physics, Chemistry (Theoretical and Practical), Botany, Zoology, Geology and Palæontology, Mining, Surveying, Agriculture.

The Laboratory is open for Instruction in Practical Chemistry, Metallurgy, and Assaying, from ten to four o'clock every week-day during the Session, except Saturdays and Holidays.

The Session commences on MONDAY, OCTOBER 2.

Programmes may be obtained on application to the Secretary, Royal College of Science, Stephen's Green, Dublin.

FREDERICK J. SIDNEY, LL.D., Secretary.

Silicates of Soda and Potash in the state of Soluble glass, or in CONCENTRATED SOLUTION of first quality, suited for the manufacture of Soap and other purposes, supplied on best terms by W. GOSSAGE and Sons, Widnes Soapery, Warrington.

London Agents, CLARKE and COSTE, 19 and 20, Water Lane, Tower Street, E.C. who hold stock ready for delivery.

Chloride of Calcium (Purified Muriate of Lime), total insoluble impurities under $\frac{1}{4}$ per cent.

CHLORIDE OF BARIUM (Muriate of Baryta), free from Iron and Lead, total impurities, water excepted, under $\frac{1}{4}$ per cent.

GASKELL, DEACON, & CO.,
ALKALI MANUFACTURERS, WIDNES, LANCASHIRE.

THE CHEMICAL NEWS.

Vol. XXIV. No. 619.

ON THE EXISTENCE OF SULPHUR DICHLORIDE.*

By JOHN DALZIEL and T. E. THORPE.

When dry chlorine in excess is passed through molten sulphur, a dark red fuming liquid slowly distils over. This on renewed distillation commences to boil at about 50° or 60°, and the thermometer slowly rises to 136° or 137°, at which point it remains stationary, and orange-yellow disulphide, Cl_2S_2, passes over. The fraction boiling below 136° frequently amounts to three-fourths of the original quantity of liquid; on again submitting it to distillation, the same order of things is repeated, and but a comparatively small portion distils over 136°. At each distillation the liquid becomes lighter in colour, until at length, by long-continued boiling, it assumes the bright yellow tint of the disulphide, and boils constantly at 136° to 137°. This behaviour would seem to indicate the existence of some compound of chlorine and sulphur which slowly undergoes decomposition on distillation, ultimately forming the disulphide, and the observations of Dumas and Soubeiran, and of Marchand, Davy, and Rose, point to a body richer in chlorine than the disulphide, and their analyses lead to the formula SCl_2. On the other hand, Carius denies the existence of sulphur dichloride in the dark red liquid obtained by heating sulphur in chlorine, and asserts that the compound analysed by Dumas and others was a mixture in atomic proportions of the disulphide with a tetrachloride of sulphur hitherto unisolated, $Cl_2S_2 + SCl_4 = 3Cl_2S$. According to Carius, the amount of chlorine contained in the liquid over and above that required by the formula S_2Cl_2 is altogether dependent on the temperature; but the fact of the protracted distillation required to break up the product into a liquid boiling constantly at 136° to 137° implies, however, that the excess of chlorine is held by some other force than that of mere solution; at the same time we are not altogether without facts more directly indicating the existence of the dichloride. Rose has obtained a compound of this body with the terchloride of arsenic, $2AsCl_3Cl_2S$, and according to Guthrie it yields with the olefines compounds of the general formula $C_nH^n{}_2Cl_2S$. Hübner and Gueront† have lately made an observation, which also tends to support the idea of the existence of this body. A quantity of the pure chloride, S_2Cl_2, was placed in a strong freezing mixture, and a current of dry chlorine passed through it for some time, the excess of this gas (that is, that existing merely in solution) being displaced by a stream of dry carbon-dioxide passed through for three or four hours. Whilst still in the freezing mixture a small quantity of the chloride was withdrawn and analysed, when numbers were obtained exactly agreeing with those required by the formula Cl_2S.

We have repeated this experiment with precisely the same result. A quantity of pure S_2Cl_2 was first prepared; it boiled constantly at 136° to 137°, and was analysed with following results:—

	Calculated.		Found. I.	Found. II.
S_2	64 ..	47·42	— ..	—
Cl_2	71 ..	52·58	52·48 ..	52·67
	135	100·00		

About 20 grms. of this liquid were then saturated with chlorine in the manner described by Hübner and Gueront; after the excess of chlorine had been removed by carbon dioxide, it yielded the following numbers on analysis:—

	Calculated.		Found. I.	Found. II.	Dumas.	H. & G.
S	32	31·07	—	—	31·9	30·5
Cl_2 ..	71	68·93	69·25	69·06	68·1	69·3
	103	100·00			100·0	99·8

The existence of this body would therefore appear to be fully proven, for it is scarcely possible that such an agreement can be the result of an accidental coincidence.

From these experiments, therefore, we draw the same conclusions as those deduced by Hübner and Gueront, viz.—that there exist two compounds of chlorine and sulphur analogous to the oxides of hydrogen. First, a non-volatile chloride, having the formula SCl_2, corresponding to H_2O, which on distillation splits up into chlorine; and the second, chloride, S_2Cl_2, corresponding to peroxide of hydrogen, $2Cl_2S = S_2Cl_2 + Cl_2$.

It will be at once apparent that in one respect the analogy between these chlorides and the oxides of hydrogen is incomplete, in so far that the most stable oxide of hydrogen, is water, into which the dioxide is easily converted by heating, whereas the reverse of this happens with the corresponding sulphur chlorides, the most stable compound being the S_2Cl_2, into which body and free chlorine the SCl_2 is resolved on heating.

* Read before the British Association, Edinburgh Meeting, Section B.

† *Zeitschrift für Chemie*, xv., 1870, 455.

ON THE COMPOSITION OF THE GASES EVOLVED FROM THE BESSEMER CONVERTER DURING THE BLOW.

By GEORGE J. SNELUS,
Associate of the Royal School of Mines.

1. *Design of the Investigation.*

The members of the Iron and Steel Institute will remember that Professor Roscoe, in his lecture on Spectrum Analysis, alluded to the difficulty of determining the cause of the greater part of the lines in the Bessemer spectrum, and pointed out, that while the majority of observers referred them to carbon in some form, there were others who believed them to be mainly due to manganese. Assuming the lines to be due to carbon, it is clear that an analysis of the gas producing the lines would be a step towards solving the difficulty, since it would show us which condition of carbon we must refer them to. This is important because we know that carbon in different gaseous combinations and at different temperatures produce, as Dr. Watts has pointed out, several distinct spectra.

Another question which suggests itself on examining the spectrum is, that supposing the characteristic lines are due to carbon, "How is it that the spectrum of carbon is not seen in the earlier stages of the blow, when an analysis of the metal proves incontestibly that carbon is being burnt in considerable quantities from the commencement?"

It appeared to me that analyses of the gas at different stages of the blow might help to a solution of these problems, for though it is generally assumed that during the process of conversion the carbon of the pig is burnt to carbonic oxide, this, as far as I am aware, has never been *proved* to be the case. It will be seen from the analyses, that this turns out to be only partially true, and that the composition of the gases evolved affords us an insight into the nature of the process going on that could not be supplied by analysis of the metal and slag at successive stages.

2. *Method of Collecting the Gas.*

The gas for analysis was collected by means of a long iron gas-pipe, on the end of which a swan-neck trumpet mouth-piece of fire-clay was fixed, which was inserted in the neck of the converter, after it had been turned up. This generally got clogged up with slag during the experiment, and therefore served only for one trial. It was allowed to dip into the vessel, so as to be certain that no air could be drawn into the tube by induction. To the other end of the pipe glass tubes were attached at particular periods of the blow when the gas was required, and sealed up with the blow-pipe before being removed. A constant stream of gas was allowed to rush through the tube the whole time, and as this was done for two minutes before the first sample of gas was collected, it may be safely assumed that the whole of the air was swept out, and that the gas analysed was a true sample of that produced by the direct action of the blast upon the metal and its constituents.

It was found that during the first part of the blow, the gas would not light at the end of the iron tube, but that from about the commencement of the boil to the end of the blow, it burnt with the pale blue flame characteristic of carbonic oxide.

Samples were taken every two minutes and subjected to analysis with the subjoined results.

3. *Methods of Analysis Employed.*

The gases were analysed in a modified form of the apparatus, described by Professor Frankland, for analysing the gases incident to water analysis, which was found extremely convenient. Samples 3 and 5 were analysed by different methods, the carbonic oxide in one case being estimated by absorption with a hydrochloric solution of subchloride of copper, and in the other by explosion with detonating gas and oxygen, and subsequent absorption by potash, after the method of Bunsen. It will be seen that the results agree closely.

4. *Details of the Analyses of Gas, with Deductions therefrom.*

Sample 1.—This was taken two minutes from the start of a blow which lasted 18 minutes. It contained:—

Carbonic acid	10·71
Oxygen	0·92
Carbonic oxide	none
Hydrogen (not estimated)	88·37
Nitrogen	
	100·00

This I considered to be an unlooked for result, because it is usually assumed that the carbon is burnt directly to carbonic oxide at all stages of the blow. Taking the nitrogen in this sample at 87 per cent, this corresponds to 23·05 vols. of oxygen. 10·71 vols. carbonic acid contain 5·35 vols. carbon vapour, which, referred to air as unity, represent 4·43 parts by weight of carbon. The carbonic acid contains its own volume of oxygen, which deducted from 23·05 leaves 12·34 vols. = 13·62 parts by weight of oxygen to combine with other elements than carbon. Now, ordinary English Bessemer iron contains little else for oxidation than carbon, silicon, and iron; the manganese being usually small in quantity, traces only of the sulphur disappearing, and the phosphorus remaining untouched. Of the three oxidisable elements, it is known from analysis of the slag that the iron is not burnt to any extent till towards the end of the blow, so that we have only to consider the carbon and silicon.

The 13·62 parts of oxygen may, therefore, be assumed to be combining with silicon alone, so that as 32 parts of oxygen unite with 28 silicon, or in the ratio of 8 to 7, we have 11·91 parts silicon being oxidised at this stage, along with 4·43 parts of carbon; thus showing that, though both elements are being oxidised, it is the silicon which is disappearing most quickly. Now this is exactly what analysis of the metal proves, for a charge containing, on running into the converter—

3·57 per cent carbon
2·26 per cent silicon

was found by Mr. Barker in a few minutes to have lost—

0·53 per cent carbon and
1·305 per cent silicon.

As an example of the nature of the gas evolved at a point between the times when this first sample was taken and that obtained two minutes later, I give here analyses made by my friend, W. Thorp, F.C.S., of the Rivers' Commission Laboratory, of two consecutive tubes of gas which I collected four minutes from the commencement of a blow, which, from the converter being new, or the iron cold, lasted 29 minutes:—

	No. 1 tube contained.	No. 2 tube contained.
Carbonic acid	8·940	9·296
Oxygen	0·916	0·113
Carbonic oxide	0·078	0·044
Hydrogen	90·066	90·544
Nitrogen		
	100·000	100·000

Sample 2.—Taken four minutes from commencement; contained:—

Carbonic acid	8·57
Carbonic oxide	3·95
Hydrogen	0·88
Nitrogen	86·58
	100·00

It will be noticed that carbonic oxide is gradually increasing, while carbonic acid is decreasing in quantity.

Sample 3.—Taken six minutes from start; contained—

	By absorption.	By explosion.
Carbonic acid	7·89	8·20
Carbonic oxide	4·65	4·52
Oxygen	absent	absent
Hydrogen	—	2·00
Nitrogen	87·55	85·28
	100·00	100·00

Dissecting these results after the manner of those for No. 1, we find that 85·28 nitrogen correspond to 22·61 vols. oxygen. The carbon is combined with 10·46 vols., leaving 12·15 vols. (13·42 parts by weight) of oxygen, to combine with other elements. This will require 11·74 parts silicon, while the carbon going off as gas amounts to 5·27 parts. Carbon is, therefore, now being oxidised more rapidly in proportion to the silicon than was the case when No 1 sample was taken.

Sample 4.—This was taken ten minutes from the start, and as soon as possible after the boil had commenced. The complete spectrum was now visible and constant, and remained so to the end of the blow. The gas contained:—

Carbonic acid	3·58
Oxygen	none
Carbonic oxide	19·59
Hydrogen (not estimated)	2·00 (probably)
Nitrogen	74·83
	100·00

The great increase in the proportion of carbonic oxide, and corresponding decrease of carbonic acid, will here be noticed. This accounts for the increased luminosity of the flame at this period, as we have now a large volume of gas actually burning at the mouth of the converter. Assuming all the oxygen now being evolved in combination to be derived directly from the blast at present

passing through the iron, we have for the 74·83 vols. nitrogen 19·84 vols. oxygen entering the converter, but the carbonic acid contains 3·58 vols., and the carbonic oxide 9·79 vols., together 13·39 vols., in combination with carbon, leaving 6·47 vols. for other work. This would oxidise 6·25 parts silicon, and there are now 9·6 parts of carbon being burnt, so that the conditions are now reversed, carbon being oxidised at a more rapid rate than silicon. This is the point at which the carbon lines become well defined, and the analyses, we think, shows why this is so.

Sample 5.—Taken 12 minutes from start; gave—

	By absorption.	By explosion.
Carbonic acid	2·47	2·30
Oxygen	absent	—
Hydrocarbons	absent	—
Carbonic oxide	29·58	29·30
Hydrogen	—	2·16
Nitrogen	67·95	66·24
	100·00	100·00

This sample of gas was specially tested for hydrocarbons, as being the most likely period of the blow to detect them if they were formed to any extent. But although the gas was left in contact with fuming sulphuric acid for 12 hours, no absorption took place. As the results by explosion agree in showing the absence of these gases, I think we may fairly conclude that none are formed.

Sample 6 was taken 14 minutes from start, and four minutes from end of blow. It gave—

Carbonic acid	1·34
Oxygen	absent
Carbonic oxide	31·11
Hydrogen (not estimated)	2·00 (probably)
Nitrogen	65·55
	100·00

The large percentage of carbonic oxide, and almost absence of carbonic acid, is remarkable, 65·55 parts nitrogen correspond to 17·37 oxygen, 16·89 vols. (18·66 parts by weight) are combined with 13·45 parts of carbon, leaving 0·53 parts of oxygen which would combine with 0·46 parts silicon; so that at this point it is practically carbon alone that is being oxidised, the last traces of silicon disappearing very gradually.

Looking through these analyses, we note the broad fact, that carbonic acid is formed in the first part of the blow with little or no carbonic oxide, while during the latter part, carbonic oxide is formed with only traces of carbonic acid. The question "Why is this?" suggests itself: why should the carbon take up twice as much oxygen at one time as another, under apparently the same conditions? My own impression is, that both this chemical reaction, and also the difference between this carbon spectrum and that from carbonic oxide, under ordinary circumstances, are functions of temperature. It is certain that at the commencement of the blow the temperature cannot be much above a yellow heat, while at the end of the blow it is undoubtedly a good white heat; now, it appears to me, that under the conditions in the converter, carbonic oxide is the most stable body at a high temperature, and carbonic acid at a lower one. This agrees with the experiment of our V.-P., I. Lowthian Bell, where he shows that the conditions of equilibrium for these gases in the presence of metallic iron are—

Low red heat	150 vols. carbonic acid	for each 100 carbonic oxide.
Full red ,,	47 ,, ,,	
Approaching whiteness	11 ,, ,,	

It also agrees with the general observation, that if the iron is cold when it comes from the melting furnace, the period of the boil is delayed, while if the iron has been kept in a reverberatory melting furnace for a considerable time at a high temperature, this period is reached more quickly. The action of the oxygen upon the silicon may have something to do with the degree of oxidation of the carbon, for I find that the time when the boil takes place depends closely upon the quantity of silicon contained in the iron. Thus, with pig containing about 2½ per cent silicon, the boil takes place about the middle of the blow, while with Swedish iron, which contains only about 1 per cent silicon, this point is, I believe, reached mnch sooner.

Alterations of temperature produce changes in spectra, and I think it will be found that this Bessemer spectrum, or at least that part of it which is due to carbon, is simply the spectrum at which it is burning at the mouth of the vessel.

5. *Comparison of the Gas with Spectroscopic Appearances.*

1st Stage—

	Spectrum observations show—	Analysis of the gas shows—
0 to 4′.	Faint continuous spectrum. No actual flame.	Carbonic acid evolved but little orno carbonic oxide.
4 to 8′.	Sodium, potassium, and lithium lines appear. Towards the close occasional flashes of carbon lines.	Carbonic acid still given off with but little carbonic oxide. The temperature, certainly rising and causing the volatilisation of alkaline metals.

2nd Stage—

8 to 10′.	Dense flame. Bright carbon lines in red, blue, and green fields.	Carbonic oxide evolved in quantity and burning at a high temperature at the mouth of the converter.
10 to 14′.	Bright green carbon lines more distinct.	Carbonic oxide much increased in quantity.
14 to end.	Carbon lines bright till close, when they suddenly disappear.	Carbonic oxide still being evolved up to end of reaction.

6. *Luminosity of the Flame.*

It has been suggested by Mr. M. Williams (see *Nature*) that the great brightness of the flame might be due to hydrocarbons, but analysis shows that this supposition is untenable. I think it more likely that the reason why we get such a bright flame from carbonic oxide during the blow is, that it is burning at the mouth of the converter at a much higher temperature than we get when we ignite a jet of the cold gas; for it is evident that the carbonic oxide formed in the metal-bath must have even a higher temperature than the metal itself, and this is superadded to the temperature developed by carbonic oxide burning in air. This is in accordance with the explanation given by H. Ste.-Claire Deville and Kirchhoff of the increase of luminosity of flames when burnt under great pressure, viz., that the temperature of the flame is thereby increased.

7. *Comparison of Converter Gas with Blast-furnace Gas, and with Gas from Siemens's Producer.*

It may be interesting to compare the composition of the gas during the latter part of the blow with other available gases met with in an iron works. I have selected as blast-furnace gases a sample of gas from a Cleveland furnace, by I. L. Bell, Esq., and one from a Bessemer furnace, by Wm. Crossley, Esq., and have added two samples of gas from Siemens's producers at Dowlais, which I have recently had occasion to analyse.

	Siemens's producer gas. I.	Siemens's producer gas. II.	Bessemer converter. Mean composition of gas during last half of the blow.	Cleveland B. Fce. gas.	Askam Fce. on Bessemer pig.
Carbonic acid	4·3	5·2	1·34	17·30	8·36
Carbonic oxide	25·6	24·4	31·11	25·20	34·97
Hydrocarbons	2·8	trace	—	—	—
Marsh gas	1·6	2·4	—	—	—
Hydrogen	—	8·6	2·00	0·10	2·16
Nitrogen, &c.,	65·7	59·4	65·55	57·40	54·51
	100·0	100·0	100·00	100·00	100·00

8. *Value of the Gas as Fuel.*

It will be seen from these analyses that the gas from the Bessemer converter during the last half of the blow is really of as much value as any gas made purposely, or incidentally, at an iron works. This is a most important fact, and if we consider the amount of fuel thus going to waste the question naturally suggests itself whether it cannot be made available.

If we assume that during the latter half of the blow two-thirds of the total carbon in the pig is burnt, and take the melted iron to contain $3\frac{1}{2}$ per cent carbon, we find that a Bessemer works, using only 1000 tons of such pig per week, is wasting a quantity of fuel equal to $23\frac{1}{3}$ tons pure carbon, or say 25 tons coke.

9. *How the Gas could be made available.*

Now, I would suggest that it is possible, by simple mechanism, to collect this gas and pass it under boilers, when it would save its equivalent of coal. The large body of flame is not wanted for any purpose. True, the workman now depends upon its indications to afford him the means of judging when the blow is completed, but the spectroscope would do this with greater accuracy with a fraction of the gas which now roars from the converter.

The nature of the gases evolved during the blow will, of course, vary with the quality of the iron used, but as it is not possible to use iron with much less than 3 per cent carbon, the quantity of carbonic oxide evolved cannot be much less than that found in the foregoing analyses, and I believe that whatever may be the nature of the iron, the general results will be the same. It would be interesting to have a similar series of analyses of gases from highly manganiferous pig for comparison, and I trust that other workers in this interesting metallurgical department will supply the deficiencies which my own analyses leave.

Dowlais Laboratory,
August, 1871.

Comparison of Amounts of Silicon and Carbon Oxidised.

No. 1	Silicon	72·91	100·00
	Carbon	27·09	
No. 2	Silicon	69·80	100·00
	Carbon	30·20	
No. 3	Silicon	69·01	100·00
	Carbon	30·99	
No. 4	Silicon	39·58	100·00
	Carbon	60·42	
No. 5	Silicon	4·24	100·00
	Carbon	95·76	
No. 6	Silicon	3·34	100·00
	Carbon	96·66	

Comparison of Amounts of Carbon Oxidised to CO *and* CO_2.

No. 1	C to CO	0	100·00
	C to CO_2	100	
No. 2	C to CO	31·52	100·00
	C to CO_2	68·48	
No. 3	C to CO	35·54	100·00
	C to CO_2	64·46	
No. 4	C to CO	84·54	100·00
	C to CO_2	15·46	
No. 5	C to CO	92·72	100·00
	C to CO_2	7·28	
No. 6	C to CO	95·87	100·00
	C to CO_2	4·13	

Tabulated Statement showing Composition of Gases and Spectroscopic Observations during the Blow.

	No. 1. 2 minutes from start.	No 2. 4 minutes.	No. 3. 6 minutes.	No. 4. 10 minutes.	No 5. 12 minutes.	No. 6. 14 minutes.
Carbonic acid ..	10·71	8·57	8·20	3·58	2·30	1·34
Oxygen	0·92	—	absent	none	none	none
Carbonic oxide ..	none	3·95	4·52	19·59	29·30	31·11
Hydrogen	88·37	0·88	2·00	2·00 prob.	2·16	2·00 prob.
Nitrogen		86·58	85·28	74·83	66·24	65·55
Hydrocarbons ..	—	—	—	—	absent	—
	100·00	100·00	100·00	100·00	100·00	100·00
Observations:						
With spectroscope.	Faint continuous spectrum.	Sodium line just appearing, but in flashes.	Sodium, potassium, and lithium lines.	Full spectrum, including the carbon lines.	Full spectrum.	Full spectrum.
With naked eye.	No actual flame, abundance of sparks thrown out.	Abundance of sparks.	Quantity of sparks decreasing.	Flame dense and bright; very few sparks.	Dense flame; still fewer sparks.	Dense flame; scarcely any sparks.

PREPARATION OF HYDROSULPHURIC ACID.

By JOHN GALLETLY.

In making some experiments on the action of sulphur on paraffin, I have found that a mixture of these substances, either in equal parts or with a larger proportion of sulphur, when heated in a flask not greatly above the melting-point of the sulphur, begins to evolve hydrosulphuric acid, and continues to give off this gas steadily, while kept moderately heated, for a considerable time.

I have used this process repeatedly, and consider it the most convenient for laboratory use. With a round flask holding about a pound of the materials fitted with a tube bent at right angles about $\frac{1}{2}$-inch bore and 12 to 18 inches long, containing a little loose cotton wool, and having a smaller tube fitted to the end of this for dipping into the liquid through which it is desired to pass the gas, a convenient stream can be obtained lasting several days. The production of the gas can be stopped and renewed at pleasure by withdrawing or applying the heat. An Argand lamp should be employed, or if a Bunsen is used, the top

piece should be on the tube for spreading the flame, so as to avoid heating the flask on one spot. Heavy paraffin oil used for lubricating machinery can be substituted for the solid paraffin, and good results are also obtained with commercial stearic acid, but with the latter the tube conveying the gas soon becomes covered with drops of a milky liquid, which is probably water and finely divided sulphur. With paraffin the tubes remain clear and bright, except for a little sulphur sublimate close to the neck of the flask.

I observe that Reinsch recommends a laboratory process for obtaining pure sulphydric acid by heating in a glass flask equal parts of sulphur and suet. The recommendation does not seem to have been generally followed, but the advantages resulting from the substitution of paraffin for suet may lead to the more usual adoption of this process.

Addiewell Chemical Works.
Sept. 4, 1871.

ON A NATIVE SULPHIDE OF ANTIMONY FROM NEW ZEALAND.*

By M. M. PATTISON MUIR, F.C.S.
Student in the Laboratory of the Andersonian University, Glasgow.

In the gold mines at the Thames, New Zealand, there are found tolerably large quantities of grey antimony ore, or stibnite, associated with the quartz and other rocks of the older series, from which gold is extracted.

The analysis of a sample of this stibnite, which I obtained about a year ago, I have now the honour to lay before the Association.

The sample had the appearance of a large mass of steel grey crystals, radiating chiefly from a central point; some of the crystals being fully an inch in length, and generally very perfectly formed. The crystals were prisms belonging to the trimetric system, soft, and easily cut with the knife in the direction parallel to the principal axis, showing, when cut, a brilliant metallic lustre.

Adhering to the crystals was a small amount of gangue, composed seemingly of siliceous matter.

For the purpose of analysis a large crystal was broken off perfectly free from any foreign matter. The specific gravity of the crystals = 4·625. The following are the results of the analysis:—

Antimony	71·09
Iron	0·24
Arsenic	traces
Sulphur	28·47
	99·80

ON THE CAUSES OF THE PHENOMENA OBSERVED WHEN THE BESSEMER FLAME IS VIEWED THROUGH COLOURED GLASSES.

By J. SPEAR PARKER,
Chemist to the Cyclops Steel and Iron Works, Sheffield.

In a former communication (Chemical News, vol. xxiii, p. 25), I described the appearances seen when the Bessemer flame was observed through a combination of a blue and a deep amber or orange glass. I should not be surprised if others have failed in obtaining such well marked alterations in the colour of the flame as I there mentioned, for a very small variation in the depth of colour of the glass used is sufficient to mar the effect. Out of two dozen glasses obtained ostensibly of the same colour, I was only able to select four or five which gave the required result. If either the blue or the orange be too deep, the flame has a reddish appearance throughout, only showing different shades of red and crimson; if, on the other hand, the colour be not deep enough, the flame at the beginning and end of the process is more of a light orange than crimson, and during the period in which the carbon spectrum is exhibited appears of a much greener colour. The combination may be a little varied, however, without any great detriment if a little deeper blue be compounded with a somewhat lighter orange or *vice versa*.

I anticipated that the changes in colour of the flame when viewed through these glasses were owing to the nature of the spectrum given by the flame, and an examination of the absorption exercised by these glasses has confirmed my conjecture.

As before, the spectroscope I used was a direct vision instrument with five prisms; on placing the blue glass before the slit and viewing direct sunlight, a spectrum was obtained containing well-defined dark bands. The least refrangible portion of the spectrum from A to a little beyond B was transmitted apparently without any diminution of brightness, then a very intense black band appears extending beyond C; another dark band occurs with the line D in the centre, and between these two partial absorption takes place, only a faint reddish light being visible; on the termination of the band beyond D, a clear bright space occurs in the yellowish green, and again a broad absorption-band, not so dark as those previously mentioned, extends beyond the lines E and *b*, the blue and more refrangible portion being freely transmitted. If a double thickness of glass be interposed, the space from near B to beyond D appears as one broad dark band, while the light admitted in the yellowish green has been more rapidly absorbed than that in the red.

With one thickness of orange glass, the red, orange, and yellow are freely transmitted, but the more refrangible rays are absorbed with gradually increasing intensity till light is scarcely visible beyond F. With two thicknesses, though the red is little affected, even the yellow seems scarcely so bright by comparison, and all is darkness beyond E.

With the combination of one blue and one amber used for observing the Bessemer flame, the bright red band is seen as through blue glass, then the first dark band, again faint reddish light, the second dark band, the bright yellowish green space, again a broad absorption-band, while the blue and violet are dimly visible. Without further experiment this explains why increased depth of *either* colour should render the flame as seen through the combination redder, for both glasses absorb the green and blue more rapidly than the red rays; hence, if these were first balanced, increased depth would cause the red to predominate. An examination of the Bessemer flame by means of the spectroscope, with a blue glass interposed, shows the cause of the curious alterations in the colour, and why they agree with the indications of that instrument. When the carbon spectrum was fully developed, I found that the most prominent and brilliant group of lines occurring in that spectrum—the first in the green—fell in the centre of the second bright space. The potassium line is visible in the extreme red, but the lithium line, on the contrary, falls in the first dark band and is invisible; the first red group in the carbon spectrum is almost obliterated, and there is but a faint indication of the sodium line, then appears the bright space with the triple group in the centre, the remaining green lines, &c., being again obscured.

Hence when the flame is first observed the red light predominates, the flame appears crimson. As soon as the carbon lines flash through the spectrum, yellow flashes are seen through the glasses, and shortly the flame pre-

* Read before the British Association, Edinburgh Meeting, Section B.

sents the appearance of a light gamboge-yellow, a rose-coloured cone in the centre, and crimson edges. The production of this yellow, I think, is an additional illustration of the compound nature of that colour, for the red which previously predominated has added to it additional green light (in consequence of the appearance of the group of bright lines) and the result is yellow. However, it might be explained on the old principle, that the green being of a yellowish tint, the red and true green neutralise, the excess of yellow predominating. The central rose-coloured cone corresponds to the hollow of a Bunsen's flame, where no combustion can occur, and consequently the characteristic spectrum is not produced. With regard to the crimson edges, it is possible that here the carbon lines are not developed, complete combustion having occurred. In the "spiegel flame," as I before remarked, the green groups are brighter and more prominent than in the ordinary spectrum, and this gives a greenish yellow hue when seen through the glasses. I think the slightly different appearances observed by Mr. Rowan, and Professor Silliman, are easily explained. Mr. Rowan used two blue glasses, which though doubtless of a lighter tint than the one I employ, together caused the red to predominate throughout, as previously explained. Professor Silliman, while using one blue, used two *light yellow* glasses; hence the absorption of the more refrangible blue and violet might not be sufficiently complete, and the blending of those colours would cause the ashy blue, &c., which he observed.

As these changes are shown to be owing to the disappearance of the carbon lines, the glasses may be used with greater confidence in the accuracy of their indications; and for use in the workshop are much better adapted than a delicate instrument like the spectroscope.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

PHYSICAL AND MATHEMATICAL SECTION.

March 28th, 1871.

E. W. Binney, F.R.S., F.G.S., President of the Section, in the Chair.

Mr. Brothers, F.R.A.S., after some preliminary remarks as to the chief objects of the English Eclipse Expedition to Sicily, in December last, exhibited on the screen a series of photographs illustrating, in the first instance, the means adopted for obtaining photographs of the eclipse. A series of pictures was then shown illustrating the corona as photographed during the eclipses in 1860, 1868, and 1869, and the whole of the pictures taken during the totality in 1870 at Syracuse. These were shown in comparison with the pictures taken in Spain by the American observers, and also with sketches taken by members of the English expedition in Spain. These illustrations showed in a remarkable manner the advantages of photography in depicting phenomena such as are seen during eclipses of the sun—the strict identity of the positions of the rifts or dark spaces in the corona being shown most perfectly. The identity of those rifts was also shown by comparison with a drawing made by Professor Watson at Carlentini, in Sicily.

During the evening Dr. Roscoe, F.R.S., explained the importance of spectrum analysis in investigating the solar phenomena, and described the preparations he had made for viewing the eclipse from his station on Mount Etna, about 5000 feet above the sea-level.

The photographs and other illustrations were exhibited by means of Mr. T. Harrison's powerful electric apparatus.

Annual Meeting, April 25th, 1871.

E. W. Binney, F.R.S., F.G.S., President of the Section, in the Chair.

The following gentlemen were elected Officers of the Section for the ensuing year:—

President—Joseph Baxendell, F.R.A.S.
Vice-Presidents—E. W. Binney, F.R.S., F.G.S., Alfred Brothers, F.R.A.S.
Secretary—G. V. Vernon, F.R.A.S., F.M.S.
Treasurer—Thomas Carrick.

"*Performance of the Electro-Magnetic Engine.*" By the Rev. H. Highton, M.A.

(1). I am sure that Dr. Joule is a sufficient lover of truth not to feel offended if I submit his last explanations on this subject to the test of facts and experiments.

Not having myself the means of trying experiments with sufficient accuracy to venture to publish results, I will make use only of M. Favre's and Dr. Joule's own experiments.

(2). The whole basis of Dr. Joule's new reasoning is, that when a magnetic engine works rapidly less heat is evolved and more absorbed in it. Taking his own figures as a basis, I find he calculates that when the current is reduced to one-half what it was when the engine was at rest, the heat evolved *per hour* would be one quarter, and *per equivalent* of *zinc* consumed one-half. Now let us take the measurement by M. Favre's calorimeter (*Comptes Rendus*, vol. xlv.). When the engine was at rest, the calorimeter in which it was placed showed, per equivalent of zinc consumed, 2219 heat-units. When it worked slowly, raising a weight, it evolved 2947 units, and when it worked rapidly, raising no weight, it showed 4769 units. In that case, therefore, the effect was exactly the reverse of what Dr. Joule supposes.

(3). I have taken Dr. Joule's own experiments described in the *Philosophical Magazine*, vol. xxviii., and have calculated, on the data he gives, what weight ought to have been raised in each experiment. I subjoin a table of what should have been raised and what actually was raised:—

Expt.	Foot-pounds calculated.	Actual.
I.	19,377	21,100
II.	18,628	17,820
III.	11,533	8,800
IV.	11,232	9,000
V.	17,416	10,031
VI.	18,033	12,673

In order that any mistake I may have made may be detected, I subjoin the calculations themselves in an appendix. The numbers are calculated on the supposition that the resistance of the battery could be neglected. If Dr. Joule in those experiments acted on the erroneous principle, into which he was misled by Jacobi, that the resistance of the wire should be equal to that of the battery, each of the above calculated numbers should be reduced by one-half, which, in every case, would make the work actually done considerably more than the calculation, in some cases more than double.

(4). Let me next observe that if, instead of a wire 389 feet long, and 1-16th of an inch in diameter, Dr. Joule had taken one which was half the length and half the section, all his figures would apply equally well; or, again, a wire of German silver a quarter the length, and with four times the resistance; or, to take an extreme case, a wetted cord enclosed in an insulating tube 1-100th part the length, and with 100 times the resistance.

(5). Dr. Joule when he demonstrates that there is no variation in economy, whatever the arrrangement of the conducting metal, or whatever the size of the battery, demonstrates too much; for it would follow from this,

that no diminution in the size of the battery would affect the result injuriously. Why, then, should he prescribe a battery of such a size that the resistance may be neglected? Take, again, his own figures in the 4th vol. of "Sturgeon's Annals." By reducing his battery from 40 pairs to 10, he increased his economic duty from 65·00 to 97·00 or 50 per cent.

(6). But in reality Dr. Joule's views in 1840 were more correct than they are now; for he was then not so far committed to the theory of the mechanical equivalence of heat. In 1840 he allowed that an economy could be effected by increasing the quantity of wire. Let us see whether he *was* right then, or whether he *is* so now. In his experiments in 1845 he used twice as much wire in his first two experiments as in his four last. What was the consequence? In his first two experiments the average of foot-pounds per hour was 19,460 and duty per grain of zinc 98·35. In the four last experiments the average per hour 10,125, and duty per grain of zinc 51·8, thus clearly showing, that doubling the quantity of wire nearly doubled both the actual work done and the economical duty.

(7). Again, a comparison of his two first experiments would tend to prove that reducing the intensity below one-half reduces not only the work done per hour, but the duty also, instead of increasing it. For the full current being 2232, a reduction to 920 produced 21,100 foot-pounds of work per hour, and a duty of 102·9; whereas a reduction to 850 (by increasing the turns from 140 to 180 per minute) produced only 17,820 foot-pounds of work per hour, and a duty of only 93·8, or nearly 10 per cent less.

(8). Dr. Joule's accurate and most valuable experiments are still the great storehouse of facts on this subject. What I contend is, that they disprove, not prove, his own theory.

——

Dr. Joule said in noticing Mr. Highton's remarks,—I would refer him to my paper on the calorific effects of magneto-electricity and the mechanical value of heat, published in the *Philosophical Magazine* for 1843, vol. xxiii. He will there find it stated, pp. 274, 351, as the result of my experiments, that the heat evolved by the wire of my revolving electro-magnet varied with the square of the current passing through it, and was not affected by the resistance presented by magneto-electric induction in consequence of the working of the electro-magnetic engine. This fact is the basis of my reasoning in that paper, and the neglect of it has involved Mr. Highton in errror, as may be seen in his reply to Mr. Apjohn's most lucid exposition of the true theory in the Chemical News, vol. xxiii., p. 105.

The correctness of Jacobi's formula for the proper arrangement of the wires of a battery to produce the maximum magnetic effect is not necessarily connected with the subject of economy of work. Nevertheless I may refer Mr. Highton to my experiments on this subject in "Sturgeon's Annals" for 1839, by which I showed that the attraction of electro-magnets for one another is proportional to the square of the current between very wide limits.

Mr. Highton seems to forget, when commenting upon the large amount of duty obtained in the first two experiments of my paper with Scoresby, that in them the theoretical duty was also greater than in the others, owing to the current being worked down to a lower intensity. Another reason, explained in the paper was, that in those two experiments, recently mixed, and therefore hot solutions were used in the battery, the potential of which was thereby increased.

Mr. Highton is in error if he supposes that my paper in the *Proceedings* for March 21st contains a new theory, or that I have abandoned any of my original views. My object in that paper was simply to place the true theory in a form in which it might be easily understood by those who have not worked on the subject.

NOTICES OF BOOKS.

Alkali Act, 1863. Seventh Annual Report by the Inspector of his Proceedings during the year 1870. Presented to both Houses of Parliament by command of Her Majesty, 1871. Eyre and Spottiswoode.

The end for which the Alkali Act was passed, may be considered as attained; but there has arisen from the indefatigable labours of Dr. Angus Smith, a new branch of chemical science—chemical climatology. The importance of this new science it would be difficult to exaggerate—the likelihood that in a few years there will be some standard to which may be referred the paradoxical conclusions drawn from the statistics of the death-rate in towns as an indication of their healthiness, must claim for it almost general attention. The results of Dr. Smith's endeavours to establish such a science form the principal portion of the report for this year. He says:—

"The results do not in principle differ from those obtained last year, but the figures are more numerous, and it seemed advisable to calculate again the averages, often adding the new experiments. This has been done for the rain. . . . It has appeared to me necessary to examine the atmosphere in order to see what amount of muriatic acid it contained in places where that is manufactured. From that I was led to examine it also in other places, in order to make a full series of comparisons, and next I was naturally conducted to a comparison of the amount of muriatic acid and chlorides in relation to other substances. This part of the work may now be said to be accomplished, and the results, I hope, will be of use in all sanitary inquiries in future whenever the chemical method is adopted. That it will be adopted more frequently now is my belief. It is safer to examine the condition of the air by a few chemical experiments than by waiting to see how many deaths take place in a thousand of the population."

The report first considers the method of introducing the air into sample bottles; both the air-pump and a loose bellows-pump were employed. The results proved that the cumbrous air-pump might well be dispensed with for the bellows-pump, thus admitting the collection of samples with greater facility. Then follows an examination of the rain for different localities, the Inspector placing more reliance on air-washings than on the examination of continued rain, because when very wet the rain gives an exaggerated idea of the purity of the atmosphere; and when the season has been very dry, there obtains, on the other hand, an exaggerated idea of the impurities. The amount of chlorides in the rain depends mainly on two causes—the distance from the sea, and the distance from manufactures. Valencia has been taken as 100, as affording a good specimen of sea atmosphere. Sulphuric acid or sulphates measures the manufacturing activity and also the decomposition, the amount increasing inland on account of vegetable and animal matter. Ammonia, the result of decomposition, is a measure of the sewage in the air; but by itself it is not impure. On the contrary, the amount of albumenoid ammonia is a measure of the non-purified sewage in the air, and includes the most dangerous substances, germs of living things, vegetable or animal.

The following are some of the comparative results:—

		Parts per million.
Ireland, Valencia	1·00	0·034
Scotland, inland	1·26	0·043
,, sea-coast	3·11	0·1055
England, inland	3·15	0·108
German specimens	3·59	0·122
Liverpool	4·67	0·159
Runcorn	5·59	0·190
London	6·03	0·205
Manchester, 1869	6·21	0·211
Manchester, 1870	8.32	0·283

		Parts per million.
Scotland, towns (not Glasgow)	6·23	0·212
England, (6 manufacturing towns)	6·26	0·213
Glasgow	8·82	0·300

But these are not a tithe of the many observations. There is one very notable fact, that in all the tables the result always shows badly for Glasgow.

In the case of the practical application of the Alkali Act, Dr. Smith advises, where damages are complained of relatively to two or more works in the locality, that a system of valuation should be established, so that the well-regulated works should not suffer equally with the careless manufacturer. He says :—

"Such a system if acted on by authority might be united with the first extension of the Alkali Act. It would give a right of inspection of works from which acids escape, at least when complaints were made. Coal smoke may some day be included, especially when people for economy burn a very inferior coal. To confine the extension to acids would avoid any great innovation. Acids are easily estimated, and it would be enough to give the acidity without stating the separate amount of each acid. We cannot very easily distinguish the different effects, and it is of little consequence to a man whether his land is poisoned by muriatic acid or sulphuric. At present this kind of distinction is the only consolation I can give to those who complain of injuries done by gases other than muriatic acid, and these complaints are the more numerous class."

CORRESPONDENCE.

ON THE CHARRING-POINT OF TEXTILE FABRICS.

To the Editor of the Chemical News.

Sir,—In connection with the concluding portion of Dr. Crace Calvert's experiments "On the Action of Heat on Protoplasmic Life and on Cotton Fabrics," and reported in the Chemical News of last week, permit me to mention that two and a half years ago I made a number of experiments in this direction, when altering the disinfecting chamber belonging to this borough, where previously the temperature rarely exceeded 212° to 220° F.

The object, of course, was to determine a safe point up to which the heat of the chamber could be raised, without damaging the clothing and bedding through scorching, placed there for supposed disinfection.

The substances taken were thin deal shavings, coarse bleached flannel, tissue-paper, piece of mohair dress, piece of print dress, piece of print muslin, piece of curtain muslin, together with some cotton-wool.

All the specimens were suspended freely, so that the heated air came fully in contact with every part of them; the thermometer was also similarly suspended. After half an hour's exposure at 200° F., and afterwards a like time at 250° F., the whole were found to be intact and unchanged. At 290° F. the fabrics, or some of them, gave off a vapour having the odour of scorching; but at 300° F. they were without visible detriment or change of colour. On continuing the heat for half an hour at 330° F., the shavings were found of a faint brown colour, barely perceptible; the other samples were of a slightly higher colour. The cotton-wool possessed a scorched smell, but such was not discernible in any of the others.

The temperature was now raised to 350° F. and continued as in each of the other tests for half an hour. The colour of each experimental piece was a little heightened, the cotton-wool and the flannel most so, whilst least of any the tissue-paper and print muslin.

I did not consider, judging from previous and more recent experiments, that the colouration was permanent, but would wash out, nor that the fabrics were at all damaged.

Half an hour's exposure at 365° to 370° F. gave a permanent scorching to all the specimens, the shavings, however, least so. At this temperature all the pieces were considered as damaged, although not materially.

I have always taken the view mentioned by Dr. Calvert, that the ordinarily employed temperatures of disinfecting stoves are inoperative upon germ life, and the virus of contagia. It is only right, however, to state that in this town the Public Chamber has the furnace within it, and as coke is the material employed, the whole place with the articles under treatment is impregnated strongly with sulphurous acid that very likely has a destructive action upon germs. Nevertheless, I am strongly of opinion that much more satisfactory results would be attained by thoroughly impregnating infected materials with the vapour of phenol at a moderate temperature, and in the presence of steam.

The results here arrived at as to the destructive action of heat upon such things as are likely to require disinfection, differ from those recorded by Dr. Calvert; but it must be noted that the conditions of experiments vary, the present ones are more in accordance with actual practice.—I am, &c.,

Richard Weaver, C.E.

The Sanitary Laboratory,
Leicester, Sept. 25, 1871.

THE LECLANCHE BATTERY.

To the Editor of the Chemical News.

Sir,—I find that what I said about the Leclanché battery at the Post Office has led to a false impression, which I am asked to correct. I learn on the best authority that it is used only on circuits of considerable resistance, and not much work, for which it is found very suitable. I had good authority for what I said, but it no doubt referred to some isolated trials on short circuit, and with hard work. It is obvious that it would not be ordinarily used for such purposes.—I am, &c.,

H. Highton.

Putney, Oct. 2, 1871.

VALENCY OR ATOMICITY.

To the Editor of the Chemical News.

Sir,—A reply to "W. H. O's." letter in the Chemical News, vol. xxiv., p. 156, will be found in two principles of the modern theory of atomicity.

Let me illustrate the first by diatomic oxygen. The molecule of oxygen gas contains two atoms, and the theory regards these as united by each of the atomicities of 1 atom being engaged or satisfied by an atomicity of the other, or, in other words, by an "exchange of two atomicities." But we may conceive two oxygen atoms united by exchanging only one atomicity, leaving vacant another in each atom, and so forming the diatomic radical $(O_2)''$. The molecular constitution of ozone, $(O_2)''O$, proves the existence of such a radical. Hence—

(1). Two atoms of a polyatomic element may, by an exchange of atomicities, give rise to a radical of an atomicity corresponding to the number of points of affinity left vacant.

The second principle might almost be called an extension of the first. It is—

(2). In a single atom of a polyatomic element, a pair, or several pairs, of the atomicities may satisfy each other.

This leads to a distinction between atomicity and valency. The former is invariable, being determined by

the greatest number of monatomic atoms (or radicals) which an atom ever fixes. But the valency of the same atom may vary from one molecule to another, for it denotes only the number of atomicities which the atom actually satisfies in a given molecule. Obviously this will either equal the atomicity, or be less by some *even* number.

Fe is now regarded as hexatomic, from its analogy with Cr, and from its maximum valency, exhibited by potassium ferrate, $Fe\overset{VI}{\{} O''_2(KO)'_2 \}$. By (2), it may also be quadrivalent, as in $Fe\overset{IV}{S''_2}$; or bivalent, as in $Fe''O$. By (1), two quadrivalent atoms can exchange an atomity and produce the sextivalent radical, $(Fe\overset{IV}{\ }_2\overset{VI}{\ })$.

The pentatomicity of $N\overset{V}{\ }$ is proved by its maximum valency in $N(H_4Cl)$. By (2), it may be trivalent as in $N'''H_3$, or monovalent as in $O(N'_2)''$. Nitric oxide appears anomalous, but just as N_2O_4 splits up into $2NO_2$ at a temperature below 100°, so NO may be the result of *dissociation* by even an extremely low temperature, and the true formula for nitric oxide $(N'''_2)\overset{IV}{\ }O_2$.—I am, &c.,

R. Routledge, B.Sc.

Bowdon, Cheshire,
Sept. 30, 1871.

ESTIMATION OF PHOSPHORIC ACID.

To the Editor of the Chemical News.

Sir,—In answer to Mr. B. J. Grosjean's questions (Chemical News, vol. xxiv., p. 33) relative to my paper on the above subject, I would say that by "pure aluminic sulphate" I meant, not the normal salt, but one that contained only aluminic, sulphuric, and hydric oxides. Had I used the normal salt I should not have published results obtained by so old and well-known a process as that of the estimation of aluminic oxide by ignition. The same is true of the ammonio-sodic phosphate.

I should be very much pleased if Mr. Grosjean would give us the results which he has obtained, both by the aluminic sulphate and the mercurous nitrate processes. —I am, &c.,

Charles E. Munroe.

Cambridge, Mass, U.S.A.,
Sept. 1, 1871.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, September 4, 1871.

This number contains the following original papers and memoirs bearing upon chemistry and allied sciences:—

Relation Existing in the Sun betweeen the Protuberances and other Remarkable Parts.—Rev. A. Secchi, S.J.—A lengthy and very interesting memoir elucidated by engravings.

Some Observations on the Simultaneous Distillation of Water and of certain Alcohols Soluble therein.—J. Pierre and E. Puchot.—The conclusions which may be drawn from the facts communicated in this exhaustive essay are:—When a mixture of water and amylic alcohol, or of water and butylic alcohol, is submitted to distillation, the temperature of the boiling liquid remains the same until there remains in the retort only one of the two liquids. This temperature of ebullition is always lower than that of the boiling-point of the most volatile of the two liquids—in the instance here mentioned below 100°. For each of these mixtures there exists a constant *rapport* between the proportions of water and alcohol which pass over by distillation, but this *rapport* varies with the varying alcohols, being 2 to 3 in the case of amylic, and 1 to 5 in the case of butylic alcohol and water mixed. When a mixture of butylic and amylic alcohol is made along with water, the temperature of the ebullition is not constant, but varies according to the varying proportions of the alcohols used for the mixture; but the boiling temperature remains always lower than the boiling-point of the most volatile liquid present.

On Petroleum.—H. Byasson.—This memoir treats on petroleum as regards its composition, its industrial applications, its origin, and the best means of ascertaining its inflammability; this latter particular is ascertained by the measurement of the pressure of the vapours of the petroleum exerted upon a column of water—a kind of manometer tube.

Spectrums Exhibited by Carbon, Boron, Silicium, Titanium, and Zirconium.—L. Troost and P. Hautefeuille.—The contents of this highly valuable paper are not suited for useful abstraction; an observation also relating to the following paper:—

Spectra of Sulphur, Selenium, and Tellurium.—A. Ditte.

Preparation and Properties of a Sulphuret of Selenium.—A. Ditte.—After referring to the researches of Berzelius on this subject, the author states that he has prepared a crystalline compound of the two elements alluded to, by the action at a low temperature (between 0° and 5°) of sulphuretted hydrogen on a concentrated solution of selenious acid, and by purifying the precipitate thus formed by the aid of benzine and sulphide of carbon. The resulting compound is a crystalline, orange-yellow, transparent substance, consisting, in 100 parts, of:—Sulphur, 28·68; selenium, 71·40. This body is produced by the following reaction:—$SeO_2+2HS=2HO+SeS+S$. The free sulphur is soluble in benzine or sulphide of carbon; sp. gr. of the compound, at 0° = 3·065.

Formation of Secondary Monamines by the Action of the Bases of the Formula $CnH(2n-7)H_2N$ upon the Chlorhydrate of Naphthylamine.—C. Girard and G. Vogt.—The contents of this paper (the first instalment of a memoir on this subject) are, notwithstanding their intrinsic value, not suited for abstraction, on account of the large number of lengthy and complex formulæ required for the proper elucidation of the subject.

Jahrbuch der Kaiserlich-Königlichen (Austro-Hungarian) Geologischen Reichsanstalt, No. 2, 1871.

In addition to a number of papers treating on the geology and mineralogy of the Austro-Hungarian Empire, this number contains the following papers relating to chemistry and allied sciences:—

Phosphorite Deposits Situated on the Banks on the Dniester, in Russian and Austrian Podolia, and in the Bukowina.—F. Schwackhofer.—This lengthy essay, illustrated by several tabulated forms and engravings, treats on the phosphorite in a mineralogical, genetical, and chemical point of view. It appears that, on the whole, the deposits of this mineral are very rich in phosphoric acid, and in many respects the composition of the nodules of this phosphorite approaches that of pure apatite. Among the minerals, petrified wood is met with, which has a hardness = 4; sp. gr., at 17° = 2·937. The percentage composition of this mineralised wood (which, however, has a distinctly organised structure, and has been thereby ascertained to belong to the *Pinus* species) is:—Tribasic phosphate of lime, 67·46; free phosphoric acid, 2·26 (the wood exhibits an acid reaction when brought into contact with moistened litmus-paper); fluoride of calcium, 9·33; carbonate of lime, 13·56; carbonate of magnesia, 0·96; sulphate of lime, 3·26; oxide of iron, 0·26; alumina, 0·05; silica, 0·04; organic matter, 2·99; water, 0·44.

Simple Instrument for Detecting, as well as Measuring, the Intensity of Earthquakes.—Dr. E. Stahlberger.—The description of an ingeniously arranged contrivance; illustrated by engravings.

Microscopical Investigation of the Pechstein of Corbitz.—Dr. B. Behrens.—The mineral alluded to is an unisilicate which, from its more pitch- than glass-like appearance, is termed pitch-stone The contents of this paper treat on the microscopical structure of this mineral, which structure is illustrated by several engravings.

Account of the Analyses and Investigations Made in the Laboratory of the Geological Institute.—K. Ritter von Hauer.—This exhaustive paper contains the results of a very large number of analyses and investigation of various minerals, including coals, coke, brown coal, peat, pyrites, limestones, iron, and other mineral ores; these analyses are chiefly of local interest only.

The American Journal of Science and Arts, September, 1871.

This number contains the following original papers relating to chemistry and allied sciences:—

Nature and Duration of the Discharge of a Leyden Jar Connected with an Induction Coil.—O. N. Rood.—Second part of an essay on this subject, illustrated with woodcuts and diagrams.

Memoranda Concerning the Introduction of the Manufacture of Spelter into the United States.—J. Wharton.—An important contribution to the metallurgical industry of the great Trans-Atlantic Republic.

Destructive Distillation of Light Petroleum Naphthas at Comparatively Low Temperatures.—S. D. Hayes.—Reserved for reproduction; an observation also applying to the following paper:—

Observations on the Colour of Fluorescent Solutions.—Dr. H. Morton.

Mineralogical and Chemical Composition of the Meteoric Stone that Fell near Searsmont, Maine, May 21, 1871.—J. L. Smith.—The sp. gr. of the specimen examined = 3·701. Nickeliferous iron and stony matter separated by mechanical analysis gave, for 100 parts:—Stony matter (including a little sulphuret of iron), 85·38; nickeliferous iron, 14·62. The iron afforded:—Iron, 90·02 per cent; nickel, 9·05; cobalt, 0·43; phosphorus and copper, not estimated. The portion soluble in nitro-hydrochloric acids (soluble, 52·3 per cent; insoluble, 47·7) gave, in 100 parts:—Silica, 40·61; protoxide of iron, 19·21; magnesia, 36·24; sulphuret of iron (accidental constituent, only present as mechanical mixture), 3·06. Composition of insoluble part:—Silica, 56·25 per cent; protoxide of iron, 13·02; alumina, 2·01; magnesia, 24·14; alkalies, NaO,KO, with trace of LiO, 2·10. Composition of stone:—Nickeliferous iron, 14·63 per cent; magnetic pyrites, 3·06; olivine, 43·04; bronzite, a horneblende, with a little albite or orthoclase and chrome-iron (small black specks, not estimated), 39·27.

As usual, this number contains several valuable original papers bearing upon astronomy, geology, and natural history.

Journal für Gasbeleuchtung und Wasserversorgung, Nos. 15 and 16, 1871.

These numbers do not contain any original papers besides those specially bearing upon subjects pertaining to gas- and water-works' engineering and management.

Annales des Mines, Nos. 5 and 6 (double number), 1870.

The original papers contained in this number do not treat on subjects related to chemistry or allied sciences.

Nos. 1 and 2 (double number), 1871.

This number contains the following original papers relating to chemistry and collateral sciences:—

Essay on Red-Lead, or Minium, and a New Method of Preparing it.—G. Mercier.—This paper, illustrated by engravings, describes a series of experiments made on the large scale with the view to obtain a more rapid, less expensive, and less tedious method whereby massicot may be converted into red-lead.

Note on the Use of Nitro-Glycerine in the Working of Marble Quarries of the Valley of La Vire, near Saint Lô, La Manche, France.—H. Harlé.—This paper contains an account of the preparation of nitro-glycerine on the spot where it is to be used for blasting purposes in quarries or mines; it appears that, in this way, the use of nitro-glycerine has become very prevalent in mining operations in the country above named.

Exhaustive Essay on the Various Explosive Substances Used in Mining Operations.—A. Henry.—This essay contains the following sections:—Elements of the comparative value of the different explosive substances used in mining operations—viz., gunpowder, gun-cotton, nitro-glycerine, dynamite, dualine, and lithofracteur; mode of applying these materials, and results obtained therefrom in practice; on conditions of safely manufacturing, carrying, and warehousing blasting-powder; conclusions. This important essay is illustrated by engravings.

Memoir on the Siebengebirge and the Eifel.—R. Zeiller.—A geologico-metallurgical monograph, illustrated by maps and charts.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, July, 1871.

This number only contains the two following original papers relating to physico-chemical sciences:—

Formation of the Anhydrite met with along with Rock-Salt. G. Rose.—This exhaustive chemico-mineralogical monograph does not admit of any useful abstraction. As is usual with the eminent author, this essay testifies to his high accomplishments and excellent method of research.

Electrical Oscillations Observed in Rectilinear Conductors after the Opening of a Collateral Current.—Dr. J. Bernstein.—Illustrated by woodcuts and several tabulated forms.

Journal de Pharmacie et de Chimie, June, 1871.

This number contains the following original papers and essays:—

Researches on the Products of the Oxidation of the Principal Normal Alcohols.—J. Pierre and E. Puchot.—This lengthy essay contains the following sections:—Introduction, treating on the principal products of oxidation of normal alcohols in general; preparation of the amylic valerianate, $C_{10}H_9O_3,C_{10}H_{10}O$, by the oxidation of amylic alcohol; preparation of the butylic butyrate, $C_8H_7O_3,C_8H_9O$; preparation of propylic propionate, $C_6H_5O_3,C_6H_7O$.

Electrolysis of Phthalic Acid.—E. Bourgoin.—This essay contains the description of the result of a series of experiments instituted by the author, with a view to ascertain the effect of electricity upon phthalic acid and its salts. The acid is decomposed, the reaction being represented by the following formula:—

$$C_{16}H_6O_8=(C_{16}H_4O_6+O_2)+H_2;$$

at the positive pole, $(C_{16}H_4O_6+O_2)+H_2O_2=C_{16}H_6O_8+O_2$. Solution of neutral phthalate of potassa, reaction:—

$$C_{16}H_6O_8+12O_2=3H_2O_2+4C_2O_4+4C_2O_2.$$

Phthalate of potassa and free alkali; this mixture behaves exactly as the neutral salt.

General Conditions of the Production of the Phenomena of Incandescence; Origin of these Phenomena.—A. Boillot.—This essay treats exhaustively on the phenomena of combustion in a wider sense, including the spontaneous and sudden decomposition of such substances as anhydrous nitric acid, chloride of nitrogen, iodide of nitrogen, and nitro-glycerine. The author reduces the phenomena alluded to simply to "*mouvement de la matière*," that is to say, the succession of the different positions a body takes up.

On Iodated Cotton.—C. Méhu.—The contents of this paper bear upon the properties and preparation of a pharmaceutical compound of cotton wool, impregnated with 5 per cent of iodine, and employed for external use.

Polytechnisches Journal von Dingler, second number for July, 1871.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Gold-Ruby Glass.—W. Müller and Dr. F. Knapp.—This very exhaustive memoir treats on that kind of glass which owes its beautifully red-purplish colour to gold. The first portion of this monograph contains a review of the literature of the subject alluded to, and of the various theories and opinions held on the condition of the gold while acting as a pigmentary or staining matter. The other sections are the following:—The gold—from this part of the memoir it appears that the quantity of gold required to impart colour to the glass mass is very small indeed, since 1 part of gold in 100,000 of the metal (as the molten glass mass is technically called) distinctly yields a rose-red colour; influence of the composition of the glass mass; influence of temperature and of the length of time taken by the smelting of the glass mass; influence of the so-called glass gall; influence of the cooling; colours of gold-stained glass and the variations thereof; the annealing; constitution of the gold-containing glass. The authors did not succeed in discovering by experiments what the condition is of the gold in the glass; the chief reason of this failure is that the quantity of gold is infinitesimally small.

On Nickeling and Cobalting by the Wet Way.—Dr. F. Stolba.—The author's process, described at great length, is based upon the fact that nickeling and cobalting by the wet way (that is to say, the coating of other metals with a more or less thick film of either nickel or cobalt) succeeds by using along with either a solution of or the dry salt of nickel, chloride of zinc in dilute solution, metallic zinc, and some pure hydrochloric acid.

Cleaning Glass Vessels wherein Petroleum has been Kept.—Dr. F. Stolba.—Thin milk of lime, used for washing glass vessels wherein the liquid alluded to has been kept, forms with the petroleum an emulsion, and renders it possible to remove any traces, and, by the addition of a small quantity of chloride of lime to a second washing with milk of lime, even the smell so completely as to render the vessels so cleaned fit for pouring and keeping beer therein; if warm milk of lime be used, the operation, which otherwise takes considerable time for completion, is rendered shorter.

Detection of Woody Fibre in Paper.—Dr. J. Wiesner.—A microscopico-technical paper. By the proper application of the microscope, the author finds that not only can woody fibre be detected in paper, but even the kind of wood recognised which has been pulped.

Description of an Apparatus suited for Exhausting Oil Seeds by means of Canada Oil (Petroleum Spirit) for the Preparation of Oils to be Used as Food and other Purposes.—Dr. H. Vohl.—Illustrated by engravings.

Comparison of the Relative Value of Canada Oil and o Sulphide of Carbon for the Purpose of Extraction of Oils from Seeds.—Dr. H. Vohl.—The sp. gr. of well-refined Canada oil = 0·68; that of purified sulphide of carbon = 1·265. 100 litres of the former liquid weigh 68·0 kilos.; the same quantity of the latter weigh 126·5 kilos. While, abroad, the price of 100 litres of the Canada oil is such that, as compared with the same bulk of sulphide of carbon, the former liquid costs 8 thalers 29·4 sgr. less than the latter (the thaler is equal to 3 shillings, the silbergroschen is equal to about 1 penny).

Composition of a Dressing (Weaver's Glue) to be Applied to Calico Fabrics, and Obtained from France.—Dr. T. Finckh.—The author's aim in testing the dressing was to find out the best means of preparing it for use, the result being that 2 parts of caustic soda are used along with water to saponify from 4 to 5 parts of palm oil; to the resulting soap immediately sufficient hot water is used to dissolve it, and next 30 parts of glycerine (sp. gr. = 1·214) are added to the yet hot fluid. After cooling, 8 parts of wheaten starch are stirred through the fluid, which is next brought up with water to weigh 100 parts. A small quantity of carbolic acid is added to prevent fermentation of this mixture, which should be kept in a cool place, and not made up in too large quantity at once; for use as dressing, to 100 lbs. of potato-starch from 6 to 8 lbs. of this mixture are taken.

Easy Method of Testing Soft, or Potassa, Soaps for the Quantity of Oil or Fat and Alkali Contained therein.—Dr. U. Gräger.—Reserved for full translation.

Notes on Ultramarine.—C. Fürstenau.—Microscopical research of the pigment alluded to proves that it is not a homogeneous mass, but contains:—(1) A blue-coloured glass-like sintered mass; (2) deep blue-coloured grains of unequal size, the larger of which exhibit a white-coloured nucleus; (3) unacted-upon kaolin; and a colourless enamel-like substance. The last-named materials were found by the author in all kinds of ultramarine, even of the best makers.

Strong Vegetable Glue.—A. Selle.—This preparation is a mixture of nitrate of lime, water, and pulverised gum, in the proportion of 2, 25, and 20; the solution of the nitrate of lime contains 33·3 per cent of that salt. This glue may be used for glass, porcelain, wood, cardboard, marmor, &c.

Les Mondes, September 7, 1871.

The original papers and essays, relating to chemistry and allied subjects, met with in this number are the following:—

Dry Distillation of Wood.—M. Maiche.—From this lengthy paper, written by a practical distiller of wood, we quote the following particulars:—This industry does not pay unless the greatest care is taken to utilise advantageously all the products, which, for 100 kilos. of wood submitted to distillation, amount to 50 kilos. of raw produce, wherein are contained:—Methylic alcohol, 2 kilos.; crystallisable acetic acid, 3 kilos. (*i.e.*, that quantity of glacial acetic acid may be obtained): tar, 10 kilos.; water, 35 kilos.; and a residue of charcoal, weighing 22 kilos. Dry wood, submitted to distillation at 700°, yields, among other products, an oil which, like paraffin oil, can be used in lamps; it boils at 90°, and is devoid of smell. The author has also tried, as yet only on a small scale, to submit chopped-up wood to distillation in water containing 10 per cent of sulphuric acid; the result is the formation of acetic acid very abundantly, and of a peculiar aromatic principle insoluble in cold water.

Notes on the Mineral Statistics of Italy.—M. Giordano.—This paper, from the hand of the Chief Inspector of Mines for the kingdom just named, contains information on the extraction of sulphur (by far the most important of the Italian minerals); iron ores and the iron manufacture; copper, lead, and zinc ores, which are exported chiefly to England and Belgium, owing to the fact that Italy lacks mineral fuel; gold, of which annually about 400 kilos. are obtained; and, lastly, an account of the engineering establishments of Italy.

September 14, 1871.

Among the original matter contained in this number the following relates to chemistry and collateral sciences:—

Ammonia Engine.—C. Tellier.—An account of the mode of action and principles of the application of ammoniacal gas instead of steam for the purpose of imparting motion to machinery. This application is based upon:—(1) The great solubility of ammoniacal gas in water; (2) the facility of liquefying that gas; (3) the fact that at ordinary temperatures the gas exerts a pressure sufficiently strong to be industrially applied; (4) the possibility of superheating ammoniacal vapours without a too high temperature; (5) the fact that the gas can be dissolved in water and recovered and again applied for use.

Exposition of an Economical Method of Application of Steam.—M. Autier.—Although not exactly belonging to the subjects usually treated of in our pages, we call attention to this subject, which is here treated of in the shape of a review of a book, the chief theme of which is cheap motive force with all kinds of fuel. It appears from the *resumé* here published that the author, a practical engineer, is well up to his subject, which entails economy of construction of engines and boilers, economy of fuel and labour, and a decrease of wear and tear.

Elements of Organic Chemistry.—Dr. Sacc.—Attention is here called to this work, recently published at Paris by Lacroix. From the preface of this book it appears that the author's aim has been to produce what he terms "Première Tentative d'une Chimie Naturelle et Pure." The excellent editor of *Les Mondes* speaks highly of the volume, which is sold at 2s. 6d., and contains 478 pages.

September 25, 1871.

This number does not contain any original papers relating to chemistry and collateral sciences, but we call attention to a paper:—

On Portable Tramways for Agricultural Use.—M. Corbin.—Illustrated by engravings. The contrivance is intended especially to facilitate the removal of root-crops from the field, by a rapid and very cheap method of conveyance which can be applied everywhere.

Hints for the Proper Arrangement of Meteorological Observatories.—V. Regnault.—Illustrated by engravings.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, September 7, 1871.

This number, the first of a new volume, opens with an excellent preface which, undoubtedly, proves that "La France intelligente, éclairée, et libérale ne périt pas, et n'est nullement éteinte." The following original matter is met with in this number:—

Chenot's Process of Iron and Steel Manufacture.—C. Mène.—The author describes at length a mode of manufacturing iron by which the metal is obtained in a spongy state instead of being smelted. The operation is conducted in peculiarly arranged furnaces, the ore being first calcined. The spongy metal is next converted into steel by being first soaked in either molten resin, coal-tar, or other suitable similar substance, and then calcined. The carbonated spongy mass is next ground to powder, and having been placed in moulds, is very strongly compressed, after which the solid lumps are put into crucibles and fused. It appears from experiments made on the large scale at Clichy, that the iron thus obtained (no mention is made of the nature of the reducing agent employed) is superior in every respect to that produced by blast furnaces; as to the cost of this process nothing is mentioned, but, since cast-steel of excellent quality, or malleable, or, if desired, cast-iron, can be produced at will, and the operation of puddling and refining are dispensed with, it is probable that the expense will not exceed that of the usual process, while the yield of metal from the ore is stated to be in favour of Chenot's process, by which phosphorus and sulphur are also eliminated.

Apparatus for Exhibiting the Phenomena of Cooling Water far below its Freezing-Point and the Effects of its Expansion on Freezing.—F. Hamel.—The description, accompanied by a woodcut, of a neat and highly instructive apparatus made by M. Alvergnat, Passage Sorbonne, Paris.

Description of Foucault's Heliostate, Constructed by J. Duboscq, Rue de l'Odéon, Paris.—C. Mène.—Illustrated by a woodcut.

Studies on the Chemical Dissociation of Bodies.—C. Mène.—The first portion of a well and clearly written essay on this subject.

NOTES AND QUERIES.

Electro-Deposition—Crimson Spirit.—(1). Can any of your readers tell me of a good practical method of depositing bright platinum on iron or copper? (2). Can aluminium be anyhow deposited by the battery? (3). How can I make "crimson spirit" used by silk dyers?—Inquirer.

Electrical Phenomena.—A few days ago I stood near a person cleaning windows; I noticed that, after wiping the glass with a wet leather, she used an old silk handkerchief as a duster to dry the pane I also noticed that while the glass was being rubbed with the silk a crackling sound emanated from the pane. Taking notice of this circumstance I waited till the evening, when it was perfectly dark, and repeated the experiment thus:—In the first place, I took a pane and rubbed it with the handkerchief, and I thus obtained a number of flashes of light with crackling accompaniment. I then rubbed the pane with the wet leather, and again rubbed with the silk; the flashes and noise were both more decided than before, the former being very bright; with prolonged rubbing they gradually died away, but on rubbing again with the leather, and afterwards with the handkerchief, they again became bright and more copious. I repeated the experiments with different panes and on three different windows successfully. The kind of electricity is positive, as that of dry glass and silk. The experiments were conducted out of doors, and the weather at the time was cold, with a slight mist in the atmosphere. I have tried the experiment with a cotton instead of a silk duster with nearly equal success. The experiments have been repeated on subsequent evenings, sometimes successfully, and sometimes not, the former predominating over the latter. I have sent this notice of the above, because I have not yet seen a description of anything similar, and because it seems to prove that absolute dryness is not indispensable to electrical experiments, and to show that it is unnecessary to roast the apparatus to death, as is the common practice of some lecturers.—W. Jesse Lovett.

TO CORRESPONDENTS.

D. R.—It will be better to keep the solution boiling or nearly so the whole time of passing the gas.

W. H.—Several kinds of laboratory-labels have been noticed in our columns; they have also been advertised in this journal.

J. P. Barnett, New York.—Wormley's "Micro-Chemistry of Poisons" is the only book we know of which treats on the subject.

BOOKS RECEIVED.

Flint. A paper read before the Geologist's Association, June 2nd, 1871. By M. Hawkins Johnson, F.G.S.

The Journal of the Iron and Steel Institute, vol. ii. London: E. and F. N. Spon.

Miscellanies. By John Addington Symonds, M.D., Selected and Edited, with an Introductory Memoir, by his Son. London: Macmillan and Co. Bristol: J. Arrowsmith.

On the Relative Powers of Various Substances in Preventing the Generation of Animalculæ or the Development of their Germs, with special reference to the Germ Theory of Putrefaction. By John Dougall, M.D., Glasgow. London: J. and A. Churchill, New Burlington Street.

Sixth Report of the Quekett Microscopical Club, and List of Members.

On the Economical Production of Peat and Peat-Charcoal. Liverpool: Peat Engineering and Sewage Filtration Company.

NOTICE TO AMERICAN SUBSCRIBERS.

In answer to numerous inquiries, the Publisher begs to state that Subscribers in the United States can be supplied with the CHEMICAL NEWS from this Office, post free, for the sum of £1 2s. 4d. per annum payable in advance.

THE

QUARTERLY JOURNAL OF SCIENCE,

AND

Annals of Mining, Metallurgy, Engineering, Industrial Arts, Manufactures, and Technology.

Edited by WILLIAM CROOKES, F.R.S., &c.

Now ready, No. XXXII., *October*, 1871, price 5s., Illustrated.

CONTENTS.

I. The Fuel of the Sun. By W. Mattieu Williams, F.C.S.
II. Molecules, Ultimates, Atoms, and Waves. By Mungo Ponton, F.R.S.E.
III. Some Further Experiments on Psychic Force. By William Crookes, F.R.S., &c.
IV. The Recent Gun-Cotton Explosion.
V. Thoughts Suggested by Patent Rights.
VI. On Modern British Ordnance and Ammunition. By Lieut. S. P. Oliver, R.A.

Notices of Books. Progress of the Various Sciences. Recent Scientific Literature, &c., &c.

London: Offices of the Quarterly Journal of Science, 3, Horse-Shoe Court, Ludgate Hill, E.C.

Chemical Technology, or Chemistry in its Applications to the Arts and Manufactures. By Thomas Richardson and Henry Watts. Second Edition, illustrated with numerous Wood Engravings.

Vol. I., Parts 1 and 2, price 36s., with more than 400 Illustrations.

Nature and Properties of Fuel: Secondary Products obtained from Fuel: Production of Light: Secondary Products of the Gas Manufacture.

Vol. I., Part 3, price 33s., with more than 300 Illustrations.

Sulphur and its Compounds: Acidimetry: Chlorine and its Bleaching Compounds: Soda, Potash: Alkalimetry: Grease.

Vol. I., Part 4, price 21s., 300 Illustrations.

Aluminium and Sodium: Stannates, Tungstates, Chromates, and Silicates of Potash and Soda: Phosphorus, Borax: Nitre: Gun-Powder: Gun Cotton.

Vol. I., Part 5, price 36s.

Prussiate of Potash: Oxalic, Tartaric, and Citric Acids, and Appendices containing the latest information and specifications relating to the materials described in Parts 3 and 4.

Bailliere and Co., 20, King William Street, Strand.

North London School of Chemistry, Pharmacy, &c.—For Instruction in Practical Chemistry and Evening Classes for the Study of Chemistry, Botany, Materia Medica, &c. Conducted by Mr. J. C. BRAITHWAITE, *for thirteen years Principal Instructor* in the Laboratories of the Pharmaceutical Society of Great Britain, and Demonstrator of Practical Pharmacy, Pharmaceutical Latin, &c.

Mr. Braithwaite, having taken the premises adjoining his house, has been enabled *nearly to double the size of his Laboratories*, and, at the same time, procure a large piece of ground which *he has had laid out as a Botanic garden*. Every facility is, therefore, offered to Students desirous of acquiring a practical knowledge of this branch of their education.

The Session 1871—1872 will commence on the 2nd of October, when the Laboratories will re-open at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

THE CHEMICAL and TOXICOLOGICAL CLASS will meet as usual every Monday and Thursday evening, commencing October 2nd, at 8 p.m.

The LATIN CLASS for the reading of Physicians' Prescriptions, Cæsar's Commentaries, &c., every Tuesday and Friday evening, commencing October 3rd, at 8 p.m.

The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday evening, commencing October 4th, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will be continued every Saturday, until further notice, at 10 a.m.

Fee to either of the above Classes Half-a-Guinea per Month. Pupils can enter at any period.

Gentlemen Privately Prepared for the Examinations of the Pharmaceutical Society, and the "Modified Examination for Assistants," &c.

All Fees must be paid in advance.

Letters of inquiry should be accompanied with a stamped envelope.

Mr. Braithwaite receives a few Pupils to Board in his house.

Address—54, Kentish Town Road, N.W.

Methylated Spirits.—David Smith Kidd, Licensed Maker, Commercial Street, Shoreditch, N.E. Also FINISH, FUSEL OIL, and RECT. NAPHTHA.

PRACTICAL CHEMISTRY.

Laboratory, 60, Gower Street, Bedford Square, W.C.

Mr. Henry Matthews, F.C.S., is prepared to give Instruction in all branches of PRACTICAL CHEMISTRY, particularly in its application to MEDICINE, AGRICULTURE, and COMMERCE.

The Laboratory is open daily, except Saturday, from ten to five o'clock; on Saturday, from ten till one o'clock.

Mr. Matthews is also prepared to undertake ANALYSES of every description.

For Particulars and Prospectuses, apply to Mr. Henry Matthews, the Laboratory, 60, Gower Street, Bedford Square, W.C.

BERNERS COLLEGE of CHEMISTRY.—EXPERIMENTAL MILITARY and NAVAL SCIENCES, under the direction of Professor E. V. GARDNER, F.E.S., &c.: of the late Royal Polytechnic Institution and the Royal Naval College.

The Laboratory and Class Rooms are open daily.

Especial facilities for persons preparing for Government and other examinations.

Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

For particulars, &c., apply to Prof. E. V. G., 44, Berners-street, W.

ANALYTICAL LABORATORY AND SCHOOL OF TECHNICAL CHEMISTRY.

7 and 9, HACKIN'S HEY, LIVERPOOL.

Conducted by A. NORMAN TATE, Analytical and Consulting Chemist, and Chemical Engineer.

Established for Educational Purposes connected with Chemistry in its practical Applications to Manufactures, Commerce, &c.; for the performance of Analyses, Assays, and Chemical Investigations; and for affording information respecting the construction, &c., of Chemical Manufactories, and the conduct of Chemical Manufacturing Processes.

The Course of Instruction, in addition to the ordinary Chemical studies, comprises, as far as possible, all such other subjects as are necessary to give the scientific and practical information required in the Arrangement, Construction, and Management of Chemical Manufactories, and in the Application of Chemistry to Industrial Pursuits.

Students' Fees may be known on Application.

Plans, &c., for Chemical Apparatus and Manufactories are supplied, and the Erection of Plant and Buildings is superintended when required.

TECHNICAL EDUCATION.

SCIENCE AND ART DEPARTMENT.

Royal College of Science for Ireland,

STEPHEN'S GREEN, DUBLIN.

Session—1871-72.

This College supplies, as ar as practicable, a complete Course of Instruction in Science applicable to the Industrial Arts, especially those which may be classed broadly under the heads of CHEMICAL MANUFACTURES, MINING, ENGINEERING, and AGRICULTURE.

A Diploma of Associate of the College is granted at the end of the Three Years' Course.

There are Four Royal Scholarships, of the value of £50 each yearly, with Free Education, including Laboratory Instruction, tenable for two years. Two become vacant each year. They are given to Students who have been a year in College. There are also Nine Exhibitions attached to the College, of £50 each, with Free Education and Laboratory Instruction, tenable for three years. Three become vacant each year. These are awarded at the Annual May Examinations of the Science and Art Department.

The Fees are £2 for each Course, or £10 for all the Courses of each year, with the exception of Laboratory.

The Laboratory Fee is £12 for the full Course of nine months, or £2 per month.

SUBJECTS OF INSTRUCTION.

Applied Mathematics, Mechanism and Machinery, Descriptive Geometry, Geometrical, Mechanical, and Engineering Drawing, Experimental Physics, Chemistry (Theoretical and Practical), Botany, Zoology, Geology and Palæontology, Mining, Surveying, Agriculture.

The Laboratory is open for Instruction in Practical Chemistry, Metallurgy, and Assaying, from ten to four o'clock every week-day during the Session, except Saturdays and Holidays.

The Session commences on MONDAY, OCTOBER 2.

Programmes may be obtained on application to the Secretary Royal College of Science, Stephen's Green, Dublin.

FREDERICK J. SIDNEY, LL.D., Secretary.

THE CHEMICAL NEWS.

Vol. XXIV. No. 620.

NOTE ON A NEW SCOTCH ACIDULOUS CHALYBEATE MINERAL WATER.

By JAMES DEWAR, F.R.S.E.

It is generally known that this country is extremely deficient in well-marked chalybeate waters. Plenty natural waters, containing small proportions of iron, are to be met with in the United Kingdom; but, with the exception of those of Tunbridge Wells, Harrogate, Sandrock (Isle of Wight), Heartfell, near Moffat, and Vicarsbridge, in the vicinity of Dollar, they contrast very unfavourably with those of the numerous spas of the continent of Europe. If we restrict ourselves to an examination of the chemical characters of the above-mentioned Scotch chalybeates, we observe that the iron is present in large quantities in the form of sulphate, along with sulphate of alumina, on which account they are more nauseous to invalids, and are at the present time rather unpopular.

Recently my brother, Dr. Alexander Dewar, Melrose, sent me for analysis a sample of a new well water, whose peculiarity had previously attracted his attention. A chemical examination of the water in question showed it to be a well-defined acidulous chalybeate, unusually rich in carbonate of iron. The following are the analytical details. (As the surface-water gets access at present, a very exhaustive analysis appeared unnecessary):—

	Grs. per gallon.
Carbonate of iron	17·5
Alumina	1·8
Silica	8·5
Sulphate of magnesia	7·8
Chloride of calcium	16·0
Carbonate of calcium	4·1
Alkaline chlorides	11·4
	67·1

Carbonic acid gas per gallon 40 cubic inches.

With the exception of the celebrated "Dr. Muspratt's chalybeate," at Harrogate, which contains 10·8 grains per gallon of carbonate of iron, along with 16·0 grains of protochloride, I do not know of any natural water in this country containing such a large proportion of iron in the form of carbonate. And it is to be observed that the water is not associated with a large quantity of other salts.

The well whence the foregoing sample was taken has not been long sunk, and its water is perfectly different from all of those in its immediate vicinity. Should it maintain its present character, I have no doubt that, judging from its own qualities, as well as from its favourable climatic situation, along with the general interest attached to the locality, this chalybeate is certain to recommend itself to the medical profession.

ON THE ESTIMATION OF SULPHUR BY BARIUM.

By E. F. TESCHEMACHER and J. DENHAM SMITH.

We have read the remarks of Messrs. Nicholas Glendinning and Alfred Edger, in the Chemical News, on the "Estimation of Sulphur by Barium."

In our memoir on this subject we pointed out that when a boiling solution containing sesquioxide of iron, sulphuric acid, and a large excess of hydrochloric acid was precipitated by chloride of barium, and the resulting sulphate of barytes washed by moderately strong and hot hydrochloric acid, and finally, by boiling water, there might sometimes be observed on the sides and bottom of the beaker containing the filtrate and washings, after these had cooled and been allowed to stand for several hours, a film, which film we stated to be sulphate of barytes; adducing this observation as one proof amongst others of the solubility of sulphate of barytes in hot and moderately strong hydrochloric acid.

Now, the very first statement Messrs. Glendinning and Edger make, after announcing that they differ from our conclusions, is, "We attribute this (film?) to sulphate of iron" (*sic in orig.*).

In the face of the absurdities involved in this quotation, and the proof it affords of the incompetency of its authors, our would-be critics, to deal with any question of analytical chemistry, we take leave to decline following them through the opinions, contradictory statements, and unproved assertions which compose the rest of the remarks of these somewhat hazy writers of Newcastle-on-Tyne.

NOTES ON THE COLOUR OF FLUORESCENT SOLUTIONS.

By Professor HENRY MORTON, Ph.D.,
President of the Stevens Institute of Technology, N.J.

II.

I have recently observed a curious action, which while it in no respect affects the general conclusions given in the Chemical News (vol xxiv., p. 77), nor the main observations on which they were founded, throws out the corroborative experiments by which I thought that they might be established when a spectroscope was not at hand.

Obtaining some very anomalous results of late, I was led to mistrust the action of the Geissler-tubes in which the solutions had been examined. These were of the ordinary kind of jacketed spirals, selected as being nearly identical in size and other particulars.

It had been observed from the first that the internal spiral gave a faint blue fluorescence, which could only be seen on close inspection, and in all cases the tube being but partly filled, it was considered that a light appearing in the part covered by the fluid, many times more bright than that from the uncovered part of the spiral, was sufficient evidence of fluorescence in the liquid.

Late experiments have, however, proved that this was not so. Any liquid, however devoid of fluorescent properties, gives all the appearance of fluorescing in these tubes, and on a little thought the cause of this became clear.

The only fluorescent light that can be seen from the glass of the spiral is that which comes off tangentially, the foreshortening increasing its effect, while from the outer surface, that emitted radially is masked by the bright electric discharge behind.

In passing from the glass to air most of this light will suffer total reflection at the outer surface of the glass, but if water or any other liquid is substituted for the air, its greater refracting power (approaching that of glass) will diminish the above-named action, so that much more of the light will reach the eye. The truth of this explanation was supported by the observation that the nearer the index of refraction in the liquid came to that of glass the brighter was the light seen through it.

This fact renders of no account the observations before made on filtered and diluted solutions of turmeric, but a fresh observation with the spectroscope on tubes free from fluorescence, has fully confirmed my former conclusions as to the true colour of fluorescence in this liquid.

No correction need be applied to the description already published in the case of the asphalt solution, but I may add to what was there stated another striking example.

If one of the little Geissler-tubes containing nitrogen, called spectrum-tubes, be jacketed by means of a perforated cork and a large glass tube, and the jacket filled with pure or non-fluorescent benzine, then illuminating the tube, and with a pipette dropping in that petroleum product called "cosmoline," a lubricating oil made by E. F. Houghton, of Philadelphia, each drop will appear of a rich blue as it dissolves in the benzine, which soon acquires a magnificent blue fluorescence. Increasing, however, the quantity of the cosmoline oil until its colour begins to take effect, the tint of the fluorescence gradually changes to a rich green. By a little care a blue solution may be superposed on a green one in the same tube.

Mr. Houghton informs me that this "cosmoline" is prepared by concentration from crude petroleum at low temperatures by the aid of a vacuum, accompanied by filtration through animal charcoal, by which colour and odour are removed.

Another semi-solid preparation of cosmoline which has a very light colour gives a solution with benzine fluorescing of a magnificent blue.

Returning to the solutions of turmeric, I have found that the fluorescent body in that substance is not its essential oil nor its brown colouring matter, but either the yellow colouring matter itself or something so closely allied to it in solubility that I have thus far been unable to effect any separation.

In connection with this, I am much indebted to Mr. Robert F. Fairthorne, of Philadelphia, who has aided me greatly in the preparation of the various constituents of turmeric in a state of purity.

In my former paper I mentioned that uranium nitrate in solution gave a very faint fluorescence. This appearance, I now find, was due entirely to the above explained action of the tube, and a number of carefully conducted observations now convince me that this substance, while it fluoresces so vividly in the solid state, loses that property entirely when in solution.

DETERMINATION OF COPPER, NICKEL, AND ZINC BY THE BATTERY.

By J. M. MERRICK, S.B.

(Continued from p. 101).

The amount of zinc contained in the double sulphate of zinc and ammonia was next determined.

The sulphate was made with utmost care, and well crystallised.

The crystals were weighed in the platinum crucible, dissolved in hot water, the solution supersaturated with ammonia, and subjected to the action of a comparatively feeble galvanic current.

If too strong a current be used, the deposit will become flaky or spongy, and very difficult to wash and dry unoxidised. This was the case in the second determination below, which accounts for the comparatively large error.

The deposit of zinc was washed with water first, then with alcohol, and very carefully dried and weighed.

(*l*). 0·5443 grm. ammonio-sulphate of zinc gave 0·088 grm. metallic zinc = 16·16 per cent.

(*m*). 0·815 grm. ammonio-sulphate of zinc gave 0·133 grm. metallic zinc = 16·31 per cent.

In this case, as explained above, the deposit was spongy, and probably oxidised a little.

Theory.	*l.*	*m.*
16·20	16·16	16·31

Some determinations of copper in the purified and re-crystallised sulphate were also made with the following results, viz.:—

(*n*). 0·77 grm. sulphate of copper gave 0·1959 grm. metallic copper = 25·44 per cent.

(*o*). 0·79 grm. sulphate of copper gave 0·2013 grm metallic copper = 25·46 per cent.

Theory.	*n.*	*o.*
25·46	25·44	25·46

The atomic weight of copper is here taken at 31·75.

The following determinations were made with larger amounts of the salts, and in a large platinum dish.

(*p*). 1·0075 grm. double sulphate of nickel and potash gave 0·1334 grm. metallic nickel = 13·24 per cent.

(*q*). 0·39212 grm. double-sulphate of nickel and potash gave 0·5286 grm. metallic nickel = 13·45 per cent.

(This determination may fairly be thrown out, as the battery was allowed to run all night, and the nickel on the edges of the liquid had a chance to oxidise, and thus increase the apparent percentage up to 13·45).

In the following determination the large dish used was counterbalanced to within 2 grms. by platinum crucibles, and abundant time allowed in every weighing for the platinum vessels on each scale to condense the amount of moisture proper to the temperature of the balance case.

The balance used is one of Becker's make, turning readily with 0·0001 grm. when loaded with 55 grms. in each pan; but even this is, I am confident, not delicate enough for the perfectly accurate determination of small quantities of metals by the galvanic method.

(*r*). 1·7857 grms. double phosphate of nickel and potash gave 0·2369 grm. metallic nickel = 13·27 per cent.

Theory.	*p.*	*q.*	*r.*
13·29	13·24	13·45	13·27

It will be observed that in this method of determination the metal is weighed *as such*; that is, we have no assistance in our work from an increased atomic weight, as *e.g.*, when sulphur is determined as sulphate of baryta, and, consequently, the utmost care is required in weighing. In every case, for exact work, the platinum dish should be balanced as near as may be by one of equal size. The metallic deposits should be washed with alcohol, dried very cautiously, and the plated dish allowed to stand on the balance at least ten minutes before its weight is taken. In this way, and by using for the work an only moderate battery power, I believe determinations can be made whose exactness and nicety will depend on the delicacy of the balance employed.

Indeed, I see no reason to doubt that, with a sufficiently delicate balance, the results will not vary much in the third decimal figure, and I believe it is by this process that the atomic weights of copper, nickel, and cobalt will finally be settled.

Laboratory, 59, Broad Street, Boston, Mass., U.S.
August 15, 1871.

CONTRIBUTION TO OUR KNOWLEDGE OF THE COLOURING MATTER CONTAINED IN COCHINEAL.

By C. LIEBERMANN and W. A. VAN DORP.

In order to judge of the constitution of the colouring matter of cochineal we considered it best first to investigate the nature of the nitrococcic acid, as being the most thoroughly known product of the decomposition of the colouring matter alluded to.

The acid just mentioned is formed by the action of nitric acid upon the colouring matter, while, according to Warren de la Rue, the formula of nitrococcic acid is $C_8H_5(NO_2)_3O_3$. Since this acid, as stated by the author just named, saturates two atoms of basis, it cannot be the nitro-product of one of the isomeric methoxybenzoic acids, but it might be, as suspected by Strecker, derived from a cresotic acid provided the formula (above-mentioned) correctly expresses the molecular size of the acid.

We have found that nitrococcic acid can be obtained readily and in large quantity by employing for its preparation commercial carmine instead of the chemically pure pigment of cochineal, which is difficult to prepare. When finely pulverised, carmine is gradually put into a vessel containing boiling nitric acid (sp. gr. 1·37) as long as the violent evolution of red vapours continues; the whole mass solidifies after evaporation, yielding a mixture of crystals of oxalic and nitrococcic acid, from which the former is removed by re-crystallisation from a very weak nitric acid solution, the latter being obtained in a pure state in the shape of large foliated silvery crystals. On heating the nitrococcic acid along with water to 180° in a sealed tube, there escapes from the latter, when opened after the operation, a considerable quantity of carbonic acid, while at the bottom of the yet warm tube an oily fluid is observed, which, on cooling, solidifies, exhibiting a yellow-coloured crystalline structure; by the aid of water, in which liquid nitrococcic acid is more readily soluble, the newly formed substance is freed from any adhering nitrococcic acid. On further investigation of the yellow-coloured body, it was found to possess the composition of trinitrocresol, $C_7H_4(NO_2)_3OH$, agreeing, as regards its properties, in all respects with the trinitrocresol obtained by Duclos from coal-tar cresol. The trinitrocresol obtained by us, as just mentioned, fuses at 104°, and its potassa salt, $C_7H_4(NO_2)_3OK$, crystallises from an aqueous solution, exhibiting yellow coloured, needle-shaped crystals.

Nitrococcic acid is, consequently, one of the isomeric trinitro-cresotic acids, but, since these have not been hitherto obtained from any of the now-known cresotic acids, it is not possible by comparison to decide from which of these acids it is derived. The dissociation of nitrococcic acid by the action of water takes place according to the following formula:—

$$C_8H_5(NO_2)_3O_3 = C_7H_5(NO_2)_3O + CO_2.$$

The same kind of dissociation takes place when nitrococcic acid is heated along with pure hydrochloric acid to 180°; no substitution of the nitro-group by chlorine takes place.

From the formation of cresol from nitrococcic acid, we conclude that the colouring matter of cochineal contains methyl groups to which remnants of benzol (*benzolreste*) unite. In order to protect that portion of the molecule of carmine which, by the action of nitric acid, becomes nitrococcic acid, from the oxidising and nitrating influence of that acid, we have tried to bring about a dissociation of the pigment by means of concentrated sulphuric acid.

When a solution of carmine in concentrated sulphuric acid is submitted to heat, the yellowish-red colour of that solution changes at 120° into violet, while CO_2 and SO_2 are evolved; the heat having been increased to, and kept for some time at, 140° to 150°, there is, by the addition of water to the acid solution, precipitated another newly formed pigment in the shape of a brown-coloured flocculent substance, which, having been collected on a filter, well washed, and next dried, and then treated with boiling alcohol, leaves, on evaporation of that menstruum, the new body which we term *ruficoccin*, difficultly soluble in cold water, and thereby distinguished from carminic acid and carmine-red, soluble in alcohol, exhibiting a magnificent yellow fluorescence. This substance is, to some extent, sublimable, giving off red fumes, and solidifying in needle-shaped yellowish-red crystals. Previously mordanted textile fabrics are dyed by this pigment similar to cochineal, but the dyes are less brilliant; upon being analysed, the formula of this body was ascertained to be $C_{16}H_{12}O_6$.

Considering the origin and reactions of ruficoccin, and finding these to be very nearly analogous to rufigallic acid and the opianic acid pigment, $C_{14}H_8O_6$, derived from anthracene, we do not doubt that it (the ruficoccin) contains the complex of dimethylanthracen, and that, we think, the constitutional formula of the former mentioned substance is—

$$C_{14}H_2\begin{cases}(CH_3)_2\\(OH)_4\\II\\O_2.\end{cases}$$

The origin of ruficoccin can be readily explained when it is assumed that two molecules of the substance which, by nitration form nitrococcic acid, join with elimination of water.*

$$2\left(C_6H_2\begin{matrix}CH_3\\(OH)_2\\COOH\end{matrix}\right) - 2(H_2O) = C_{14}H_2\begin{cases}(CH_3)_2\\(OH)_4\\II\\O_2\end{cases}$$

The behaviour of ruficoccin with zinc dust confirms our view just expressed, for by the action of that metal ruficoccin yields a hydrocarbon akin to anthracen, which new hydrocarbon fuses at a high temperature, and sublimes, forming a white foliated matter, which combines with picric acid, yielding a red-coloured combination. The hydrocarbon alluded to fuses at 190°, but we have not analysed it as yet, being desirous to obtain it in larger quantity first. The formula found by us for ruficoccin is closely the same as that which Hlasiwetz and Grabowsky have found for coccinin obtained by the dissociation of carmine-red under the influence of fusing caustic potassa; coccinin behaves as a hydrochinon of ruficoccin, since, after its (the coccinin's) spontaneous oxidation by contact with air, it exhibits the same colouring phenomena as ruficoccin does. The fact that by the fusion with caustic potassa the reduction product is formed agrees with the analogous behaviour of anthrachinon; Hlasiwetz and Grabowsky have observed that along with coccinin succinic acid was formed. Although these chemists ascribe the formation of that acid to the decomposition of a glucoside sugar, it is, according to newly-made discoveries by Baeyer† on pigments, and considering the similarity of the cochineal pigment with the pigments contained in some kinds of dye-wood, not quite impossible that carmine-red is either a derivative of succinic acid, or from an acid which, by fusing with caustic potassa, is converted into succinic acid.—*Berichte der Deutschen Chemischen Gesselschafft zu Berlin.*

* The fact that this compound contains 1 atom of oxygen more than the cresotic acid, the mother or parent substance (*Muttersubstanz*) of the nitrococcic acid, is explained by the observation that, by the dissociation of the cochineal pigment by nitric acid, the gap, or breach rather, made by the dissociation is filled by NO_2, while, in the case of the dissociation by sulphuric acid, the breach is filled by OH.

† These will be published in our columns at a future date.

NOTE ON PURE CARBOLIC ACID.

By Professor CHURCH, M.A.

Since 1856 I have occupied myself a good deal with experiments as to the practical hygienic applications of carbolic acid, particularly as to its use in dentistry and in throat affections, and also as regards its employment as a disinfectant. The rank of carbolic acid as a most valuable contribution from chemistry to medicine is so well assured that it is unnecessary to insist upon this point here. Yet there is an objection urged against this substance, which has some apparent force, simply because the best preparations of commerce are so seldom free from a gas-like or naphthalic odour, which, though entirely foreign to carbolic acid itself, has condemned its use in some quarters. About 11 years ago, in preparing pure carbolic acid for the use of a surgeon-dentist to whom I introduced it, I adopted a plan which I shortly afterwards described before the Odontological Society, and to which I have been lately asked to give greater publicity. My plan, which is very simple, is as follows:—

One pound of the best carbolic acid of commerce (I use Calvert's white crystallised acid) is poured into 20 pounds

of cold distilled water, taking care not to permit the *whole* of the acid to enter into solution. With a good sample, if after shaking repeatedly at intervals, between two and three ounces of the acid remain at the bottom of the vessel used, this will be a sufficient residue to hold and contain all the impurities. With bad samples, less water must be used or more acid. The aqueous solution should be syphoned off, and filtered if necessary through Swedish paper till perfectly clear; it is then placed in a tall cylinder, and pure powdered common salt added with constant agitation till it no longer dissolves. On standing the greater part of the carbolic acid will be found floating as a yellow oily layer on the top of the saline liquor, and merely requires to be removed by a syphon or pipette to be ready for use. As it contains 5 per cent or more of water, it does not generally crystallise, but it may be made to do so by removing it to a retort, and distilling it from a little lime. The portion collected up to 185° C. or thereabouts has at ordinary temperatures scarcely any odour, save a faint one resembling that of geranium leaves; and I have taken advantage of this curious resemblance still further to mask the slight smell proper to absolutely pure carbolic acid by the addition to it of four drops per fluid ounce of the French oil of geranium. This addition has the further advantage of liquefying the pure crystallised product.

The carbolic acid purified as above has been so highly appreciated by those professional and private persons to whom I have distributed samples, and who were dissatisfied with the purest commercial samples, that I have thought it best to publish my simple plan, for which, however, I claim no originality. It involves, I know, considerable loss of material, but the saline liquor remaining may be distilled and thus made to yield up a second portion of pure carbolic acid, and it will be found a very pleasant and effective domestic disinfectant and deodoriser.

When dissolved in 230 parts of water and used as a gargle, or in 25 parts for painting the throat, or in 50 parts for a carbolic spray, the pure acid is rarely, if ever, objected to even by the most fastidious person. Of course it may be readily mingled with olive or other oil (1 : 25) or with glycerine, for dressing cuts and sores, and when introduced into the little air-purifier invented by me and noticed in your columns some months back, diffuses wholesome and inoffensive vapour in any place where there are disagreeable effluvia of vegetable or animal origin.

THE GASES FROM THE BESSEMER CONVERTER.

By W. MATTIEU WILLIAMS, F.C.S.

Mr. Snelus, in his paper printed in the last number of the Chemical News, disputed my supposition that the brilliancy and whiteness of the Bessemer flame, especially in its latter stages, may be partially due to the combustion of hydrocarbons, the basis of his conclusion being that he does not find any hydrocarbons by the means he has adopted for collecting the gases.

I never supposed that he would find any hydrocarbons there, for the simple reason that they must be oxidised before they reach the mouth of his collecting tube. He might as well dispute the combustion of carbon because he finds no uncombined carbon in the same place. If I am right, he should find not hydrocarbons, but the products of hydrocarbon combustion, viz., carbonic acid, carbonic oxide, and *water*. He has looked for and found the two former, but has altogether omitted the consideration of the water.

In consequence of this omission, his investigations throw no new light upon this question, but leave it exactly where he found it. He does not tell us whether any deposition of moisture could be obtained by cooling down his sealed collecting tubes, or anything else concerning the hygrometric condition of the gases they contained. All the analyses stated by Mr. Snelus make up exactly the 100 parts without any loss. Did he dry his gases before making these analyses, and if so, how much did they lose in drying? If they were dry already, what became of the water originally contained in the atmospheric air used for the blast?

In asking these questions I am not finding fault with what Mr. Snelus has done, but, on the contrary, regard his work as an important contribution to our knowledge on this subject. My object is simply to show that further investigations are necessary before the question which I raised respecting the hydrocarbons can be answered either way.

My reasons for suspecting that hydrocarbons are burning in the Bessemer flame are—that the so-called "carbon spectrum" which it exhibits is far more complex than the carbon spectrum proper; that the colour and general appearance of the flame is quite different from that produced by the combustion of simple carbon or carbonic oxide under such circumstances; that the spectrum is more like a hydrocarbon than a simple carbon spectrum; that the flame presents exactly the appearances we can obtain by artificially mixing carbonic oxide and hydrocarbon (coal-gas for example) in certain proportions; and, further, that in the Bessemer converter during the blow we have the materials and conditions which, theoretically, should produce such an admixture of hydrocarbon and carbonic oxide.

I protested against the looseness of describing the Bessemer spectrum as a "carbon spectrum" on the ground that each compound of carbon affords its own special spectrum, and that the Bessemer spectrum is one of these compound spectra, and I directed the attention of spectroscopists to the interesting practical questions relative to the state in which carbon exists in steel which the study of the Bessemer spectrum might help to solve if it could reveal the composition of the Bessemer flame. My paper was written before Dr. Watts's recent investigation on this subject were published. These have, in a great measure, removed the objections I made to the previous spectroscopic investigations of the Bessemer flame.

In examining this subject we must always remember that we are not dealing with an ordinary hollow flame supplied with oxygen from outside. From such a flame we might, by the method adopted by Mr. Snelus, obtain the *combustible* gases. The Bessemer flame is quite different. It is supplied by forcing air through *solid* combustibles, some of which yield gaseous *combustion products*. Mr. Snelus can only thus obtain the gaseous products of combustion by his method, and even though he had looked for water and found it among them, the question of whether hydrocarbons were burning would still remain unanswered. If, however, the spectroscopist can succeed in identifying the characteristic spectrum of the Bessemer flame with that of any particular hydrocarbon, or nitrocarbon such as cyanogen, or a mixture of cyanogen and hydrocarbon, he may throw some light on the much debated question of whether steel is a compound of simply iron and carbon, or iron and a hydrocarbon, and why it is that cyanides and other nitrocarbon compounds are so effective in steel making.

Woodside, Croydon,
Oct. 7, 1871.

NICKEL PLATING AS APPLIED TO PHOTOGRAPHIC PURPOSES.

By JOHN SPILLER, F.C.S.

About ten years ago, when visiting the bank-note printing establishment of Messrs. Bradbury and Wilkinson, in Fetter Lane, I was shown some nickel-coated plates from which the "nature printing" specimens had been prepared, and had an opportunity of seeing the electro-deposition

of pure nickel upon copper and other metals practically carried out as one of the branches of their printing operations. This process was being applied conjointly with, or as a substitute for, the method of steel facing (*acierage*) of which they are the patentees, and it struck me at once that the permanent quality of the nickel deposit so formed was capable of wider application, and might serve as a means of protecting steel objects from the rusting influence of damp air.

At my suggestion a few steel articles—particularly a dinner-knife, spatula, and split-ring—were coated with nickel, in order to test the degree of protection which such a process would offer when applied to swords, bayonets, helmets, breast-plates, spurs, harness chains, and steel accoutrements generally. The experiment proved perfectly successful, and without prejudice to the colour, and steps were then taken with the view of submitting the idea to the notice of the War Office authorities, particularly as the cost of applying such a process did not appear likely to stand in the way of its general adoption when the great saving of time in cleaning these articles was duly taken into account.

Beyond establishing the fact, no immediate result followed, and from that time to the present year the application of electro-deposited nickel has, so far as I am aware, been restricted to the specific purposes for which Messrs. Bradbury and Wilkinson have continued to apply it in their establishment. Within the last two or three years fresh attempts in my original direction have led to the employment of this process in America, where a patent was taken out for the application, and a company now working under a licence of the American patentees has recently commenced operations in London and Birmingham. I am indebted to the energetic manager of the Plating Company (Limited), Mr. Channer, of 34, Kirby Street, Hatton Garden, for the opportunity of inspecting a vast collection of objects to which the nickel-coating has been applied, and have been furnished likewise with small specimens of copper, brass, and steel coated with the metal in question, by which I am enabled to substantiate the statements made in their prospectus relative to the wonderful degree of protection afforded to the underlying metals by the superficial deposit of pure nickel. I have since had my regulation sword coated at their works, and find it now perfectly secured against rusting in wet weather, and so easily kept in condition that the blade and scabbard require only to be wiped with a washleather, instead of undergoing the tedious process of burnishing, to fit it for appearance on parade.

A small square bar of steel similarly coated has been repeatedly immersed in water for hours together without showing any signs of rusting, and I find it possible to bury it in flowers of sulphur for several days without tarnishing the lustre of the nickel surface. Neither has this latter severe test any effect upon the copper and brass bars upon which the nickel coating has been applied, and these metals may even be immersed in an aqueous solution of nitrate of silver without effecting the reduction of that metal. In one of the angles only, where the coating seems to be imperfect, was there any indication of silver reduction in the case of the brass tube, the steel bar being perfectly protected over the whole surface against the action of silver and copper solutions. Here, then, is a valuable property which I was not led to anticipate in the case of electro-deposited nickel, for I could not have predicted from my chemical knowledge that a metal of the zinc and iron group would be proof against the action of nitrate of silver; but the experiment proves it to be so, and we must regard pure nickel as belonging (from this point of view) to the class of noble metals, resisting, like gold and platinum, the attack of sulphur and of highly corrosive metallic solutions.

The nickel facing when burnished has a whiter colour than polished steel, although not equal to silver itself, its aspect being rather that of rolled platinum. A chemist to whom I showed the specimens pronounced them at once to be very similar to platinum in regard to colour, thus confirming my own impression on this head. It withstands the action of heat also remarkably well, for the fusion-point is very high, and oxidation occurs only at elevated temperatures. With the view of testing its general applicability to laboratory work I am having a brass scale-pan coated with nickel, and will report later as to its success. For fine balance beams and weights, lens mountings, reflectors, laboratory microscopes, Sykes's hydrometers, still worms, egg beaters, camera fittings, and a variety of apparatus used by the chemist and photographer, the nickel coating will probably find extensive application; and I have seen some oval picture-frames of very pretty effect made from stamped brass coated with nickel. It remains to be mentioned that burnished and matt surfaces of this metal may be used in combination for ornamental purposes.—*The Photographic News.*

ON THE DETERMINATION OF MOLYBDIC ACID AS PLUMBIC MOLYBDATE.

By THOMAS M. CHATARD.

Great difficulty has always been experienced in determining molybdenum by any of the methods generally in use. The precipitation as mercurous molybdate, and the subsequent treatment, are both tedious and unsatisfactory, and an accurate determination as sulphide is almost impossible, the filtrate remaining blue even after repeatedly passing sulphydric acid and filtering.

The following method will, I hope, be found to give satisfaction, both as to ease of working and accuracy of results.

Add to the boiling solution of the molybdate, plumbic acetate in slight excess. Boil for a few minutes; the precipitate, at first milky, will become granular and will subside easily, leaving a perfectly clear supernatant liquid. Care must be taken in boiling, as the thick milky fluid is very apt to boil over. A ribbed filter is to be used and the precipitate is to be washed with hot water. The washing proceeds with great ease and thoroughnes, and not the slightest milkiness should be apparent in the filtrate. The precipitate is dried at 100°, separated from the filter and ignited in a porcelain crucible.

The results were as follows:—

Grms.			Grms.		Per cent.
1·0744	Na_2MoO_4	gave	1·9176	$PbMoO_4$	= 46·64 Mo.
1·4440	,,	,,	2·5738	,,	= 46·60 ,,
1·2221	,,	,,	2·1811	,,	= 46·66 ,,
1·2871	,,	,,	2·2999	,,	= 46·74 ,,
			Mean = 46·66.		

The theoretical percentage of Mo in Na_2MoO_4 is 46·60 if Mo = 96, this being the number given by the most recent determinations.

The process seems therefore to give very good quantitative results, and is both easy and expeditious. The precipitated molybdate separates easily from the filter and can be heated to low redness without decomposition.

Analogy would seem to offer a good method for tungstic acid, and experimental analyses were made for this purpose, but after repeated trials the process was finally abandoned, as the precipitate came down so finely divided that it passed through the filter. The precipitation seems, however, to be complete, and I have hopes that with closer filter paper greater success will be obtained.

Attempts were made to determine arsenic as arsenate of lead, but without good quantitative results. On the other hand, I tried to determine lead as molybdate, tungstate, and arsenate, but without success, as the presence of an excess of the precipitant in such cases seems to exert an injurious effect, the filtrate or washings speedily becoming cloudy.

It may not be out of place to mention some work upon molybdenum undertaken some time ago, which, though unsuccessful, is not without interest. Various methods were devised of weighing the molybdenum as sulphide.

One way was to precipitate molybdic acid as mercurous molybdate in the usual manner. The suspended molybdate was boiled and sulphydric acid passed into the boiling liquid.

The mercurous molybdate was decomposed and mercurous sulphide and molybdic sulphide were the results. The sulphides were thrown upon a filter and washed with cold sulphydric acid water, dried and ignited in a current of sulphydric acid, but this process failed to give satisfactory results.

Again, sodic molybdic was heated with four parts of dry sodic hyposulphite till all the free sulphur was driven off, leaving, according to theory, $Na_2SO_4 + MoS_3$. The mass was then digested with hot water, filtered and treated as before. When any of the sulphur was left, it was found that some of the molybdenum went into solution as sulphomolybdate of sodium. Even after adopting every precaution, enough was still dissolved to vitiate the analysis: —*American Journal of Science.*

ON THREE MASSES OF METEORIC IRON FROM AUGUSTA CO., VIRGINIA.*

By J. W. MALLET,
Professor of Analytical and Applied Chemistry, University of Virginia.

Nearly two years ago I learned that a lump of iron, which from the description given of it I supposed to be meteoric, had been turned up by the plough in Augusta Co. in this State, and soon afterwards I obtained possession of this specimen by the kind assistance of Hon. J. B. Baldwin, of Staunton. It proved to be beyond question a meteorite, weighing about 56 lbs.

A few months later, I saw at the Annual Fair of the State Agricultural Society in Richmond, a second mass, of smaller size, weighing about 36 lbs., which had come from the same county, and was exhibited along with some iron ores by Major J. Hotchkiss, of Staunton. Learning from me that I was about to examine and analyse my own specimen, and was anxious to compare it with the other found in the same part of the country, Major Hotchkiss was obliging enough to lend me the latter, and to permit me to cut off enough for analysis.

Quite recently he has placed in my hands a third specimen — also from Augusta Co. — weighing but about 3½ lbs.

I shall speak of these three masses as No. 1, No. 2, and No. 3, in the order in which they are mentioned above; No. 1 being my own specimen, and Nos. 2 and 3 those of Major Hotchkiss.

All three present quite the same general appearance. They are of a very irregular pear shape, one end of each mass being larger and more rounded than the other—the smaller end of each is somewhat flattened, but by concave surfaces, in one direction. No 1 was more massive and rounded than the others—No. 2 most flattened—the latter had some rude resemblance in shape to a shoulder of mutton. The dimensions of the masses before cutting were as follows:—

	No. 1. Centimetres.	No. 2. C.m.	No. 3. C.m.
Maximum length	28	27	11
,, width, at large end	21	10	9
,, ,, at small end	17	19	5
,, thickness, at large end	13	13	8
,, ,, at small end	11	5	3

The exact weights before cutting were:—

No. 1.	No 2.	No. 3.
25,429 grms.	16,441 grms.	1644 grms.

the masses being entire, nothing having been previously detached from any one of them.

The surface of each of the masses is rough and irregular. At some points, which have been rubbed, the iron exhibits its metallic lustre, and traces of its crystalline character may be observed, but nearly the whole surface is covered with a dark brown crust, consisting essentially of hydrated ferric oxide, which varies from about an eighth to a third of an inch in thickness. This crust is hard, and pretty firmly adherent. On exposure to moist air a rusty liquid exudes in drops from numerous points upon the surface, and in this watery liquid chlorine, iron (chiefly as ferrous chloride), and nickel were detected. The masses are of course magnetic, and on examination give evidence of feeble magnetic polarity, with multiple poles.

The union of hardness and toughness in the iron makes it quite difficult to cut, and in attempting to obtain with the planing machine a slice of considerable size the ordinary cutting tools were blunted and broken; it was found necessary to drill a row of holes and connect these by a cut made with the planer.

The specific gravity was taken for Nos. 1 and 2 with solid pieces of about 140 grms. and 95 grms. respectively, cut from the interior of the masses, and for No. 3 with about ten grms. of clean shavings (from the planer) in a specific gravity bottle.

The results were:—

	No. 1.	No 2.	No. 3.
Specific gravity, at 15° C.	7·853	7·855	7·839

The interior structure of the iron is compact and highly crystalline, of much the same general character throughout, but a few small grains and streaks of a brownish yellow mineral were noticed, which on being picked out and examined proved to be troilite. They are, however, minute fissures running through several portions of the metal.

Traces of the Widmannstättian figures may be detected upon a polished surface even without the aid of an acid, and when the iron has been etched by nitric acid the markings are exceedingly distinct and beautiful, fully as much so as in any specimen of meteoric iron I have ever seen. The general appearance is a good deal like that of the iron from Lenarto in Hungary, and some of the Mexican specimens. In the mass No. 1, upon the principal cut surface, narrow, well-defined bands of alternate nickel-iron and Schreibersite are parallel or intersect each other at angles of about 60° and 120°; in the figures on the principal surface of No. 2, the angles of intersection more nearly approach 90°; on the much smaller cut surface of No. 3, the figures are somewhat more irregular, but the angles approach 60°. By etching surfaces obtained in other planes it was rendered evident that the difference of appearance is merely due to looking at different projections of the same crystalline structure.

The metal soon rusts upon cut surfaces, especially where the exudation of chlorine occurs, and this renders more distinctly visible the slight fissures which penetrate the interior.

The iron is not passive, though very easily rendered so by nitric acid. It reduces copper rather slowly from the sulphate, and if the whole surface be covered by the latter metal and then washed under a stream of water, rubbing hard with the hand or a cloth, a part of the copper comes off very easily, leaving the remainder firmly attached and reproducing very beautifully the Widmannstättian figures, obviously a case of galvanic deposition, the Schreibersite being the electro-negative solid and receiving the coating of copper.

By the prolonged action of acid delicate white laminæ of Schreibersite are brought into view, which if com-

* From the *American Journal of Science and Arts*, vol ii., July, 1871.

pletely detached are found to be flexible and strongly magnetic.

The following are the results of chemical analysis :—

	No. 1.	No. 2.	No. 3.
Iron	88·706	88·365	89·007
Nickel	10·163	10·242	9·964
Cobalt	0·396	0·428	0·387
Copper	0·003	0·004	0·003
Tin	0·002	0·002	0·003
Manganese	trace	—	trace
Phosphorus	0·341	0·362	0·375
Sulphur..	0·019	0·008	0·026
Chlorine	0·003	0·002	0·004
Carbon	0·172	0·185	0·122
Silica	0·067	0·061	0·056
	99·872	99·659	99·947

These numbers are so closely accordant that there can be no doubt of the masses being essentially identical in chemical composition.

The nickel and iron were separated, in a cold and quite dilute solution, by means of carbonate of baryta, and the precipitates obtained were carefully tested as to purity before the weights were finally accepted as correct.

Considerable quantities of material were used for the determination of the minor constituents. Particular attention was given to the identification of the minute quantity of tin present, as Professor J. Lawrence Smith has lately mentioned* the fact, that he has never found this metal in the course of numerous analyses of meteoric iron. The precipitate with sulphuretted hydrogen, which contained the tin and copper, was in each case obtained from a solution of more than a hundred grms. of the iron.

I feel satisfied that the chlorine is not of meteoric origin —not an essential constituent of the original masses— but has been derived from the soil in which the iron has lain imbedded. The exudation of watery drops containing metallic chlorides is observable only at points on the outside and on cut surfaces along the lines of fissures communicating with the outside. Although chlorine is mentioned above as found in the general analyses of the planing machine shavings, I failed altogether to detect it in a specially selected solid piece of some 50 grms. taken from a part of No. 1 destitute of fissures or flaws.

The siliceous residue is set down as silicic acid, but some of it seems to have in reality existed as silicide of iron. A part of this residue having been examined with the blowpipe to identify it as silicic acid, another portion was looked at with a magnifying power of 250 to 500 diameters, and in polarised light was seen to consist of an amorphous powder, and rounded, transparent grains of very small dimensions, for the most part from 0·0025 to 0·0100 millimetre in diameter, of well-marked doubly refracting character.

It seems in the highest degree probable that these three masses of meteoric iron represent portions of a single fall from the heavens, agreeing so closely as they do in external character and appearance, in density and internal structure, and in chemical constitution; having, moreover, all been found at but short distances from each other. The precise localities from which they came are as follows :—

No 1, from a spot on the land of Mr. Robert Van Lear, about five miles (a little east of) north from Staunton, in 38° 14′ N. lat. and 79° 10′ W. long.

No. 2, from the land of Mr. M. Fackler, about one mile to the south-east of the locality of No. 1.

No 3, about half a mile still further south-east, or rather a little north of a N.W. and S.E. line passing through the last-named locality.

It will be interesting to watch for the possible detection of other masses in the same neighbourhood.

* *Am. Jour. Sci.*, II., xlix., 333, (May, 1870).

This makes the fourth recorded instance of meteorites found within the State of Virginia, the three preceding having been :—

1. Meteoric stone, which fell in Chesterfield Co., June 4th, 1828, (*Am. Journ. Sci.*, I., xv., 195, and xvi., 191).
2. Meteoric iron, found in Grayson Co., described by Professor Rogers of this University in 1852, (*Am. Journ. Sci.*, I., xliii., 169.
3. Meteoric iron, found in Roanoke Co., and described by Professor Rogers in 1842 (*Am. Journ. Sci.*, I., xliii., 169).

ON THE

CHANGE OF COLOUR PRODUCED IN CERTAIN CHEMICAL COMPOUNDS BY HEAT.*

By Professor EDWIN J. HOUSTON,
Of the Central High-School of Philadelphia.

At a meeting of the Optical Section of the Franklin Institute, held April 26th, 1871, Dr. Wm. H. Wahl exhibited specimens of the double iodides of mercury with copper and silver, discovered by Meusel.† The colour of each of these salts is changed in a remarkable manner by the action of obscure heat rays. The author, in connection with Mr. Elihu Thomson, of the Central High School, was led to undertake an extended series of experiments, with a view of ascertaining the law by which these peculiar changes are governed. The author desires to state that Mr. Thomson's share of the investigations was equal to his own.

Familiar changes of a similar though less striking nature at once suggested themselves, among the most prominent of which might be mentioned the darkening of the red protoxide of mercury in the preparation of oxygen.

The experiments were conducted as follows :—

The substances were placed in the state of dry powders on strips of sheet copper, and heated by means of an ordinary Bunsen burner.

It soon became evident that quite a number of compounds underwent a change of colour when so exposed. The colours observed, however, together with those already known, appeared at first to present facts of the most discordant nature.

In some cases the colours were changed so as to approach the violet end of the spectrum, while in others they approached the red end. To avoid all sources of error, the conditions of the original experiment were carefully considered. Briefly they are as follows :—

1. A certain colour presented by the compound at ordinary temperatures.
2. A decided change of colour, on the application of obscure heat rays.
3. A complete return of the original colour on the removal of the heat, and the cooling of the body to its former temperature.

Bodies not presenting all these phenomena were rejected.

The largest class of bodies that was excluded by this method was that in which a permanent change of colour was produced by heat. In this case the change is caused either by the heat being raised to a temperature sufficient to cause a decomposition of the body, by a change from the amorphous to the crystalline state, by a partial sublimation and subsequent deposition of the sublimate, by a change in the crystalline form, or by some other permanent change in the arrangement of the molecules.

Changes in colour produced by dehydration were also rejected, as, for instance, in the case of the chloride of

* From advance-sheets of the *Journal of the Franklin Institute*. Communicated by Dr. W. H. Wahl.

† *Ber. d. Deutsch. Chem. Gessell.*, iii., 123. *Jr. für Prak. Chem.*, II., ii., 136.

cobalt, which, when hydrated, is a pale pink, but when anhydrous, a deep blue. Hydrous and anhydrous salts are distinct chemical compounds, and have therefore a different molecular arrangement. A class of cases of a somewhat similar nature was also rejected. Here the change of colour was produced by a loss of the water of crystallisation, as, for instance, the sulphate of copper, which changes from a deep blue to a white.

After these sources of error were removed and quite a number of bodies discovered presenting phenomena fulfilling all the requirements of the original experiment, the law became evident. *In every case the colour in its change approached the red or heat end of the spectrum.* Not a single exception to this law was observed.

Before stating the explanation of the way in which these changes are produced, a few words in reference to the relation existing between light and heat may be necessary. That light and heat are produced by a vibratory motion of the molecules of bodies, and that they differ from each other, merely in the rapidity of the vibrations of these molecules, the facts presented by the science of the present day, leaves scarcely room for doubt. A hot body differs from another cooler than itself, not in virtue of any peculiar substance or fluid which it possesses, but simply in the fact that its molecules are in more rapid motion. Increasing the temperature of a body is equivalent to increasing the rapidity of the vibration of its molecules. As the body is made hotter, its molecules vibrate more and more rapidly, until finally a *red heat* is obtained, and light is emitted along with the heat. Now we know that a ray of white light, popularly speaking, is a mixture of seven different kinds of rays, viz., the colours of the solar spectrum. Moreover, we know by actual measurement, that these colours, in the order of the number of vibrations required to produce them, commencing with the least, are as follows: red, orange, yellow, green, blue, indigo, and violet, those of the violet being about twice as rapid as those of the red.

If, then, light differs from heat, merely in the fact that the molecules of a body emitting light are in more rapid motion than those of a body emitting heat, when that rapidity in the vibrations of the molecules of a hot body is reached, that it commences to give out light along with the heat, the colour first emitted should be red, since that colour is produced by the least number of vibrations per second, and the colours which successively appear should be orange, yellow, green, blue, indigo, and violet, until finally, these by their intermixture produce white light, and the body becomes *white-hot*. These considerations are fully sustained by the beautiful experiment of Draper, who viewed through a prism the light emitted by a platinum wire heated by a current of dynamical electricity. The colour which first appeared was red, and then successively, orange, yellow, green, blue, indigo, and violet, or more accurately, when the platinum wire became white-hot, it gave a continuous spectrum from the red to the violet.

The boundary between heat and light, then, is found at the extreme end of the red of the spectrum. It is evident that though the range of the spectrum must vary with the sensibility of the eye of the observer—that is, that the heat vibrations will become light vibrations sooner to some eyes than to others—yet in all cases the colour first observed will not be a pure red, but a dark brown; a colour produced by the mixture of black, or the absence of colour with the few red rays first emitted.

It should be borne in mind that the arrangement of the spectrum into seven colours is merely a matter of convenience. In point of fact there is an almost infinite variety of tints. The red, for instance, is merely taken at the mean of the dark red and the orange-reds, and so for the other colours.

Remembering these preliminary considerations a fuller statement of the law of the changes may now be given.

In all cases in which the colour of a body is changed by the application of heat, and the original colour regained on cooling, the nature of the body being in no wise altered, the character of the change is as follows: the addition of heat causes the colour to pass from one of a greater to one of a less number of vibrations; the obstruction of heat from one of less to one of a greater number.

In accordance with this law, violets are changed by heat into indigo violets or indigoes, indigoes into blues, blues into bluish-greens or greens, greens into yellowish-greens or yellows, yellows into orange-yellows or oranges, oranges into orange-reds or reds, and finally reds into brownish-reds or blacks; by cold the inverse order is observed. In many instances substances were noticed that ran down the scale two or more colours; for example, the green iodide of mercury, which passes from yellowish-green through the yellow, and orange to the red.

Among the most sensitive substances noticed are the following, arranged by their colours in the order of the spectrum.

Reds.—*Ferrocyanide of Copper.*—Colour at ordinary temperature, mahogany-brown; darkens by heat to brownish-black, original colour returning slowly on cooling.

Brown-Red Sulphide of Antimony—Kermes mineral.—Colour brownish-red; changes to darker brownish-red.

Anhydrous Sesquioxide of Iron.—Colour, brownish-red; changes to dark red, brown, brownish-black and black at a temperature greatly below a red heat.

Subiodide of Copper.—Colour, dark red. The changes presented by this substance are very remarkable. On the application of quite a low heat it changes to darker red, and afterwards to a brownish-red, brown, brownish-black, and finally almost a black. The return to its original colour on cooling is rapid.

Protosulphide of Mercury—Vermillion.—Colour, bright red, or vermillion; darkens to brownish-red.

Subchromate of Lead.—Colour, red; changes quite readily to dark red and brownish-red.

Red Oxide of Lead—Red Lead.—Colour, red; changes readily to dark red.

Bichromate of Potassa.—Colour, red; changes to dark red. The change in this case is best observed by heating a small crystal of the salt.

Oranges.—*Bisulphide of Arsenic.—Realgar.*—Colour, when pulverised, orange-red; changes to red, dark red, and brown; returns readily.

Protoxide of Mercury—Red Precipitate.—Colour, orange-red; changes to red, dark red, and brownish-red.

Iodide of Lead.—Colour, orange; changes to darker orange, orange-red, and red.

Oxalate of the Protoxide of Iron.—Colour, light orange; darkens. In this case the heat must be quite low, as the substance is readily decomposed.

Yellows.—*Chromate of Lead.*—Colour, yellowish orange; changes to orange, orange-red, and deep orange-red.

Subsulphate of Mercury—Turpith Mineral.—Colour, yellow; changes to orange-yellow, orange, and orange-red.

Chromate of Baryta.—Colour, yellow; changes to orange-yellow.

Bisulphide of Tin—Mosaic Gold.—Colour, brownish orange-yellow; changes to a dark red very nearly approaching a black; quite sensitive.

Tersulphide of Arsenic—Yellow Orpiment.—Colour, orange-yellow; changes to deep orange-yellow, yellow, orange-red, and red.

Greens.—*Subiodide of Silver.*—Colour, greenish-yellow; very sensitive; changes first to an orange-yellow, and then to a deep orange.

Subiodide of Mercury—Green Iodide.—Colour, yellowish-green; more sensitive than the preceeding; changes to a yellowish-green, and then successively to an orange-green, reddish-orange, red, and brownish-red. These changes succeed each other very rapidly. They may be best observed by heating at once up to the brownish-red,

and noting the changes of colour that occur as the body cools.

In all the above cases the original colour is fully regained on cooling.

The substances named are by no means all that have been observed to come under the law. Quite a number of other compounds have been noticed; but none of them are as sensitive as those already mentioned. In no case, however, has any compound been found of the colour of blue, indigo, or violet, that, in the solid state, undergoes any decided change whatever, on the application of a temperature short of that producing either a decomposition or a permanent change in the arrangement of its molecules. Nor is this fact contrary to what might be expected. Near the heat end of the spectrum, where the difference between the light and heat vibrations is not so great, we might reasonably expect the particles of a solid to be influenced by each, and to accept a motion which should be a mean of the two, but when we get as far in the spectrum as the blue or indigo, the greatest heat that we can intermingle with the blue or indigo, even if pushed to the point of incandescence, would be but dull red. Now long before this temperature is reached most bodies would undergo decomposition, and were this not the case, even then we could hardly expect the particles of a solid, trammelled as they are in their freedom of motion by the force of cohesion, to accept a mean of two kinds of vibrations, which differ so greatly in their wave lengths. Still it must be borne in mind that solids differ very greatly from each other in the freedom of motion of their molecules, and it is not improbable that a number of solids as high in the scale of colour as the blues, indigoes, or violets, may eventually be found conforming to the law.

A few very significant facts were noticed in this connection in the case of two pure white substances, viz., the oxides of zinc and of tin; their behaviour is as follows:—

Oxide of Zinc—Nihil Album.—Colour, white; changes on the application of heat to a scarcely perceptible bluish-white, green, and yellowish-green. Does not entirely return on cooling, though it resumes nearly its original colour.

Oxide of Tin.—Colour, white; here the range is more remarkable. It changes first to a pale green, then to a decided yellowish-green, and even runs as far down the scale as orange and reddish-orange; returns on cooling to a greenish-white.

These two substances have not been included in the regular list of solids, as they fall somewhat short of the conditions of the original experiment. They conform sufficiently to it, however, to call attention to their behaviour.

Experiments were also made on solutions of various solids. As a general rule, it has been found that a substance in solution is more sensitive to the action of heat than when in the solid state. This, indeed, should be so, as the action of the solvent is simply, by its adhesion for the solid, to separate it into very small particles and to give them much greater freedom of motion. Solids in solution have been found as high in the scale as the violet, which conform perfectly to the law.

These experiments were conducted as follows:—

The solution was made of the required strength and then divided between two thin glass test-tubes, of the same size and thickness. They were then held, side by side, between the eye and the light, and carefully compared by transmitted light. If any difference in tint was observed, the solutions were poured together and again thoroughly mixed. If any difference still existed on again dividing them between the two test-tubes, one of the tubes was rejected as differing in thickness or colour from the other, and replaced by another until exactly the same tint was obtained. It will readily be seen that these precautions were necessary, in order that the results obtained should not be equivocal. One of the solutions was heated in a Bunsen burner, and the change carefully noted by comparison from time to time. Of course the highest temperature was limited to the boiling-point of the solution under the pressure of the atmosphere. In many cases, however, decided changes were observed long before even this point was reached. No experiments were tried on temperatures obtained by boiling under high pressures in confined glass vessels, though there is every reason to believe that by these means splendid results would be obtained. It is purposed, if time allows, to pursue the investigation in this direction at some future day.

Of course, in all cases where the colour did not entirely re-appear on cooling, the experiment was rejected.

The solvent used was water. As the colour of a solid in solution varies with the strength of the solution, it will be understood that in all cases the amount of solid dissolved was that requisite to produce the tint described.

The following are amongst the most sensitive substances noticed:—

Reds.—*Rose Aniline.*—Solution of a strength sufficient to produce a decided red; darkens perceptibly on the application of a boiling heat.

Decoction of Logwood.—Solution of a deep red; darkens on the application of heat.

Chloride of Cobalt.—Colour of solution, pinkish-red; changes to a darker pinkish-red.

Sesquisulphate of Iron.—Colour of solution, light red; changes to brownish-red.

Oranges.—*Chromic Acid.*—Colour of solution, reddish-orange; changes to an orange mixed with a greater amount of red.

Bichromate of Ammonia.—Colour of solution, orange-red; changes to a pure red.

Sesquichloride of Iron.—Colour of a weak solution, orange-red; very sensitive; changes to red and brownish-red.

Bichromate of Potassa.—Solution of an orange-red; changes to a red.

Yellows.—*Sesquinitrate of Iron.*—Colour of solution, brownish-yellow; changes to brownish-red.

Greens.—*Ferrocyanide of Potassium.*—Solution of a yellowish-green; changes to a yellow.

Chromate of Potassa.—Solution of a yellowish-green; changes to a yellow.

Nitrate of Nickel.—Solution, pale green; changes to pale yellowish-green.

Sulphate of Nickel.—Solution, green; changes to yellowish-green.

Blues.—*Chloride of Copper.*—Colour of weak solution, bluish-green; changes to a very decided yellowish-green. This substance is quite sensitive, the colour returning rapidly on cooling.

Sulphate of Copper.—Solution of a decided blue; changes to a very decided green at the boiling-point of the solution. Returns to its original colour rapidly on removal from the heat.

Violets.—*Ammonio-Oxide of Nickel.*—Solution of a violet-blue; changes to a light blue; returns fully on cooling, and cannot therefore be attributed to any loss of ammonia.

Solution of Litmus.—Colour, violet; changes to an indigo-blue.

It may be objected that the substances noticed do not present as great a range of changes as those observed in solids. It must be remembered, however, that the temperature in no case differed much from the ordinary temperature, being never much greater than 220° F., while in the experiments with solids the temperature was often more than three times as great. We feel sure that experiments with liquids at higher boiling-points will show substances running down the scale much further than the observed solids.

The Action of Cold.—It would appear from the law already stated, that the colour of a body is affected by its temperature, and that in proportion as this temperature is

raised, the colour is lowered; moreover, considering the colour emitted by the body at its higher temperature, the colour is always raised in the spectrum as the body cools. For example, take the case of the green iodide of mercury, which, as before mentioned, is yellowish-green at ordinary temperatures. By the action of heat, its colour is successively lowered through the yellow, orange, and red, which latter is reached at the maximum temperature of exposure. Cool the body from this point, and its colour will become orange, yellow, and yellowish-green, respectively.

Now, the same reasoning that applies to the cooling of the body from this higher temperature should also apply, though not with equal force, to its cooling from any temperature, such, for instance, as that of the place in which the body is situated. The colour emitted by a body at any temperature is always lower than it would be were it not for the intermingling of the heat vibrations. Remove it as much as possible from the influence of these vibrations, or, in other words, cool it, and the emitted light must be of a higher pitch of colour. It would appear then, that as the effect of raising the temperature of a body above its ordinary temperature is to lower the pitch of the emitted light, so cooling it below that temperature must be to raise the pitch. The raising, however, would hardly be as great, proportionally, as the lowering. As we recede from the boundary of the heat and light vibrations, we lessen the chance of their producing by intermingling a resulting mean vibration.

With a view of testing the truth of these theoretical considerations, experiments on the action of cold on substances in both the solid and liquid condition were made.

(To be continued).

CORRESPONDENCE.

THE AMMONIA PROCESS.

To the Editor of the Chemical News.

Sir,—In your issue of 7th July, there appeared a letter from Mr. Wanklyn on the success of his ammonia process; he concludes by saying that the sanitary officers of the Indian Government have adopted it. This is correct, but I am sorry to say that they adopted it rather too hastily, and that the results of the process, as far as has been published, say little in its favour. I have had occasion to examine the methods laid down for the analysis of water in India, both by personal experiment and by examination of the published results of the analyses made in Bengal, and as regards the ammonia-process, the results are most unsatisfactory: in the hands of other analysts it has given the wildest quantities imaginable; in my own it has been a complete failure.

Finding that water after water gave no albumenoid ammonia when treated according to Messrs. Wanklyn and Chapman's instructions, I made some test-experiments with water containing natural organic matter, quinine wine, and ammonia. I found that neither carbonate of soda nor the alkaline solution of permanganate evolved any ammonia from a quantity of fresh urine which should have given 2 milligrammes; urine not perfectly fresh would give 0·01 to 0·02 milligramme of ammonia. If before or after the experiment I added ammonia (as sulphate) to the half-litre of water in the retort I could always obtain it; even from 0·05 milligramme I would obtain 0·02 to 0·04 in the distillate.

The alkaline solution of permanganate failed to evolve any ammonia from water to which quinine had been added, or from water containing enough natural vegetable matter to decolourise a standard solution of permanganate nearly as fast as it could be poured in (no nitrites or ferrous salts being present).

Neither do Indian waters, as far as my experience goes, contain anything like the amount of ammonia said to be contained in English waters. I have never yet succeeded in detecting it, except in waters obviously containing sewage in considerable quantity; and when distilling water for laboratory use, I fail to detect ammonia in the first 100 c.c. distilled over from ten litres of ordinary well-water. I may add that my Nessler's solution is not in fault, as I can detect 0·01 milligrammes of ammonia in a distillate.

Edward Nicholson, Asst. Surg. R.A.,
Analyst of Waters, Mysore and Ceder Districts.

Bangalore,
Aug. 18, 1871.

MISCELLANEOUS.

New Appointment.—We are glad to find that Mr. Robert Routledge, who took the first place in honours for chemistry at the final B.Sc. examination of the London University last year, and who at a previous examination took first-class honours in Natural Philosophy, has been appointed conductor of the classes in Chemistry and Physical Science at the Manchester Mechanics' Institution. These classes, which are held in the evening, consist of courses on Applied Mechanics, Steam and the Steam Engine, Acoustics, Light and Heat, Magnetism and Electricity, Inorganic and Practical Chemistry.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, September 11, 1871.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Researches on the Origin of the Heat set free when the Motion imparted to a Disc of Copper is Stopped by the Action of an Electro-Magnet.—P. A. Favre.

Constitution of Luminous Spectra.—Lecoq de Boisbaudran.

Combination of Alcohol with Bases.—Dr. Berthelot.—This lengthy and very valuable memoir is divided into the following sections:—Introduction; alcohols properly so called, viz., ordinary alcohol, $C_4H_6O_2$; glycerine, $C_6H_8O_6$; mannite, $C_{12}H_{14}O_{12}$; gum-phenols, viz., ordinary phenol, $C_{12}H_6O_2$; phenates of soda, potassa, ammonia, lime, and baryta; trinitrated phenol (picric acid)—

$$C_{12}H_3(NO_4)_3O_2;$$

aldehydes; acids of mixed functions (*acides à fonction mixte*); salicylic acid; lactic acid, $C_6H_6O_6$; tartaric acid, $C_8H_6O_{12}$.

Can the Leaves of Plants Absorb Liquid Water?—L. Cailletet.—A very important phyto-physiological memoir.

As usual, this number contains important astronomical, geological, and meteorological papers.

September 18, 1871.

This number opens with the second portion of an important and exhaustive monograph:—

Rocks met with by Perforating the Western Alps between Modane and Bardonnêche.—Elie de Beaumont.—To this paper are added several interesting notes elucidating the origin of the idea of constructing this gigantic work, which was first broached, some thirty years ago, by M. Medail, of Bardonnêche, in a pamphlet published at Lyons.

Thermal Researches on Mixtures.—P. A. Favre.—The continuation of a monograph, portions of which have been published in *Comptes Rendus*, vols. l., li., lix., lxvi., the present being vol. lxxiii. This portion contains a series of tabulated forms exhibiting results of experiments.

Spectra of the Substances belonging to the Nitrogen and Chlorine Class of Elements.—A. Ditte.

Spectra of Selenium and Tellurium.—G. Salet.—The contents of these papers are not suited for useful abstraction.

Thermo-Chemical Researches on Ammoniacal Salts.—Dr. Berthelot.—Since the value of this essay depends chiefly on a series of lengthy formulæ, it is not possible to enter into any details.

Spontaneous Decomposition of Bisulphite of Potassa.—C. Saint-Pierre.—The author relates at length the results of some observations made on solutions of the salt alluded to, kept in closed vessels for several years. From these observations it appears that a solution of bisulphite of potassa becomes spontaneously decomposed, yielding sulphur, sulphuric and thionic acids. The author is engaged with similar experiments on other bisulphites.

On Methyl-Diphenylamine.—C. Bardy.—This paper is entirely written with the view to prove that the discovery of the substance just named, by the reaction of methyl-aniline upon chlorhydrate of aniline, described by C. Girard and G. Vogt (see Chemical News, vol. xxiv., p. 167), had been described some time ago (January, 1870), and published by the author in the *Moniteur Scientifique*, 1870, p. 553, and in *Brevet d'Invention*, No. 88,713.

September 25, 1871.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Thermal Researches on the Electrolysis of the Alkaline Bases and Alkaline Sulphates.—P. A. Favre.—The contents of this valuable and lengthy monograph do not admit of any useful abstraction.

Letter from J. Pierre to M. Dumas on the Phenomena Observed by J. Pierre and E. Puchot by the Simultaneous Distillation of Water and of certain Alcohols.—This communication bears upon the subject mentioned in the Chemical News, vol. xxiv., p. 167; but, since the contents of this paper consist mainly of a series of cyphers relating to results obtained, we need not here enter any further into this matter, which will be communicated more fully at a future date by the authors.

Relation Existing between the Spectral Properties Exhibited by the Elements with their Physiological Properties.—F. Papillon.

Researches on the Reciprocal Conversion of the Allotropic States of Phosphorus.—(First part.)—G. Lemoine.—This monograph, elucidated by a series of tabulated forms containing figures relating to results of experiments, contains the record of a most important scientific discovery, and proves, practically, that exact scientific research is reviving rapidly in France. The *resumé* of the labours of this *savant* on the subject in question will be published with the second portion of this paper.

Note on the French and Foreign Malt Liquors Consumed in Paris.—E. Monier.—This paper contains the results of the analysis of twelve different samples of beer, six of which are brewed in France, the rest in other European countries. The sp. gr. of these samples varies from 1·008 to 1·023. The quantity of alcohol, by bulk (c.c. in 1000 grms.), varies from 32·5 (a French brewed beer) to 60·5 (Burton pale ale); glucose, from 4·8 (French beer) to 16·30 (so-called Strasburg beer, but brewed at Paris) grms.; dextrine, albuminoid substances, &c., from 31·0 (French beer) to 58·40 (Munich, Bavarian beer) grms.; salts, from 1·60 (French beer) to 2·80 (Burton pale ale) grms.

New Zinc Paint.—M. Artus.—The author, connected with the Vieille-Montagne Co., exhibits at the meeting of the Academy samples of zinc-white made up with silicate of potassa, and used to paint zinc and other objects. This paint, which resembles stone in aspect, is air-, sun-, and water-proof, and is especially applicable to zinc-covered roofs, but also to plaster, cement, bricks, and other objects. It is also useful for rendering wood, paper, and other readily-inflammable tissues, such as are used, for instance, in theatrical decorations, uninflammable.

Polytechnisches Journal von Dingler, second number for August, 1871.

The following original papers bearing upon chemistry and collateral subjects are published in this number:—

Modified Arrangement of Leclanché's Manganese Galvanic Cell.—M. Boumans.—The description, accompanied by a woodcut, of an important improvement upon the Leclanché galvanic element; it would, however, require the reproduction of the woodcut to make the subject understood.

Studies on the Blast Furnaces Used for the Production of Iron.—C. Schinz.—This portion of the continuation of this exhaustive monograph contains the following sections:—Transmission of heat through the walls of the furnaces; reducibility of the ores; direct and indirect reduction; modulus of charge; causes which accelerate or retard the reduction and carburation of the iron reduction and carburation of the iron.

Question of the Dinas Brick-Making in general.—Dr. C. Bischof.—This paper treats on the conditions to be observed in the making of a peculiar kind of fire-brick, the properties of which are very similar to what in this country is known as Flintshire stone.

Recovering the Nitrous Acid in the Process of Sulphuric Acid Manufacture.—Dr. G. Lunge.—A lengthy essay on this subject, illustrated by several engravings.

Preparation of an Oxidised Aniline-Black Paste, and on an Aniline China Ink.—A. Müller.—20 grms. of chlorate of potassa, 40 grms. of sulphate of copper, 16 grms. of sal-ammoniac, 40 grms. of hydrochlorate of aniline, are dissolved in 500 c.c. of water, and the mixture heated upon a water-bath to 60°. After some two or three minutes, the basin or vessel containing the mixture is removed from the water-bath, because it has a tendency to boil over, in consequence of the strong evolution of vapours of trichloro-nitroform. If it happens that after some two or three hours the thickish magma has not become quite black, it is again heated to 60°. The pasty mass is next left for two days exposed to open air, after which the mass is washed until all the salts soluble in water are removed, and after having become half dry is removed from the filter. The deep coaly-black-coloured paste is either at once thickened with albumen and kept for use (for calico-printing purposes) in tinned iron canisters, or it is dried over sulphuric acid in vacuum, then exhibiting a soft, not glossy, intensely deep black-coloured powder, which, on a preliminary analysis, gave results leading to the formula $C_{24}H_{14}N_2O_{22}$. When the powder is mixed with some gum-water it is an excellent substitute for Indian ink.

Rapid Method of Drying Glue.—Dr. H. Fleck.—This paper treats on a plan of separating, rather than drying, glue from its aqueous solutions by the aid of salts, and gives to glue-boilers a few hints how to apply this method, which yields a glue which is not transparent but turbid.

Gold-like Alloy.—Dr. E. Dingler.—This alloy consists of:—Copper, 58·86; zinc, 40·22; lead, 1·90. It is both inexpensive and durable as well as malleable.

Production of Bismuth in Saxony.—Dr. Wagner.—It appears that this country produces 32,000 lbs. of the metal annually, and that, since bismuth is as yet nowhere produced in any considerable quantity, Saxony rules the market of this article.

Cheap Mode of Preparing Pure Dextrine.—O. Ficinus.—500 parts of potato-starch are mixed with 1500 parts of cold distilled water and 8 parts of pure oxalic acid, and this mixture placed in a suitable vessel on a water-bath, and heated until a small sample tested with iodine solution does not produce the reaction of starch. When this is found to be the case the vessel is immediately removed from the water-bath, and the liquid neutralised with pure carbonate of lime. After having been left standing for a couple of days the liquor is filtered, and the clear filtrate evaporated upon a water-bath until the mass has become quite a paste, which is removed by a spatula, and, having been made into a thin cake, is placed upon paper and further dried in a warm place; 220 parts of pure dextrine are thus obtained.

Journal de Pharmacie et de Chimie, July, 1871.

This number contains the following original papers and memoirs:—

Experimental Researches on the Preparation and Properties of the Chlorides of Propyl and Butyl.—J. Pierre and M. Puchot.—Propylic chloride, C_6H_7Cl, is prepared either by passing gaseous and dry hydrochloric acid into propylic alcohol until no more of the gas is absorbed, and distillation of the mixture thus obtained, or by causing perchloride of phosphorus to act upon pure propylic alcohol, care being taken to apply to the vessel wherein the liquids are contained a cooling mixture, and a peculiar arrangement of the apparatus so as to carry off, without causing inconvenience to the operators, the hydrochloric acid gas which is set free. With due care, 480 grms. of the propylic alcohol yield 180 grms. of the pure chloride, which is a very limpid, colourless, mobile liquid, exhibiting a pleasant sweetish somewhat alliaceous smell, and boils at 46·5°; sp. gr., at 0° = 0·9156. Butylic chloride, C_8H_9Cl, prepared in the same manner as just described, butylic alcohol being of course substituted for the propylic, is also a very limpid, mobile, colourless liquid, boiling at 69°; sp. gr., at 0° = 0·8953.

On Gelatiniform Matter or Albuminose, on Exalbumine, and on Galactine.—A. Morin.—The introduction to this essay gives a review of the labours of Drs. G. J. Mulder, Prevost, Mialhe, Corvisart, Tiedemann, and Gmelin, and on the nitrogenous substances met with in the animal organisms generally referred to as proteine compounds. The main portion of this paper is devoted to the subject of galactine, which term the author desires to be substituted for the other words above mentioned. Galactine, though chiefly met with in milk, is also a constituent of the animal body. The dry residue of the carefully conducted evaporation of milk consists, in round numbers, of:—Caseine, 10 parts; albumen, 1; galactine, 1; butter, 10; milk-sugar, 10; salts, 1; a nitrogenous matter soluble in alcohol, 2 parts. Galactine in fresh state is a somewhat viscous mass, which becomes solid on drying, but remains soft as putty and may be kneaded by the hand into any shape. Galactine is soluble in water, insoluble in ether and alcohol, is not by long boiling with water converted into gelatine, is precipitated like gelatine by tannin, with this characteristic difference that, whereas the precipitate produced by tannin in gelatine is insoluble at a high temperature, the precipitate produced by tannin in a solution of galactine is dissolved at 60°. Galactine, like caseine, has the property of forming emulsions with fatty substances.

Report on the Preparation of Oxygen for Pharmaceutical Purposes.—Dr. Baudrimont.—This very lengthy yet only preliminary paper, illustrated by woodcuts, treats exhaustively on the preparation of the gas alluded to, so as to make it safe and yield a pure gas. The following are the sections:—Action of the heat upon chlorate of potassa; action of the oxides, viz., of copper, peroxide of iron, and manganese, mixed with the chlorate of potassa; chemical action; mode of preparation of oxygen. The author advises:—That the peroxide of manganese should never be used unless previously calcined, whereby, although its composition be modified, it does not lose its useful effect in assisting the ready decomposition of the chlorate of potassa; to mix the calcined oxide, in the proportion of equal parts by

weight with the chlorate of potassa, care being taken to pulverise the last-named substance first; to apply to the vessel containing the mixture as little heat as possible; to test the purity of the chlorate of potassa; and to wash the gas through water; while, lastly, care should be taken to make the tubing required of as large internal diameter as consistent with the size of the retort and quantity of material used at one time, it being preferable not to operate upon too large a quantity of the mixture at a time.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, Nos. 217 and 222 inclusive, January to July, 1871.

This collection, published in one cover owing to events to which it is unnecessary further to allude, contains only the following original essay relating to chemistry:—

Processes in Use at the Dieuze Alkali-Works for the Denaturation and Utilisation of the Residues of Soda and Chlorine Manufacture.—P. Buquet.—This essay, far too lengthy for abstraction, contains the complete account of processes in actual use on the large scale, and so perfect that to the authors, P. Buquet and W. Hofmann, the chemical prize of the society above alluded to was given on July 15, 1870. This essay is divided into the following sections:—Introduction; theory of the question to be solved; oxidation of the char (soda-waste); lixiviation of the char; neutralisation of the acid chloride of manganese; utilisation of the sulphuretted hydrogen; precipitation of the iron; precipitation of the manganese; treatment of the residue; separation of the sulphate and peroxide of manganese from each other; utilisation of the sulphate of manganese for the preparation of nitric acid. An alkali-works, where 20,000 litres of chloride of manganese and 30,000 kilos. of soda-waste are daily obtained, may produce by the process herein briefly alluded to:—Pure sulphur, 1400 kilos.; sulphur as sulphuret, 2200; peroxide of manganese at 60 per cent, 770; hyposulphite of lime, 20; dry sulphate of lime, about 600 kilos.

Revue Universelle des Mines, de la Métallurgie, des Travaux Publics des Sciences et des Arts Appliquées à l'Industrie, May and June, 1871.

The only original paper relating collaterally to chemistry met with in this number is:—

Zinc Metallurgy of the Nouvelle-Montagne Company.—H. Massart.—This memoir, accompanied by a series of engravings, treats very exhaustively on the subject alluded to, entering into all the technical as well as the financial details of the mode of working of this Company, which has its works and mines in Belgium. For all who are interested in zinc metallurgy, this paper contains matter of very great value. The percentage composition of roasted blende is:—ZnO, 53·20; Fe_2O_3, 20·93; CaO, 5·86; PbO, 3·26; SiO_3, 8·15; SO_3, 8·60. Calcined calamine consists, in 100 parts, of:—ZnO, 53·27; Fe_2O_3, 26·42; CaO, 4·68; SiO_3, 16·23. Metallic zinc from blende consists, in 100 parts, of:—Zinc, 98 68; iron, 1·05; lead, 0·25; lime, 0·04. Zinc from calamine contains, in percentages:—Zinc, 99·25; iron, 0·62; lead, 0·13. Refined zinc consists, in 100 parts, of:—Zinc, 99·70; iron, 0·20; lead, 0·10.

Though not strictly belonging to the subjects usually treated of in our pages, we quote the following paper:—

Economic Conditions of the Mines of the Island of Sardinia.—M. Sella.—The copious abstract of an exhaustive report presented to the Committee of Inquiry on this subject, elected by the Chamber of Representatives of the Kingdom of Italy.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, September 14, 1871.

Continuation of the Essay, Studies on the Chemical Dissociation of Bodies.—C. Méne.

Description of Modifications of the Bunsen Gas Burner.—C. Mène.—Illustrated by woodcuts representing various contrivances by which these burners are adapted for different operations.

Analysis of Arable Soil from the Sologne.—F. Masure.—The tabulated results of the estimation of various constituents, nitrogen, phosphoric acid, alkalies, as well as description of the physical and hygroscopic properties of surface-soil and sub-soil of the portion of Central France above-named.

September 21, 1871.

The only original paper in this number is a description, accompanied by woodcuts, of:—

An Electrical Metronome of the Opera at Paris.—J. Duboscq.—It appears that this instrument, belonging to those used for acoustics, is very ingeniously made and answers the purpose perfectly.

September 28, 1871.

Among the original matter contained in this number we notice:—

Distillation of Beet-Root Molasses.—R. Corenwinder.—The gist of this paper bears upon the utility of the addition of sulphuric acid to the molasses, and upon the quantity of that acid required in any special case, which may be ascertained by a volumetrical assay. The author points out that not only the bases present in the molasses have to be saturated but that an excess of acid, sufficient to prevent during the fermentation the formation of organic acids, is absolutely required, because, by the formation of organic acids, less alcohol is obtained, as well as of an inferior quality, because it is contaminated with ethers which cause the alcohol to be bad to the taste and also injurious.

Tabulated Review of the Composition of Fertilising Substances which may be added to Manures, or are fit for use as such by themselves.—C. Mène.—A very useful catalogue, containing the results of analyses, percentically quoted, of such substances as various kinds of wood sawdust, offal from dye-works, glue-boilers, and various substances. This paper is to be continued.

Studies on the Dissociation of Chemical Bodies.—C. Mène.—The continuation of an essay on this subject.

Bibliography.—"M. Georges Ville et ses Engrais Chimiques," par M. Severin Leroy; A. Sagnier, Editeur: Paris, 1871. We call attention to this pamphlet, the contents of which are very well spoken of in this number. Many of our readers will remember that the chemical manures of G. Ville, and his agricultural experiments, have given rise to a great deal of polemic. The French pamphlet here alluded to contains, judging from what is said about it, a thoroughly disinterested review of the whole subject.

NOTES AND QUERIES.

Cement to Resist Sulphuric Acid.—Can any of your readers kindly tell me of a good cement which will resist sulphuric acid and hold glass and lead together.—H. R. Yardley.

Crimson Spirit.—This term appears to mean a solution of chloride of tin, and it is likely that, under the name alluded to, the solution you require is sold by drysalters, but the name is possibly also given to an ammoniacal solution of cochineal.

Electro-Deposition.—(Reply to "Inquirer.")—You may use a solution of platinum chloride in ether, or you may rub the objects you desire to be platinised with a moistened mixture of platino-chloride of ammonium and cream of tartar. For electro-depositing it appears that the double chloride of platinum and potassium, dissolved in a solution of caustic potassa, is the best fluid; take care to have the iron and copper perfectly bright, well polished, and free also from grease. Aluminium does not appear to have been deposited in the way you mention.

Assaying Iron Pyrites.—Is the ordinary method or methods of assaying iron pyrites for gold defective and faulty? My reason for asking is that it is beginning to be believed that pyrites, such as are worked for sulphuric acid, contain much more gold than is ordinarily admitted, that there is a decided loss in roasting (Crookes and Röhrig's "Metallurgy," Gold and Silver, pp. 629—630, and authorities there cited), and that a method has been devised with which the presence of gold in large amount can be demonstrated. Assays of mine, made upon 8 and 16 oz. lots, showed from 1½ to 40 ozs. gold per ton of 2000 lbs, in pyrites where most other assayers found no gold, and some, in California, ⅓ oz. The trouble is that no two assays made from pyrites shovelled from the self-same barrel could be made to agree.—J. M. M.

TO CORRESPONDENTS.

*** Vol. XXIII. of The Chemical News, containing a copious index is now ready, price 11s. 4d., by post, 12s., 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. Subscribers wishing to complete their sets of volumm are requested to apply to the publisher, who will give these information respecting scarce numbers and volumes. Vol. xxiv. commenced on July 7th, and will be complete in twenty-six numbers. Reading Cases, price 1s. 6d. each, post free, may also be obtained at the Office.

W. F. Catcheside.—There is a letter for this correspondent at our Office.

A. K. & Co.—Fuller's earth is found in Surrey, Kent, Nottinghamshire, and in Scotland. Address to Mr. James Cawley, Nutfield, Surrey.

Carbazotic.—(1). Picric acid has been tried as a tonic and anti-scorbutic in doses varying from 1-12 to ½ grain, but it is not found to possess any marked medicinal virtues, and its use imparts a yellow tinge to the skin and to the white of the eye. (2). Nitrites when properly prepared are neutral salts; there ought therefore to be no decomposition with the salt you mention. Watts's "Dictionary of Chemistry" will give you further information on the subject.

Dr. E.—There is a paper on the subject in the "Handwörterbuch der reinen und Angewandten Chemie," vol. v., p. 301; consult also Payen, "Précis de Chimie Industrielle," 5th edition, vol. i., p. 432. Both these works are at the Patent Office Library.

J. Young.—The full translation will appear as soon as possible.

C. R. C. Tichborne.—Received with thanks.

J. Galletly.—A proof shall be forwarded.

J. Fyfe.—Bisulphite of ammonia is a solid: you can obtain it from any good operative chemist in London.

NOTICE TO AMERICAN SUBSCRIBERS.

In answer to numerous inquiries, the Publisher begs to state that Subscribers in the United States can be supplied with the CHEMICAL NEWS from this Office, post free, for the sum of £1 2s. 4d. per annum payable in advance.

THE CHEMICAL NEWS.

Vol. XXIV. No. 621.

ON ISODINAPHTHYL.

By WATSON SMITH, F.C.S.

Instead of at once dealing with the main subject of this paper, I think a brief view of certain of the results of researches of several eminent chemists, directly bearing on the matter in hand, would be at once interesting and desirable.

The peculiar hydrocarbon diphenyl was first obtained by Fittig* by treating monobrombenzol with sodium :—

$$2C_6H_5Br+2Na=2NaBr+\left.\begin{matrix}C_6H_5\\C_6H_5\end{matrix}\right\}.$$

Now Berthelot†, in the year 1866, by passing benzol vapour through a porcelain tube heated to bright redness, obtained diphenyl as the chief product of decomposition. Berthelot distinctly says, "the body so obtained is a beautifully crystalline substance, which is identical with Fittig's diphenyl, possessing exactly the melting- and boiling-points given by Fittig, and agreeing generally with that body." A small quantity of chrysene is also said to be formed, and of a solid resinous body, of an orange colour, which is but slightly soluble in alcohol, rendering the same fluorescent. The formula

$$2C_6H_6=\underbrace{\left.\begin{matrix}C_6H_5\\C_6H_5\end{matrix}\right\}}_{\text{Diphenyl.}}+H_2$$

represents this decomposition.

(1). About the commencement of the year 1867‡, Dr. F. Losson found that dinaphthyl could be obtained from monobromnaphthalin by the action of sodium, just as Fittig had obtained diphenyl from monobrombenzol—

$$2C_{10}H_7Br+2Na=2NaBr+\left.\begin{matrix}C_{10}H_7\\C_{10}H_7\end{matrix}\right\}.$$

At the same time he (Lossen) found there was also a small quantity of a polymer formed, which he obtained as a chocolate-brown powder, scarcely at all soluble in alcohol, but more so in ether. It was easily soluble in carbonic disulphide.

(2). Dr. Lossen also found that he could obtain dinaphthyl by the oxidising action, upon naphthalin, of a mixture of manganese peroxide and sulphuric acid—

$$\left.\begin{matrix}2C_{10}H_7\\H\end{matrix}\right\}+O=\left.\begin{matrix}C_{10}H_7\\C_{10}H_7\end{matrix}\right\}+H_2O.$$

This mixture he found acted energetically upon naphthalin, there being liberated, with strong effervescence, much carbonic dioxide. When the action was completed, the contents of the retort in which the process was carried on were diluted with water, manganese sulphate and phthalic acid were dissolved out, and unaltered manganese peroxide and a resinous body left behind. The undissolved portion was boiled with absolute alcohol; and the impure body crystallised out from the filtered solution was repeatedly re-crystallised from alcohol. The dinaphthyl was thus obtained in pearly shining scales of a very light yellow colour. Lossen found that it was only possible to obtain the body quite colourless by sublimation.

Thus obtained, dinaphthyl was found to be much more easily soluble in ether than in alcohol, crystallising therefrom in moss-like clusters. By slowly cooling a solution of this body in a mixture of ether and alcohol, it was obtained crystallised in well-formed regular octahedra. It is very soluble in carbonic disulphide. Benzol dissolves it to much the same extent as alcohol does; and it crystallises from the solution of that body in the same form as it does from alcohol. Dinaphthyl melts at 154° C. Its boiling-point lies above that of mercury. Robert Otto* and Gustav Möries repeated Lossen's experiments with precisely the same results; but they tried, in order to get dinaphthyl formed more easily, and in larger quantity, to form it by first obtaining the mercury compound mercuriodinaphthyl—

$$\left.\begin{matrix}C_{10}H_7\\C_{10}H_7\end{matrix}\right\}Hg''$$

by heating monobromnaphthalin with sodium amalgam (Na_2Hg''), and raising this to a red heat with soda-lime in a porcelain tube. Mercury and a yellow crystalline mass were obtained, the greatest portion of the latter consisting of naphthalin. This yellow mass, on boiling with alcohol, yielded on cooling the rhombic tables of naphthalin abundantly, the mother-liquors exhibiting strong green fluorescence by reflected light and furnishing on evaporation a yellow mass, which, after suitable purification, deposited from alcohol small canary-yellow shining leaf-life crystals, which melted at 133° C. This body was readily soluble in alcohol, ether, and benzol. The solution of the pure hydrocarbon was no longer fluorescent.

They made a combustion, which did not seem to be satisfactory, as they only had 0·066 grm. of substance to work with, and of this they did not feel sure of the perfect purity. The percentage composition they obtained almost exactly corresponded with that of naphthalin. They consider the action to be chiefly

$$\left.\begin{matrix}C_{10}H_7\\C_{10}H_7\end{matrix}\right\}Hg''+H_2O=2C_{10}H_8+HgO.$$

About the close of the year 1866, Berthelot† concluded his remarkable series of experiments on the action of certain hydrocarbons upon one another when conducted through a red-hot tube. In one of these experiments he passes the vapour of naphthalin with hydrogen through the tube; and as to the result he says, "Almost no action at all takes place, the naphthalin remaining almost quite unaltered, and only a little benzol and acetylene are obtained."

$$\underbrace{C_6(H_4[C_2H_2(C_2H_2)]}_{\text{Naphthalin.}}+H_2=\underbrace{C_6H_6}_{\text{Benzol.}}+\underbrace{2C_2H_2}_{\text{Acetylene.}}.$$

About nine months ago I undertook, at the suggestion of Mr John Barrow, in the laboratory of whose works I was then engaged, the investigation of the action of heat upon naphthalin, with the object of discovering whether by this means it is possible to obtain anthracene, according to the equation $7(C_{10}H_8)=5C_{14}H_{10}+6H$.

This reaction Mr. Barrow supposed might take place on passing the naphthalin vapours through a red-hot tube. I accordingly tried a number of preliminary experiments in this direction, of which the results were as follows:—

(1). The odour and colour of the naphthalin which came through the tube were perceptibly altered; the colour became a deeper brown in proportion as the temperature of the tube was higher. At an incipient white heat a considerable quantity of black smoke came over with the distillate.

(2). A gaseous product was obtained proportionately larger in amount as the temperature employed was higher.

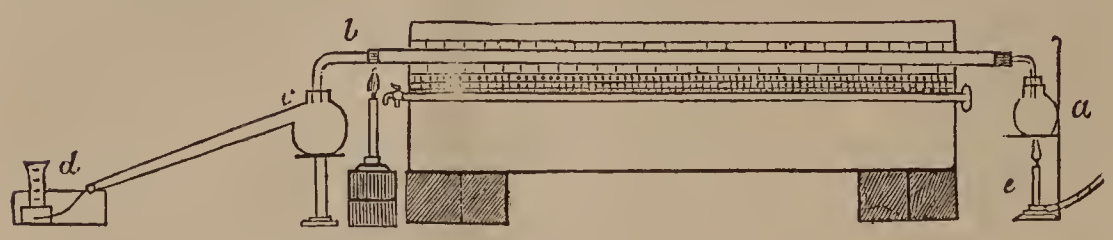
(3). On distilling the brown mass of naphthalin coming through the tube, there was invariably left in the retort a minute quantity whose boiling-point was above 350° C.

I now prepared some pure naphthalin, by treating a quantity of the crude stuff, whilst fused, with warm con-

* Read before the Manchester Literary and Philosophical Society.
† *Ann d. Ch. und Pharm.*, vol. cxxi., p. 361, and vol. cxxxii., p. 201.
‡ *Zeitsch. f. Chemie.* 1866, Dec. 14, p. 707.
‖ *Ann. d. Ch. und Pharm.*, Band cxliv., p. 71.

* *Ann. d. Ch. und Pharm.*, 1868, vol. cxlvii., p. 164.
† *Zeitschrift f. Ch.*, 1867, Jan. 31; and *Compt. Rend.*, vol. lxiii. p. 998 and 1077.

centrated sulphuric acid (about 5 per cent by volume); and, after separating, it was again shaken with hot caustic soda solution of sp. gr. = 1·18. The naphthalin thus treated was now purified by fractional distillation, the portion boiling between 210° C. and 212° C. being kept. After another distillation, the perfectly white product obtained was taken for experiment. Into a small flask (*a*) 152·6 grms. of the pure naphthalin were introduced, and the flask was connected with an iron tube (½ inch diameter), filled with small fragments of charcoal, to afford a large heated surface. That charcoal had no chemical influence beyond that of affording a large heated surface, was proved by the fact that the same results were obtained when fragments of pumice stone, soda-lime, brick, or the empty tube itself was employed. With the other end of the iron tube was connected a bent glass tube (*b*) (¼ inch diameter), fitting air-tight into a retort (*c*) so deep that the end thereof should be below the aperture of the retort-stem. With the extremity of the retort-stem was connected another bent glass tube, dipping into the pneumatic trough, over which was a jar of 340 c.c. capacity, to collect the gaseous products evolved. The iron tube was placed in a "Griffin's gas-furnace," where it was raised to a



a. Small flask with naphthalin.
b. ½-inch iron tube, filled with small fragments of charcoal.
c. Retort, to collect distillate.
d. Gas-jar, to collect and measure gas evolved.

bright red heat, in some parts approaching to whiteness. When the iron tube was red-hot, the naphthalin was distilled through cautiously. As soon as it made its appearance in the tube (*b*), the latter was heated up somewhat strongly, so as not to allow the solidification of the naphthalin. The distillate, when it commenced to run down the bend to the cool part of the tube in the retort, was worked over for a minute or two as briskly as possible; or it would certainly have stopped up that cool part of the tube which dipped below the stopper of the retort, causing a dangerous explosion from the little flask (*a*).

When the naphthalin began to run fluid into the retort, the distillation was kept up briskly for a time, all solidified particles being speedily re-melted by the hot stream, and carried before it into the retort. All danger of stopping up then ceased, as the whole apparatus was too hot to permit solidification in any part thereof.

The substance distilling over was of a deep brown-red colour, and had acquired a peculiar odour, in addition to that usual in naphthalin. The gaseous product obtained was just sufficient in the first trial to fill the gas-jar (340 c.c.). The distillation was carried on till the flask was just dry, when, on removing the flame of the lamp, there was always a back rush of vapour, accompanied by the dropping back of a dark-looking fluid, amounting in this (the first) distillation to about 1 c.c.

This small quantity of dark-looking substance which had dropped back out of the hot tube, was poured out into a small capsule, and carefully preserved, as the first contribution towards a quantity of the crude substance.

What distilled over into the retort (*c*), of reddish-brown colour, was now fused, and poured back again into the little distillation-flask (*a*), from which it was again distilled through the red-hot tube as before, in the first experiment. It not only yielded a little freshly formed substance of high boiling-point, but also left behind a little which had been formed, and carried over amongst the bulk of the naphthalin, in the first distillation. Thus a somewhat larger yield was obtained in the second and subsequent distillations than in the first. These distillations were repeated seven times, to accumulate crude material. The temperatures at which the tube was maintained were not uniform in each experiment; and the volumes of gas evolved was found to vary accordingly. Thus, in the second distillation, the heat was only just perceptibly red, and very little gas was obtained (about 5 c.c. or so).

Quantities of Gas Liberated during each Experiment, the Heat Employed Varying in Intensity.

Distillation.	Intensity of heat of tube.	C.c. of gas evolved.
1st.	Bright red heat.	300
2nd.	Only just red.	Very little, about 5 c.c.
3rd.	Bright red.	460
4th.	Do.	300
5th.	Do.	500
6th.	Do.	403
7th.	Do.	300
8th.	Do.	225
	Total	2493

Average temperature = 15° C.

The above measurements of gas evolved were not made with any great accuracy, but are just fair approximations. This gas was tested, and yielded the following results:—

(1). It gave no milkiness with lime-water.

(2). It burnt, on ignition, with a lambent bluish flame, tinged at times with a glimmering of the white carbon flame, and, on shaking with lime-water, gave therewith a very slight milkiness; but almost always there was not the slightest glimmer of the carbon flame, and not the slightest cloud with lime-water after burning.

(3). The gas, mixed with half its volume of oxygen and inflamed, exploded loudly.

From these evidences we gather that the gas is hydrogen; and the glimmering at times of the carbon flame was probably due to the presence of a little naphthalin vapour mechanically carried over, though certainly a trace of acetylene might be present at times, and would then account for it.

If a calculation be made from the volume of gas evolved, it will be found that this quantity is too great to stand good for the equation

$$7C_{10}H_8 = 5C_{14}H_{10} + 6H.$$

Weight of H actually evolved . . . . = 0·2107 grm.
,, ,, required for the above reaction = 0·1861 ,,

The above is sufficient to show that, as the amount of hydrogen evolved was too great to stand good for the above equation, the body formed from the decomposition (seeing that there was no appreciable separation of carbon) must be richer in carbon and poorer in hydrogen than anthracene is. This point will be again referred to.

Now the crude substance which had been accumulated amounted to 26·3 grms,—that is, 17·23 per cent on the naphthalin used. These 26·3 grms. of crude substance were placed in a small retort with thermometer, and submitted to fractional distillation. A very small quantity of naphthalin came over first, below 220° C.; and then the temperature very rapidly rose to considerably above 360° C., when most of the body distilled over, leaving a minute quantity of pitch in the retort. In distilling, almost all the substance solidified in the neck of the retort, which had to be kept very hot towards the end of the operation, to get the substance to run down fused into the receiver. At this stage the distilled product closely resembled anthracene in a similar stage of purification, but did not possess the peculiar odour which characterises that body in the crude state, being almost entirely free from odour.

To purify further, the solid hard substance was crushed in a mortar and made into a thin homogeneous paste with light shale spirit (or petroleum spirit), in both of which it

is much less soluble than in benzol. It was then drained on a filter, washed again several times with petroleum or shale spirit, drained, pressed in blotting paper, and dried at a temperature fully sufficient to volatilise the spirit. By this washing it was freed from a small quantity of resinous matter, and from a citron-yellow coloured substance, which coloured the spirit mother-liquors yellow by direct transmitted light, exhibiting a fine blue fluorescence by reflected light.

This fluorescence is similarly acquired when any fluids possessing any solvent action are substituted for the shale spirit.

Finally, the dried substance was sublimed at as low a temperature as possible. The sublimate consisted of a faintly yellowish-white inodorous powder, precisely resembling commercial anthracene sublimed under like conditions, but not possessing the slightest odour. The sublimate may also be obtained in delicate little plates, by very careful and slow sublimation. When possessing the faintest yellow tint, this powder imparts a delicate blue fluorescence to any solvent used.

In another preparation of a further quantity of crude substance, a large iron tube, about 4 or 5 feet long, and about 3½ inches diameter, was used, being placed in a charcoal fire. The heat was almost to whiteness. In this case there was a connection with a pneumatic trough, the open end of the tube dipping into an iron pan acting as receiver. Immense volumes of black smoke were liberated at first;* however, on moderating the heat somewhat, whilst the dense black smoke still poured out, a quantity of undecomposed naphthalin and other matters came over, dropping into the receiver. The black, almost solid mass in the receiver, after being put back into the one-gallon iron still employed, and re-distilled several times, at length left a residue, which, on fractional distillation, proved to contain some undecomposed naphthalin, this passing over below 220° C. A very appreciable residue however remained, which was distilled over, the temperature rising above 350° C. In this case, however, the solid hard substance obtained had a deep yellow tint, almost inclining to orange; and on triturating in the mortar with benzol (cold), the latter dissolved out a sticky resinous body, which coloured it a fine deep red. After washing once or twice, the crude body remaining was quite freed from this sticky substance, and remained a sulphur-yellow powder. This yellow colour was very much more intense than in the case of the experiments on the minor scale. By re-crystallisation from benzol and sublimation, it was obtained colourless.

A small quantity of this crude orange-yellow body, treated with cold concentrated sulphuric acid, yielded a very fine purple solution, better developed on warming. On heating more strongly, the colour changed to an indigo tint, and then to a dull green. As this reaction is mentioned by C. Liebermann as characteristic of chrysene, I venture to suggest that probably chrysene was present in this yellow crude substance.

With a benzol solution of picric acid in excess, no red compound was formed with this body. It was found to be much more insoluble in alcohol and shale spirit than anthracene is; from these solutions it separates on cooling in larger or smaller rhomboidal plates, according to whether the solutions are more slowly or rapidly cooled. It is almost insoluble in ether, but easily soluble in oil of turpentine, from which it crystallises in beautiful lance-shaped crystals, congregating in clusters. It is, like anthracene, very soluble in carbonic disulphide, even in the cold. The thoroughly purified substance imparts no longer any fluorescence to solvents.

Lossen's Dinaphthyl. Solubility, &c.	Isodinaphthyl. Solvents.	States of Solubility.	Crystalline form.
The reverse; more soluble in ether than in alcohol.	Proof spirit.	Scarcely at all, even on boiling with excess.	On cooling, a few small plates separate out.
	Ether.	Only very slightly.	
	Absolute alcohol.	Soluble on boiling.	Beautiful rhomboidal plates, which, on drying carefully, overlap and laminate, and have a beautiful silky appearance. They possess a very faint delicate greenish colour.
From alcohol separates in moss-like clusters.	Methylated spirit.	More so.	
In octahedra from ether-alcohol mixture.	Wood spirit.		
	Light petroleum spirit, sp. gr. 0·710.	Still more soluble than in the above.	Rhomboidal plates.
	Light shale spirit, sp. gr. =0·737.	Rather more than in petroleum spirit.	
	Carbon tetrachloride.	Slightly less soluble than in benzol.	Ditto.
About the same as in alcohol.	Benzol.	Sparingly in the cold, pretty freely in the hot fluid.	
Easily soluble.	Carbonic disulphide	Easily soluble, even in the cold.	
	Oil of turpentine.	Very easily soluble.	Delicate white lance-shaped crystals, in clusters.
Melting-point = 154° C.	Melting-point = 204° C.		
Boiling-point = above 350° C.	Boiling-point = much above 360° C.		

The fusing-point is from 200° to 204° C., and the boiling-point considerably over 360° C., certainly higher than that of anthracene. The subliming-point of this body lies considerably below its boiling-point, like that of anthracene.

A portion of the pure substance was treated with two parts of potassium bichromate and sulphuric acid, when oxidation took place as energetically as in the case of anthracene under like treatment. No crystals bearing any resemblance to those of anthrachinon could be obtained on treating with benzol. From the product which was obtained, no substance similar to alizarine, nor in fact any colouring matter, could be obtained.

Cold sulphuric acid is without action upon this body; but, when heated, the acid slowly dissolves it, when, if it be quite pure, a very faint purplish-tinted solution is

* Probably caused by the admittance of a small amount of air accidentally.

formed; if not quite pure, but containing a trace of the yellow-coloured body mentioned before, a violet or purple solution is formed, becoming green and then reddish-brown on further warming.

Hot nitric acid oxidises it, with liberation of nitrous fumes, forming heavy oily drops of a nitro-compound of a red colour; on further boiling with a large excess of acid, this compound is slowly dissolved. On addition of water, a light yellow floccular precipitate is thrown down abundantly.

Placed in a glass tube, and chlorine passed over it in the cold, no action takes place; and even on warming to a considerable extent, no change appears to occur. Treated with bromine in the cold, combination takes place with very energetic action.

After many repeated experiments on the subject, I have come to the conclusion that it is impossible to distil pure naphthaline to dryness in any quantity without this body being formed in minute quantity. This may be observed by dipping the thermometer down nearly to the bottom of the retort when the last minute quantity is being vaporised; the thermometer, lowered into this vapour, will be observed speedily to indicate a high temperature, the mercury rapidly rising towards 350° C. If this does not take place on the first distillation,—if the naphthaline, all of which has passed over, be again introduced into the retort, and the same plan again proceeded with, this observation may be made successfully, as a small quantity of high boiling substance carried over in the first distillation will be increased by a further accumulation in the second, and an appreciable quantity will be left behind.

A quantity of the pure substance crystallised from absolute alcohol was taken for analysis. The following results were obtained:—

I. 0·1240 grm. of substance gave 0·4307 grm. CO_2 } 0·0624 ,, H_2O }

II. 0·1237 ,, ,, ,, 0·4284 ,, CO_2 } 0·0626 ,, H_2O }

	I.	II.	Calculated for $\left.\begin{matrix}C_{10}H_7\\C_{10}H_7\end{matrix}\right\}$
Carbon.. ..	94·72	94·46	94·49
Hydrogen ..	5·59	5·62	5·51
	100·31	100·08	100·00

A calculation may also be made from the weight of hydrogen given off in the reaction in the hot tube; and I think it is well worthy of notice, as it was this observation which first led me to think the reaction must be as follows, viz.:—

$$2C_{10}H_8 = \left.\begin{matrix}C_{10}H_7\\C_{10}H_7\end{matrix}\right\} + 2H.$$

Weight of naphthaline converted = 26·3 grms. (about).
Volume of hydrogen at 0° C. evolved = 2363 c.c.

Then $\frac{2363}{11200}$ = $\overbrace{0{\cdot}2109}^{\text{Grm. Hydrogen.}}$ actually obtained.

$\overbrace{2C_{10}H_8}^{256}$ lose $\overbrace{H_2}^{2}$ ∴ 26·3 lose 0·2055 calculated.

Difference .. .. .. 0·0054

For the formula

$7C_{10}H_8 = 5C_{14}H_{10} + 6H$, 0·1861 should be liberated.

Conclusions.

I find from the foregoing facts:—

(1.) That, whereas Berthelot found that diphenyl could be obtained by the action of a high temperature upon benzol, identical with that obtained by Fittig from brom-benzol, the analogy does not appear to hold good with dinaphthyl formed from naphthaline.

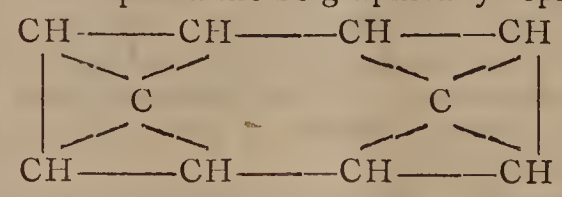
(2.) That a substance having a higher melting-point, and differing in many respects from Lossen's dinaphthyl, is formed.

(3.) That this body is the chief product of the action of heat upon naphthaline, whether a low temperature, just sufficient to induce decomposition, or a temperature close upon a white heat be employed.

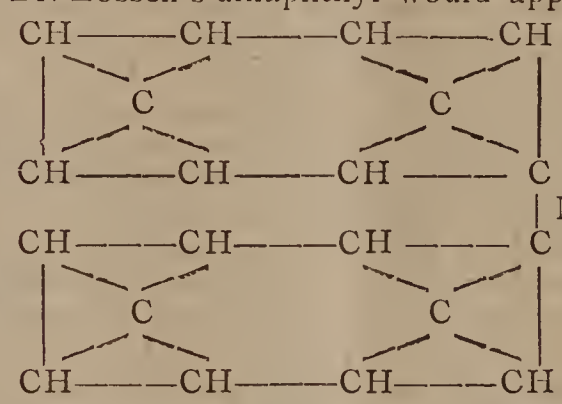
(Finally.) Observing the percentage composition of this body, and the volume of hydrogen approximatively found to be evolved in the decomposition, also that the boiling-points of dinaphthyl and this body are by no means very widely different, possibly not far apart, I propose to regard it as an isomer of dinaphthyl, and to name it accordingly isodinaphthyl—

$$\left.\begin{matrix}C_{10}H_7\\C_{10}H_7\end{matrix}\right\}.$$

If naphthaline be graphically represented as—

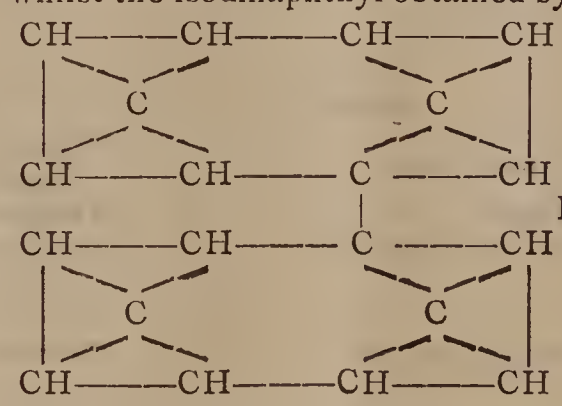


Dr. Lossen's dinaphthyl would appear to be—



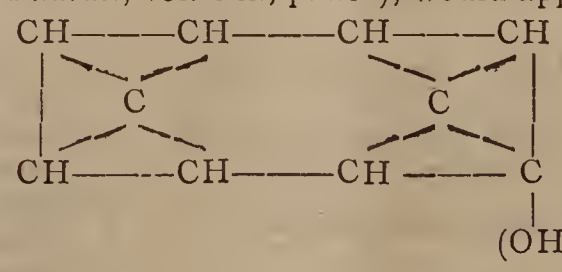
a Dinaphthyl.
Melting-point = 154° C.

whilst the isodinaphthyl obtained by myself would stand—

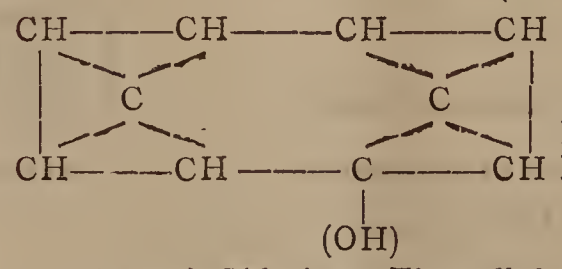


β Dinaphthyl.
Melting-point = 204° C.

Analogously, the *a* and *β* naphthols investigated by Wichelhaus, and also by Schaeffer (*Ann. der Chemie und Pharm.*, vol. clii., p. 281), would appear thus:—



a Naphthol.
Melting-point = 94° C.
Boiling-point = 279° C.



Naphthol.
Melting-point = 122° C.
Boiling-point = 287° C.

Action of Chlorine.—The effect of passing chlorine, together with naphthaline vapour, through a red-hot tube was also tried in such a way that the vapours should only come into contact in the hot tube. It was then found that complete decomposition took place, with large separation of carbon in dense black smoke.

I cannot conclude without heartily thanking Mr. Barrow, in the laboratory of whose works these experiments were carried out, for his kind assistance. My sincere thanks are also due to Professor Roscoe and Mr. Schorlemmer for their kindness in placing the combustion-apparatus in Owen's College laboratory at my disposal, and for their kind attention to me whilst there engaged.

ON A PARAFFIN HAVING A HIGH MELTING-POINT.

By JOHN GALLETLY.

In manufacturing paraffin oil from Boghead coal, I happened to have at one time as the final portion of the crude oil condenser, an old boiler to which the entrance and exit pipes were attached close to the top, so that it could become nearly filled with naphtha without the passage of the gas through it being stopped. This portion of the condenser never became warm in the slightest degree, but besides filling rapidly with naphtha, a considerable quantity of a dark tarry matter accumulated in it which had a brittle crystalline feeling when pressed between the fingers. This, I supposed at first, was due to the presence of a crystalline substance, but subsequently found it was owing to the manner in which the tarry matter encrusts itself as it condenses or deposits. When this solid matter is boiled with naphtha, a thick fused cake is found to settle down, and a dark brown powder remains floating through the liquid. On filtering, a very dark coloured fluid is obtained, which solidifies on cooling, and the brown powder remains on the filter. The fused cake and this dark powder are insoluble in any ordinary liquid in which bituminous matters dissolve, not volatile without decomposition, and therefore furnishing no easy means of purification or recognition as definite substances.

On pressing the naphtha solution after cooling and solidification, the crude hydrocarbon which forms the subject of this notice, is obtained as a soft dark coloured cake. Its purification is effected by repeated crystallisations from naphtha, which are easy enough for the first three or four times, but then become very troublesome on account of the paraffin passing through the cloth along with the naphtha. Bees'-wax behaves in a similar manner when an attempt is made to crystallise it, and it would be almost as easy to press starch-paste into a firm cake. However, I used very gentle pressure in woollen cloths, allowing the mother-liquor to soak into dry bricks. This was repeated eight or ten times, using with the last naphtha a little animal charcoal. The product, after being filtered, had steam blown through it to expel the naphtha, when hard cakes were obtained of a yellowish colour. This yellow colour was no doubt due to a very small quantity of some impurity very difficult to remove.

As thus obtained this substance resembles bees'-wax very closely, but is a little more translucent and does not exhibit any conchoidal fracture when broken. It has a much harder ring than ordinary paraffins when two pieces of it are struck together. Its melting-point is very high, being 80° C. This it attains after the first few crystallisations, and remains unaltered however often this process be repeated with considerable quantities of fresh naphtha. It is evidently, then, an individual substance, not a mixture of several homologues like ordinary paraffins. It seems to be separated from the paraffins accompanying it in the crude oil by a considerable gap. The highest of these after more than a dozen crystallisations, the later of which making little alteration, had a melting-point of 65·5° C.; the quantity obtained being reduced to a fifteenth of the weight of the material commenced with, which was paraffin melting at 56° C.

The elementary composition of this paraffin is sensibly that of the other paraffins and of olefiant gas. Below are the numbers I obtained alongside the analyses of some other paraffins, and the composition of olefiant gas.

	Paraffin 80° C.	Olefiant gas.	Anderson from Boghead 52°.	Brodie from Chinese wax 58°.	Brodie from Bees'-wax 62°.
Carbon ..	85·2	85·7	85·15	84·90	85·31
Hydrogen ..	14·4	14·3	15·40	14·21	14·44

By placing the composition of olefiant gas alongside these analyses, I do not mean to differ with those chemists who regard the paraffins as homologues of marsh-gas. On the contrary, I think the very existence of this new body, which must have a very complex molecule, as so much evidence in favour of this view, the marsh gas series being so much more stable than the olefines. The numbers, however, are useful as showing among other things that the elementary composition as determined by experiment cannot settle the question.

Besides the boiling-point being very high, namely, not far short of a red heat, this paraffin partially suffers a change on distillation, apparently about one-half of it being converted into liquid hydrocarbons. This renders a determination of its vapour density unusually difficult, and I have not attempted it.

I may state that the solid portion, after distillation, on being washed and crystallised from naphtha, retains its melting-point unaltered.

It seems to be a rule that the paraffins obtained from any particular source have solubilities diminishing as their melting-points get higher. The body under notice is not an exception to this rule, and the following table gives the solubility of several paraffins in well rectified commercial benzole :—

Melting-point of Paraffin.	Solubility in 100 c.c. at 18° C.
35·0° C.	133·0 grms.
49·6° C.	6·0 ,,
52·8° C.	4·7 ,,
65·5° C.	1·4 ,,
80·0° C.	0·1 ,,

Although only one part of the paraffin melting at 80° C. dissolves in 1000 of benzole at 18° C., it mixes with it in all proportions above its melting-point.

The densities of the paraffins also show an increase with a rise in their melting-points, but I may state that it is a little difficult to obtain exactly the same numbers with two different samples having the same melting-point. One cause of this may be owing to more or less rapid cooling, but the subject requires investigation.

The following are numbers I obtained with paraffins all from Boghead coal :—

Melting-point of Paraffin.	Specific gravity.
32·0° C.	823·6
39·0° C.	848·0
40·5° C.	852·0
53·3° C.	911·0
53·3° C.	909·0
58·0° C.	924·3
59·0° C.	924·8
80·0° C.	940·0

Brodie viewing them when he published his papers as olefines, gives the formula of cerotene as $C_{27}H_{54}$ and its melting-point at 57° to 58° C., and melene as $C_{30}H_{60}$ with a melting-point of 62° C. It is probable enough from the properties of the hydrocarbon under consideration that its molecule contains nearly half as many more atoms as melene.

Picric acid forms no compound with this paraffin.

When melted over sulphuric acid, this body gives a greasy black mass resembling drawing-chalk. A mark made on paper with this substance is scarcely to be distinguished from that of a black-lead pencil. Sulphuric acid attacks all the paraffins more or less when highly heated with them, but more easily the higher their melting-points. The carbon which separates by acting on paraffin of 80° C. melting-point is in a state of very fine division, and when the dark cake so procured is boiled with naptha the carbon passes along with the liquid through the pores of fine filter-paper.

Brodie has examined the action of chlorine on melted cerotene. He gets first a change to a waxy looking substance, then it turns gummy, and ultimately a transparent resin, becoming harder as more chlorine is absorbed; several weeks being required to complete the changes,

and the body $C_{27}H_{32}Cl_{22}$ being formed. With ordinary paraffin, Mr. James Young, jun., obtained a similar result up, at least, to the gummy stage, and afterwards Mr. W. MacIvor in Mr. Young's laboratory carried on the action till a brittle resin was obtained. On the high melting paraffin under notice chlorine acts much more rapidly, darkening it almost immediately, and giving, after a time, a thick black oily or gummy body, turning quite thin when gently warmed. I did not persevere further with the chlorine treatment after reaching the viscid liquid stage, but now subjected the material to distillation. Torrents of hydrochloric acid were evolved, and a small quantity of an oil of a strong, very peculiar odour. I can give no exact idea of this odour, and do not know to what substance it belongs, but I at once identified it as that of the oil Mr. Young obtained by distilling his viscid chlorinated paraffin. The residue of charcoal left after distillation was large.

Heated with nitric acid (sp. gr. 1·4) the 80° C. paraffin is converted in an hour or two chiefly into nitro-compounds, which are readily soluble in caustic alkalies. Ordinary paraffins undergo, as has been pointed out,* the same change with more protracted boiling. With the latter, besides butyric acid, there are acids of the succinic series produced, of greatly varying melting-points, but how many of them, from the difficulty in their separation and our imperfect knowledge of their distinguishing properties, it would not be easy to determine. The chief product is a thick clear oily nitro-compound, miscible with the warm nitric acid, and soluble in alkalies, giving when distilled large quantities of ammonia and the interesting pyridine bases. There does not appear to be a trace of aniline produced; very slight traces of aniline along with these bases giving with chloride of lime solution a bright characteristic green colour, obtained generally with the bases from shales poor in nitrogen.

A candle made of this high melting paraffin burns with a small but very clear smokeless flame, lasting a very long time. It would, however, be too expensive a material to manufacture for making candles. It occurs in the shale products as well as in those from the cannels, and could be obtained in some quantity if a tempting price were offered for it.

I hope to be able soon to complete another paper on paraffin. It is very striking how limited our knowledge is of this subject compared with our information regarding the benzole series and naphthalin. The derivation of its name has, it may be presumed, chiefly to answer for this condition of affairs.

ON THE

CHANGE OF COLOUR PRODUCED IN CERTAIN CHEMICAL COMPOUNDS BY HEAT.†

By Professor EDWIN J. HOUSTON,
Of the Central High-School of Philadelphia.

(Concluded from p. 180).

Solids.—The reduction of temperature was obtained by the evaporation of ether, bisulphide of carbon, or liquid sulphurous acid. The liquid was placed in a metallic box, furnished with eight vertical sides. Strips of paper, on which the substances were painted, were pasted on the sides of the vessel. Corresponding strips of paper, similarly prepared, were kept for comparison. Cold was produced by blowing a blast of air from a small bellows upon the surface of the liquid. The results obtained were somewhat vitiated by the deposition of the moisture of the air on the sides of the metallic vessel. This difficulty was obviated to some extent by having the paper slip, kept for comparison, equally moist.

The results, which are open to this objection, were as follows:—

Sulphide of Mercury.—Changes from a bright red to a brighter red.

Bisulphide of Tin.—Changes from a brownish orange-yellow to a lighter brownish-yellow.

Subsulphate of Mercury.—Changes from a yellow to a greenish-yellow.

Iodide of Lead.—Changes from an orange to a lighter orange.

Chromate of Lead.—Changes from a yellowish-orange to a yellowish-green.

The substances occupying the remaining sides of the vessel did not present any appreciable change.

Liquids.—The experiments with liquids were, with a few exceptions, of an unsatisfactory character. The solvent in most cases was water, and the cold could not safely be pushed lower than the point of maximum density of the solutions. The solutions were prepared in test-tubes, in a manner similar to the experiments with heat. The limitation in the application of cold was, in all probability, the cause of the changes not being of a more decided character.

The following are among some of the substances experimented with:—

Sulphate of Copper.—Solution of a pure blue; deepens on the application of cold.

Ferrocyanide of Potassium.—Saturated solution of a nearly pure yellow; becomes tinted slightly with green.

Chloride of Copper.—Solution of a bluish-green; becomes a more decided bluish-green.

Sesquichloride of Iron. — Solution, orange-yellow; becomes an orange-yellow in which the yellow is more predominant than in the preceding.

Sesquinitrate of Iron.—Solution, orange-yellow, like the chloride.

Wishing to obtain a solution that could be exposed to a much lower temperature without freezing, a solution of the chloride of copper in ether was prepared. The colour was yellowish-green. When exposed to a low temperature by the evaporation of the bisulphide of carbon, the colour changed very decidedly to a pure green. It is purposed, at our earliest convenience, to pursue these investigations at lower temperatures obtained by means of solid carbonic acid and ether. Meanwhile, we would be much pleased if any investigators throughout the country, who may be using a solution of the solid carbonic acid in ether, would observe the action of intense cold on the etherial solution of chloride of copper, or on any solution of a similar nature.

The law already stated seems now to have been clearly established, both by the number of cases that come under it, and by the fact that, so far, no exceptions have been noticed. It can hardly be urged, with fairness, that all coloured compounds should be equally influenced by the action of the less rapid heat vibrations, for the differences presented by bodies, as regards their transparency or opacity to light, or their diathermancy or adiathermancy to heat, clearly indicate a very great difference in their molecular structure, which difference offers reasons amply sufficient to explain why the colours of some compounds should be more influenced by heat than others. Again, there can be little doubt that more extended observations will increase the great number of compounds already noticed. For instance, the well-known change from red to yellow presented by the red iodide of mercury, dissuaded us at first from submitting it to an experiment. On a careful trial, however, it was found to illustrate the law, changing to a decidedly darker red up to the temperature requisite to alter its crystalline form.

The theory also receives further support and confirmation from the following considerations.

It is well known that when a yellow and a red substance, which have no chemical action on each other, are mixed together, the resulting colour is orange. The explanation is undoubtedly to be found in the raising of the

* I regret not having an opportunity of referring to a memoir which was published on this subject.

† From advance-sheets of the *Journal of the Franklin Institute.* Communicated by Dr. W. H. Wahl.

less rapid red vibrations by the yellow, and the consequent lowering of the yellow by the red, the mean resulting vibration being that capable of producing orange light.

This case, though analagous to the change produced in colour by the action of the heat, is not strictly identical with it. In an orange substance, which emits red light when heated, the change is produced as follows :—

Its molecules, while vibrating in periods requisite to produce orange light, are, at the same time, forced to accept the less rapid vibrations of heat. They are unable to do this without lowering the rapidity of the light vibrations, and the emitted light is red. Here, however, the molecules themselves transmit red light to the ether surrounding the intermolecular spaces, which ether in its turn transmits it to the eye for the purposes of vision. Now, in the case of the orange light emitted after the commingling of a yellow and a red substance, as no change other than that of mixture is produced, we must still conceive of the particles of the red and of the yellow substance vibrating in periods requisite to produce red and yellow, and the interference taking place in the intermolecular spaces. Briefly the difference is as follows :—

In the substance whose colour is changed by heat, the *molecules* transmit the changed light directly to the surrounding ether, while in the commingled bodies, the change occurs in the ether surrounding the molecules. The two cases become strictly analogous when we mingle red and yellow light.

In accordance with this view, pure orange and green when mingled should produce yellow; yellow and blue, green; green and indigo, blue; and blue and violet, indigo.

When we come to the boundary of the spectrum on the light side, in other words when we come to the violet, an apparent objection meets us. We know that violet can be produced by the mingling of indigo or blue light with red. That is two lower vibrations, and one of them at the lowest extremity of the visible spectrum, produce by their mingling a resultant higher vibration, a fact certainly improbable, and seemingly at variance with theory. It must, however, not be forgotten that the violet of the spectrum marks not the limit of the etherial vibrations, but merely our power of appreciating them. The existence of higher vibrations is shown by the actinism of the spectrum, or the effect in producing chemical decomposition, existing some considerable distance beyond the violet. In fact, Herschel, by concentrating this invisible light beyond the violet, succeeded in rendering it visible, and gave its colour the name of lavender. This light is of a pale red, inclining to a tinge of violet.

The explanation is now simple. The violet of the spectrum is not produced by the mingling of the indigo or blue with the remoter or lower red, but with that of the higher red or lavender. Indeed, we are strongly led to the belief in the existence of a spectrum beyond the visible spectrum, whose colours, could the eye be trained to appreciate them, would be lighter tints of the lower colour. This spectrum would then begin with a paler, shriller, higher red, which we actually have in the lavender. The next, which will probably some day be rendered visible, would be a paler, shriller, higher orange; and so on through the yellow, green, and the other colours.

The analogy of the less rapid vibrations requisite to produce sound is in strict accordance with these considerations. Take, for instance, the note C of the natural gamut; it requires for its production, say 128 vibrations per second; if we increase the rapidity of the vibrations to 144, we get the next higher note, or D; at 160 vibrations, E; at $170\frac{2}{3}$, F; at 192, G; at $213\frac{1}{3}$, A; at 240, B; and at 256, or just twice the number of vibrations requisite to produce C, we get a higher note, which we call C′, which though it differs from C in its pitch, and probably in its *timbre*, still bears to it in many respects a striking resemblance.

The visible range of coloured notes also constitute one octave, viz—red, corresponding, say, to C; and then orange, yellow, green, blue, indigo, and violet, corresponding respectively to D, E, F, G, A, and B. The octave, or the lavender, corresponding to C′, can only be appreciated by the eye under favourable circumstances.

It is most probably more than a mere coincidence that the interval between the lower and the higher red, which is $\frac{1}{2}$, is exactly the same as the interval between the higher and the lower C. Indeed, calculations we have made show a remarkable similarity in the intervals between the different colours of the spectrum, and the notes of the natural gamut with which we have compared them.

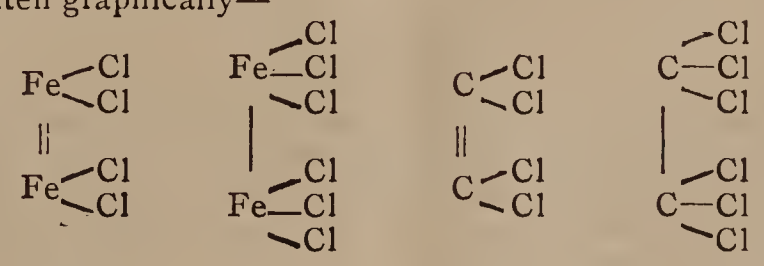
The same reasoning applies to the colours of the spectrum beyond the red, on the heat side, the next colour to which, could it be appreciated by the eye, would probably be a very dark reddish-violet, or a purple. In confirmation of this view, we have noticed that some reds, in turning into browns and blacks, possess a slight tinge of purple.

CORRESPONDENCE.

VALENCY OR ATOMICITY.

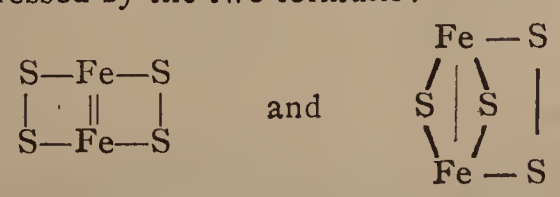
To the Editor of the Chemical News.

Sir,—Your correspondent "W. H. O." will find that the question of the apparently variable valency of iron has been discussed by Wurtz,* who adopts Friedel's hypothesis, that this metal is a tetrad ($\overset{IV}{Fe}=56$). Until the vapour density of ferrous chloride be correctly determined, it cannot be said with certainty whether the molecular formula of this compound is $Fe''Cl_2$, or $(Fe_2)^{IV}Cl_4$, or $(Fe_n)^{2n}Cl_{2n}$; the vapour density of ferric chloride, however, shows that the molecular formula of this substance is $(Fe_2)^{VI}Cl_6$. By assuming that iron is tetravalent, these two chlorides become precisely analogous to the similar carbon chlorides, $(C_2)^{IV}Cl_4$ and $(C_2)^{VI}Cl_6$; written graphically—



The fact that the specific heat of iron shows that its atomic weight is 56 is no proof that ferrous chloride does not contain *two* atoms of iron: when carbon and hydrogen combine (by the electric spark), the resulting hydrocarbon contains *two* carbon atoms, being acetylene; when chlorine acts on excess of copper, the product is cuprous chloride, Cu_2Cl_2; and, similarly, when nitric acid acts on excess of mercury, the resulting substance is mercurous nitrate, $Hg_2(NO_3)_2$. By analogy, therefore, it may be predicted that the molecular formula of ferrous chloride is Fe_2Cl_4, and hence that of the ferrous compounds generally is $(Fe_2)^{IV}X'_4$.

Pyrites may be $\overset{IV}{Fe}S_2$; but there is no reason (except simplicity) for ascribing this formula rather than Fe_2S_4: and the difference between pyrites and marcasite may be expressed by the two formulæ:—



and &c., &c.

* "Leçons de Philosophie Chimique," p. 160. Paris, 1864.

Wanklyn has suggested that oxygen (=16), as usually met with in combination, may really be a double atom; thus, if $O = 8$, and O be divalent, water may be written $H_2(O_2)''$, or graphically—

$$H—O—O—H \quad \text{or} \quad H—(O_2)''—H,$$

the double atom of oxygen being as inseparable, ordinarily, as the Fe_2 in the ferric compounds or the C_2 in the ethyl series. Carbon oxide, however, may be viewed as containing oxygen not in this form, but as single atoms; graphically, this may be written—

$$C\begin{matrix}=O\\=O\end{matrix}$$

when the four combining tendencies of the carbon are all saturated.

An argument in favour of this view may perhaps be drawn from the behaviour of carbon oxide when gently heated in presence of certain metals—*e.g.*, iron, cobalt, nickel; at temperatures not much exceeding the range of the mercurial thermometer the gas is decomposed, an oxide of the metal being produced and carbon being set free.* Under the same circumstances, carbon dioxide is perfectly inert, although it oxidises the metal at a red heat and upwards; from which it would appear as though the oxygen were in different conditions in these two gases respectively.

With respect to the abnormal oxides of nitrogen, Playfair and Wanklyn have shown† that, under certain conditions, nitrogen tetroxide has a vapour density corresponding with the molecular formula N_2O_4; but at higher temperatures, or under different conditions, the density is only one-half this, indicating the formula NO_2. Apparently, therefore, a dissociation takes place; with nitric oxide, however, the larger vapour density has not yet been observed, *i.e.*, the gas as ordinarily met with is in this dissociated condition.

The following modification of Wanklyn's hypothesis of the double atom of oxygen is capable of accounting simply for all these observed facts and apparently abnormal valencies:—*Oxygen is a triad, and has the atomic weight* 8. Ordinarily, however, a double atom is met with, which is a diad, and has the atomic weight 16; denoting the single atom by the symbol $\omega''' = 8$, we have—

$$O'' = (\omega_2)'' = \begin{matrix}—\omega\\ \|\\ —\omega\end{matrix}$$

The molecule of free oxygen, therefore, like the precisely analogous one of phosphorus, contains four atoms, being $O_2 = \omega_4$. The following formulæ show how this view accounts for the abnormal nitrogen oxides and for carbon oxide; thus we have—

Ultimate atom of oxygen .. .. ω''' $= 8$

Ordinary double atom of oxygen $\omega_2'' = \begin{matrix}—\omega\\ \|\\ —\omega\end{matrix}$ $= O = 16.$

Molecule of free oxygen .. .. $\omega_4 = \begin{matrix}\omega—\omega\\ \| \quad \|\\ \omega—\omega\end{matrix}$ $= O_2$

Ozone .. .. $\omega_6 = \begin{matrix}\omega\\ /\ \backslash\\ \omega \quad \omega\\ \|\quad |\\ \omega \quad \omega\\ \backslash\ /\\ \omega\end{matrix}$ $= O_3$

Water .. .. $\begin{matrix}H—\omega\\ \|\\ H—\omega\end{matrix}$ $= \left.\begin{matrix}H\\H\end{matrix}\right\} O$

Carbon oxide .. .. $C\begin{matrix}=\omega\\ |\\ =\omega\end{matrix}$ $= C'' = O$

Carbon dioxide .. .. $C\begin{matrix}\omega\\ /\ \|\\ —\omega\\ —\omega\\ \backslash\ \|\\ \omega\end{matrix}$ $= C\overset{IV}{}\begin{matrix}=O\\=O\end{matrix}$

Silver quadrantoxide.. .. .. $\begin{matrix}Ag—\\ Ag—\\ Ag—\\ Ag—\end{matrix}\ \omega\ |\ \omega$ $= Ag_4O$

In the nitroxygen series (assuming nitrogen to be trivalent)—

Nitrous oxide .. .. $\begin{matrix}N=\omega\\ |\quad |\\ N=\omega\end{matrix}$ or $\begin{matrix}N—\omega\\ \|\quad \|\\ N—\omega\end{matrix}$ $= N_2O$

Nitric oxide (hypothetical) .. .. .. $N_2\omega_4$ $= N_2O_2$

Dissociates into .. .. $N'''\omega''' + N'''(\omega_3)'''$ or $N\equiv\omega + N\begin{matrix}\omega\\ |\\ \omega\\ |\\ \omega\end{matrix}$

Nitrogen tetroxide at low temperatures .. $N_2\omega_8$ $= N_2O_4$

At higher temperatures dissociates into .. $N'''(\omega_3)''' + N'''(\omega_5)'''.$ or $\begin{matrix}\omega\\ |\\ N—\omega\\ |\\ \omega\end{matrix} + \begin{matrix}\omega—\omega\\ |\quad \|\\ N—\omega\\ |\\ \omega—\omega\end{matrix}$

The vapour densities, and even the existence, of the other two members, N_2O_3 and N_2O_5, are not as yet known with certainty.

The tendency of nitric oxide to take up a molecule of oxygen and pass into nitrogen-tetroxide may be readily explained by supposing that the dissociated group $N\equiv\omega$ passes into $N\equiv(\omega_5)$ by taking up ω_4, the group $N(\omega_3)$ remaining unaltered, thus:—

$$N\equiv\omega + \begin{matrix}\omega—\omega\\ \|\quad \|\\ \omega—\omega\end{matrix} = \begin{matrix}\omega—\omega\\ |\\ N—\omega\\ |\\ \omega—\omega\end{matrix}\ \|\ \|$$

This view of the constitution of oxygen may be applied to other elements: thus nitrogen itself as usually found in combination may be viewed as a complex of three atoms, each of which is triatomic and has the atomic weight $\frac{14}{3} = 4\frac{2}{3}$.

Hence, nitrogen may be trivalent or pentavalent; thus, denoting the ultimate atom by the symbol $\nu''' = 4\frac{2}{3}$, we have—

Ultimate atom .. .. $\nu''' = 4\frac{2}{3}$.

Nitrogen in triad compounds.. $(\nu_3)''' = N''' = 14$

Thus, ammonia.. .. .. $\left.\begin{matrix}H—\nu\\ |\\ H—\nu\\ |\\ H—\nu\end{matrix}\right\} = \left.\begin{matrix}H\\H\\H\end{matrix}\right\} N'''$

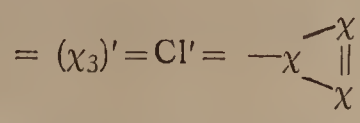
Nitrogen in pentad compounds $(\nu_3)^{v} = N^{v} = 14$

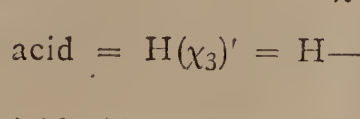
Thus, ammonium chloride $\left.\begin{matrix}H\\H\end{matrix}\ \nu\ \begin{matrix}H\\H\end{matrix}\ |\ Cl—\nu = Cl\ |\ \begin{matrix}H\\H\end{matrix}\ \nu\ \begin{matrix}H\\H\end{matrix}\right\} N^{v}$

In a similar way, chlorine, bromine, and iodine may be considered, ordinarily, as complexes of three atoms, thus:—

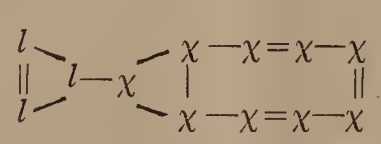
* I. Lowthian Bell. *Journal of the Iron and Steel Institute* (1871), p. 158 *et seq.*

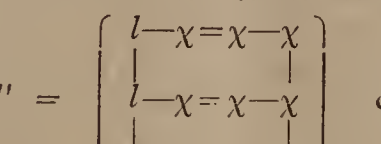
† *Journal of the Chemical Society*, vol. xv., p. 156.

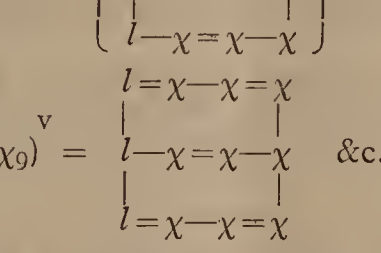
Chlorine = $(\chi_3)' = Cl' =$  usually monad.

Hydrochloric acid = $H(\chi_3)' = H$  where $\chi''' = \frac{35\cdot5}{3}$

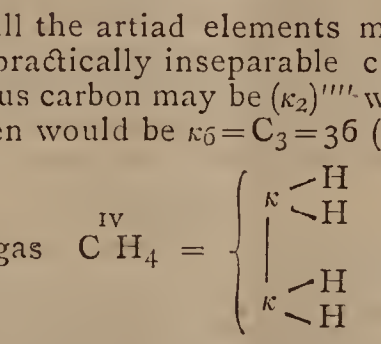
In iodine trichloride, ICl_3, either the I is monovalent, and therefore the group Cl_3 monovalent, or I is polyvalent; thus, when $I = (l_3)$ (where $l''' = \frac{127}{3}$), iodine trichloride may be—

$(l_3)'(\chi_9)' =$  &c.

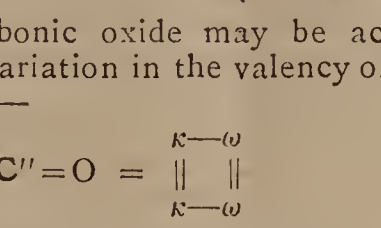
$(l_3)'''(\chi_9)''' =$  &c.

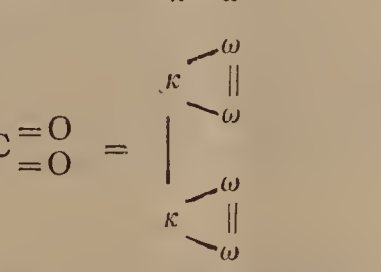
or $(l_3)^{v}(\chi_9)^{v} =$  &c.

It is evident that all the artiad elements may similarly be considered as practically inseparable complexes of trivalent atoms. Thus carbon may be $(\kappa_2)''''$ where $\kappa''' = 6$; Brodie's graphon then would be $\kappa_6 = C_3 = 36$ (Wurtz).

Marsh-gas $C^{IV}H_4 =$ 

On this view, carbonic oxide may be accounted for without assuming a variation in the valency of the oxygen complex atom, thus:—

$C'' = O =$ 

$C \begin{matrix} =O \\ =O \end{matrix} =$ 

The fact that no other compound corresponding to carbon oxide (*e.g.*, methylene) has yet been prepared (although many such attempts have been made) tends to show that the variation in valency in this compound is due to the oxygen rather than to the carbon; moreover, the quadrantoxide of silver necessitates, apparently, the possible tetravalency of oxygen.

Evidently this view of the existence of triad atoms, by a combination of which are produced the complexes (ordinarily termed atoms) of which chemical compounds are made up, might be extended to all elements. Thus lead, which is tetravalent in plumbic ethide and divalent in its ordinary compounds, may be considered as being a complex of (Pb_2) where $Pb''' = 103\cdot5$, thus:—

Plumbous chloride $\begin{matrix} Pb = Pb \\ | \quad\quad | \\ Cl \quad Cl \end{matrix}$ | Plumbic ethide $\begin{matrix} Pb - Pb \\ | \;\; | \quad | \;\; | \\ Et\,Et \quad Et\,Et \end{matrix}$

Similarly, thallium may be regarded as a complex (Tl_3) where $Tl''' = \frac{203}{3}$.

Thallous chloride $\overline{Tl = Tl - Tl}$ | Thallic chloride $\begin{matrix} \overline{Tl - Tl - Tl} \\ | \quad | \quad | \\ Cl - Cl - Cl \end{matrix}$

Until, however, the vapour densities of the metallic chlorides, &c., be obtained, it is impossible to say that some of these compounds have not double the molecular formulæ usually attributed to them: *e.g.*, plumbous chloride may be—

$(Pb^{IV} = 207)$ $\begin{matrix} Pb = Pb \\ | \;\; | \quad | \;\; | \\ Cl\,Cl \quad Cl\,Cl \end{matrix}$

instead of $Pb''Cl_2$; and thallous chloride—

$\begin{matrix} Tl = Tl \\ | \quad\quad | \\ Cl \quad Cl \end{matrix}$

instead of $Tl'Cl$; thallic chloride being—

$Tl \begin{matrix} -Cl \\ -Cl \\ -Cl \end{matrix}$

where $Tl''' = 203$.

Hence, at present it is unnecessary to extend this hypothesis to all elements—oxygen, nitrogen, chlorine, and their respective congeners being probably the only ones for which it is required in the present state of our knowledge, and even then only in special cases in the instances of the oxygen and chlorine series.—I am, &c.,

Charles R. A. Wright, D.Sc.

Chemical Laboratory, St. Mary's Hospital, W.,
October 2, 1871.

THE "DIAMOND MATRIX."

To the Editor of the Chemical News.

Sir,—I beg to inclose you photograph* of a most interesting and rare geological specimen which was discovered on the Diamond-fields ("Du Toit's Pan.")

It consists of some hundreds of diamonds cemented to a core of foreign substance. Amongst the mass there appear garnets and other bodies. The weight of the entire specimen is 19 carats, and the photograph is a magnificent image $3\frac{1}{4}$ times (lineal).

As I hope to be in England about the middle of November, controversy, which is here rife as to its constitution, formation, &c., will, I trust, be set at rest by a full examination and analysis in London of the substances in combination with the gems.

I have several valuable minerals from South Africa, and a vast fund of information regarding the newly discovered diamond-fields, which I must reserve for a time, and hope to lay many subjects of importance before the Chemical Society on my arrival in England.—I am, &c.,

T. W. Tobin.

Cape Town, South Africa,
September 1, 1871.

VITALITY OF DISEASE GERMS.

To the Editor of the Chemical News.

Sir,—Your correspondent, Richard Weaver (Chemical News, vol. xxiv., No. 619), states, that by his experiments, 350° is the highest temperature which may be used for disinfecting clothing, &c., by heat, without destroying the fabrics.

Dr. Calvert (in previous numbers) in his paper says, that at 400° germ life cannot exist, but I take it that his experiments were conducted at 100°, 200°, 300°, 400°, 500°, and 600° F. only, and that the intermediate temperatures were not tried. If this is the case, it might happen that even at 330° F. germ life will be destroyed, which will consequently render disinfection by heat practicable.

Not having the time or apparatus to repeat Dr. Calvert's experiments myself, I take the liberty of mentioning this. —I am, &c.,

H. B. Yardley.

Hudson's Wharf, Victoria Docks,
October 17, 1871.

* The photograph can be seen at our office by anyone interested in the subject.—*Ed.* C.N.

MISCELLANEOUS.

London Institution.—The first Evening Lecture of the session 1871-72 will be delivered on Thursday, November 2, at half-past seven, by J. H. Gladstone, Ph.D., F.R.S., F.C.S. Subject:—"Michael Faraday: the Story of his Life."

Quality of the Gas Supplied to London.—Dr. Letheby, the Chief Gas Examiner appointed by the Board of Trade, has recently reported to the Corporation of London, and to the Metropolitan Boards of Works, on the quality of the gas supplied to London by certain companies during the quarter which ended on the 30th of September last, from which it appears that the following is the average illuminating power of the gas of each of the Companies at the several testing places. When burnt at the rate of 5 cubic feet an hour, the common gas of the Chartered Company has been equal to 16·64 standard sperm candles at Arundell Street, Haymarket; to 16·84 candles at Gray's-Inn Road, to 17·50 candles at Friendly Place, Mile End; and to 17·59 candles at Cannon Street in the city. The Imperial Company's gas has been equal to 15·73 standard sperm candles at Camden Street; to 16·45 candles at Graham Street; and to 17·06 candles at Oakley Square; and the South Metropolitan Company's gas has been equal to 16·16 candles at the testing place at Hill Street, Peckham. The Cannel gas supplied by the Chartered Company to Cannon Street has been equal to 27·92 standard sperm candles, and at Arundell Street, Haymarket. And with respect to purity, Dr. Letheby reports that the gas of all the companies has been constantly free from sulphuretted hydrogen, except on two occasions, when traces of this impurity were present in the gas of the South Metropolitan Company, but he ascertained from investigations at the works that it was due to accidental circumstances. Sulphur in other form than this was present in the gas of the several companies in very variable proportions. In the Chartered gas (common) it amounted to an average of 29·24 grains per 100 cubic feet of the gas at Gray's-Inn Road; to 30·45 grains at Arundell Street; to 27·97 grains at Cannon Street, and to only 16·21 grains at Friendly Place. In the Imperial Gas it averaged 33·30 grains per 100 feet at Oakley Square; to 26·68 grains at Graham Street, and to 24·37 grains at Camden Street, and in the South Metropolitan gas it averaged 30·12 grains per 100 cubic feet. The Cannel gas of the Chartered Company at Arundell Street contained 25·65 grains per 100 feet, whereas the same description of gas at Cannon Street contained only 9·51 grains of sulphur. Dr. Letheby reported that, in most cases, the proportion of sulphur had been larger during the quarter than in the corresponding quarter of last year. Ammonia was not in any case in excess of the quantity prescribed by the referees.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, July, 1871.

The following original papers relating to chemistry are published in this number:—

New Method of Preparing Chloride of Antimony, and Production of an Oxide of Antimony Uncontaminated with Arsenic.—Dr. Rieckher.—The preparation of an oxide of antimony (for medicinal use) quite free from arsenic, and without the evolution of noxious gases, is obtained by treating antimony (metal) with twice its weight of oxide of iron and ten times its weight of crude hydrochloric acid. The neck of the retort wherein the operation is carried on should be connected with the receiver, which renders the use of any lute which might be acted upon by hydrochloric acid unnecessary. The mixture is to be kept boiling for several hours, whereby not only the metal is dissolved but also any arsenic it might contain removed. The receiver should be placed in cold water, a sufficient precaution to condense any hydrochloric acid gas which is evolved.

Sulphuric Acid a Product of the Combustion of Coal-Gas.—Dr. A. Vogel.—The author records a series of experiments made to prove the well-known fact that sulphuric acid is a constant product of the combustion of coal-gas, even when purified as perfectly as possible from sulphuretted hydrogen; the source whence the sulphuric acid is derived is the sulphide of carbon present in the gas.

Detection of Minute Traces of Manganese.—Dr. Böttger.—A few grammes of chemically-pure chlorate of potassa are first fused in a test-tube, and, while fused, there is put into it a minute quantity of the substance, mineral or organic, to be tested for manganese. If at the end of the reaction the contents of the thoroughly-cooled tube exhibit a peach-blossom red colour, the substance thrown into the fusing chlorate of potassa contained manganese, the presence of which may be thus ascertained in wood, human hair (especially the reddish coloured), coal, and minerals, of all of which only minute quantities are required.

Mixtures for Keeping Furs, Woollen Fabrics, and Carpets from being Injured by Moths.—Dr. Vorwerk.—Take:—Pure carbolic acid, 45·0 grms.; camphor and oil of rosemary, each, 30 grms.; oil of cloves and aniline, each, 5 grms.; dissolve these substances in methylated spirits, 2·5 litres. Pure carbolic acid, 20·0 grms.; camphor, oil of cloves, oil of lemon-rind (*Ol. citri cort.*), nitrobenzol, each, 10 grms.; aniline, 2·5 grms.; dissolve in methylated spirits, 1·5 litres. These fluids are applied to the fabrics and furs by the aid of the so-called *pulverisateurs*, spray-producers. The operation if properly done will only be required to be repeated twice or, at most, three times a year. Since these mixtures are inflammable, the operation with the *pulverisateur* should only be performed by daylight. No goods nor colours are injured by exposure to the spray.

August, 1871.

This number contains the following papers relating to chemistry and collateral sciences:—

Action of the Water Air-Pump, its Application to Boiling, Evaporation, Distillation, Filtration in Vacuum, and for Drying Herbs and Crystals.—F. A. Wolff.—The contents of this valuable essay are not suited for abstraction, as it would involve the reproduction of a series of woodcuts.

Analysis of the Water of the "Karlsbrunnen," at Nauheim (Prussia, Hessen).—Dr. Uloth.—Sp. gr. of the water at 15° = 1·00895; 1000 grms. contain:—Carbonate of lime, 0·6608; carbonate of protoxide of iron, 0·0110; carbonate of protoxide of manganese and of zinc, of each a trace; sulphate of strontia, 0·0087; sulphate of lime, 0·2277; chloride of ammonium, 0·0113; chloride of potassium, 0·0731; chloride of lithium, a trace; chloride of sodium, 9·860; chloride of magnesium, 0·2040; chloride of calcium, 1·0578; bromide of magnesium, 0·0014; arsenite of protoxide of iron, a trace; phosphate of protoxide of iron, 0·002; silica, 0·0087; nitric acid and organic matter, of each a trace; sum of fixed salts, 12·1247; partly-combined carbonic acid, 0·2949.

Zeitschrift für Chemie von Beilstein, No. 10, 1871.

This number contains the following original papers and memoirs:—

Synthesis of Piperonylic Acid and New Mode of Formation of Protocatechu-Aldehyde.—R. Fittig and I. Remsen.—After referring to some other researches bearing upon this subject, the authors state that they have made a mixture of 1 molecule of pure protocatechutic acid, 3 mols. of hydrate of potassa, and $1\frac{1}{2}$ mols. of methylen-iodide, which has been put into a tube and, after sealing, the latter has been exposed for several hours to a temperature of 140°; the contents of the tube having been submitted to a lengthy and tedious process of purification yielded a methylen-protocatechutic acid which was found to be in physical as well as chemical properties identical with piperonylic acid. This experiment proves, therefore, that the acid just named is methylen-protocatechutic acid; as regards the constitution of piperic acid it is observed that it contains the group—

$$\begin{matrix}-O\\-O\end{matrix}\!\!>CH_2.$$

Ethylen-Protocatechutic Acid.—R. Fittig and T. Macalpine.—By causing protocatechutic acid, ethylen-bromide, and caustic potassa to react upon each other in a sealed tube, the authors obtained the ethylen-protocatechutic acid—

$$C_6H_3\!\!\begin{matrix}-O\\-O\end{matrix}\!\!>C_2H_4\ ,\quad (CO.OH)$$

a body soluble in water and alcohol, very similar to piperonylic acid, fuses at 133°, sublimes at a higher temperature unaltered.

The Aldehyde of the Naphthaline Group.—J. Battershall.—The aldehyde of naphthoë acid, $C_{11}H_8O = C_{10}H_7.CHO$, is prepared by the distillation of a mixture of naphthoëate of lime and formiate of lime. The purified aldehyde is a colourless somewhat thickish fluid, heavier than water, boiling at 280°.

Benzol-Hexachloride.—Z. Heys.—The author has prepared this body, originally discovered many years ago by Prof. Mitscherlich, by

passing a current of chlorine into benzol for several days consecutively The substance alluded to is solid, soluble in alcohol, crystalline, fuses at 157°. It appears that this hexachloride of benzol has very great stability, since it is not acted upon by boiling either with nitric or with nitro-sulphuric acids.

Action of Fusing Caustic Potassa upon Sulphoxybenzoic Acid.—I. Remsen.—This paper and the two following by the same author are written solely for the purpose of vindicating the correctness of his researches against the imputations published thereupon in other periodicals.

Isomeric Sulpho-Salicylic Acids.

Oxidation of Toluol-Sulpho Acids.

Researches on the Derivatives of β-Para-Brom-Sulpho-Toluol.—F. C. G. Müller.—The amide of the ortho-toluol-sulpho acid fuses at 91°, is crystalline, soluble in water. Nitro-β-para-brom-toluol-sulpho acid is readily soluble in water, alcohol, and ether, crystalline, deliquescent; the acid and its salts are very bitter to the taste.

Nature of Sulpho- and Sulpho-Nitro-Bibrom-Benzol.—R. D. Williams.—The catalogical description of a series of salts belonging to sulpho-bibrom-benzol and bibrom-nitro-sulpho-benzol.

On Brom-Sulpho-Toluol.—H. Hübner.—A short preliminary notice on this subject; a full account will be given hereafter.

Conversion of Allylic Alcohol into Acrylic Acid.—B. Tollens.—Pure bromide of allylic alcohol yields by oxidation an acid, $C_3H_4Br_2O_2$. This acid was treated with zinc-dust, and the result of that reaction again with sulphuric acid, whereby acrylic acid was obtained. The formation of acrylic acid from an acid, $C_3H_4Br_2O_2$, is akin to the formation of the first-named acid from propionic acid; it is also a proof which confirms the following formulæ :—

CH_2	CH_2Br	CH_2
‖	|	‖
CH	$CHBr$	CH
|	|	|
CH_2OH	$COOH$	$COOH$
Allylic alcohol.	Bibrom-propionic acid.	Acrylic acid.

Action of Chloral upon Aniline.—O. Wallach.—Preliminary notice.

Electro-Thermo-Chemical Experiments.—Dr. E. Mulder and F. C. E. von Embden.—This excellent paper, being illustrated with woodcuts, does not admit of any useful abstraction.

New Edition of a Highy Valuable Work.—MM. Friedrich Vieweg and Son, at Brunswick, announce the publishing of a new edition of the well and deservedly known "Handwörterbuch der Chemie," under the title "Neues Handwörterbuch der Chemie," based upon that edited by Drs. Liebig, Wöhler, Poggendorff, Kolbe, and Fehling; the last-named of these *savants* is the editor of the new edition, with the co-operation of Drs. Bunsen, Fittig, Fresenius, v. Gorup-Besanez, Hofmann, Kekulé, Kolbe, Strecker, Wichelhaus, and others.

Les Mondes, September 28, 1871.

Exploration of the Baltic Sea.—Rev. F. Moigno.—The short and as yet preliminary account of a journey made by the Imperial German steamship *Pommerania*, for the express purpose of making a thorough survey of the sea alluded to. It appears that the greatest depth, 240 metres, is met with between the island of Gothland and the Courland coast; notwithstanding it was in the middle of July, the temperature of the water at this depth was only from 0·5° to 2° R. No marine plants were found at this depth, and animal life was only represented by two species of worms; the water at this depth and locality contains only a small quantity of salt in solution. At a less depth, 100 metres, there are animals living, and in the more shallow portions of this sea plants also vegetate.

Talpa Marina.—M. Toselli.—The description of some experiments made with a very ingenious contrivance, which may be briefly stated to be a greatly improved diving-bell, which has been tried at Baja, near Naples. This apparatus can acccommodate two persons, has an air-vessel with strongly-compressed air attached for the requirements of respiration, telegraphic apparatus for communication with the shore or vessel from which the *talpa* is lowered under water, and an arrangement also by which, without being drawn up, the machine may reach the surface of the water and float.

Extraordinary Meteor Seen at Marseilles.—Dr. Coggia.—On August 1 last, at 10.43 p.m. Marseilles mean time (5° 22′ 19″ E. of London), the author observed a large blood-red coloured meteorite, which moved slowly in a direction first west and next north, having been lost sight of at 11° 3′ 28″ p.m. The diameter (apparent) was about 15′ at first, but decreased to 0·4′. Before being lost sight of, this meteorite appeared to emit incandescent sparks.

Nomenclature of the Textile Fibres in Common Use.—Rev. F. Moigno.—Under this title the excellent *savant* calls attention to a scientific educational institute established at Melle-Lès-Gand, Belgium, which establishment, according to the few lines devoted to it here (the author recently paid it a visit), is one of the best arranged and most complete industrial-commercial schools to be met with anywhere, the museums, library, laboratories (chemical, physical, and mechanical), cosmographic, numismatic, and other collections being in every respect complete and up to the latest improvements and discoveries. It appears, further, that the teachers are not only men of high acquirements, but actively engaged in diffusing through the press useful knowledge, and part thereof is the publishing of the nomenclature of 550 plants utilisable for the purpose of rope-, cordage-, and paper-making, spinning, and weaving, &c.; to the name of each plant (inclusive of those names in use in several Asiatic and other foreign dialects) are given all the synonyms, with every information required for travellers, naturalists, and parties connected with industry. The article here alluded to contains a specimen reproduction of this work, which is in the press.

La France Scientifique (Ancien Cosmos), September 24, 1871.

The editor of this periodical, Dr. V. Meunier, has chosen as motto for his new paper:—"Régénerer la France par la Science et la Science par la Liberté." We think, judging from the contents of this number, that the editor has taken a really sensible and correct view of matters, which it would be bad taste on our part to enter into details upon here, but which, if duly carried into practice, will certainly tend best to regenerate France, and, with the "Fluctuat nec Mergitur" of the ancient coat of arms of Paris borne in mind, we sincerely hope that millions of Frenchmen will acknowledge the correctness of the author's views, and firmly united together, bearing in mind the "Bene juncti valemus pauci," achieve great things in the pursuits of peace (science, arts, industry, agriculture, and commerce), and make the Tricolore Français respected and esteemed all over the globe.

Le Moniteur des Produits Chimiques pour l'Industrie, les Sciences et les Arts et du Matériel de ces Industrie Publié par une Société de Chimistes et d'Industriels, September 25, 1871.

Pigments and Dyes Known to and Used by the Ancients.—E. Rousset.—The continuation of this paper (see Chemical News, vol. xxiv., p. 134). It appears that the Ancients used the following yellow pigments:—Ochre, massicot, orpiment, and realgar; the latter are poisonous, and do not cover well; the former are devoid of any brilliancy. As to the yellow dyes used by the Ancients nothing is positively known, but it seems that woad, saffron, and other native plants were employed. Referring to yellow pigments discovered by modern chemistry, Naples yellow (antimoniate of lead), mineral yellow (oxychloride of lead), and the chromium colours, discovered by Vauquelin (1797), cadmium yellow, discovered by Stromeyer (1817), are mentioned. Among the modern yellow dyes, purrhee and picric acid are enumerated. Vermillion, red ochres, and minium were known from a remote antiquity, though neither Greeks nor Romans were acquainted with the artificial preparation of vermillion, which has been known to the Chinese for a very lengthy series of centuries past. As to red dye-stuffs, there can be no doubt that madder was known and used not only for dyeing fabrics but also in the shape of so-called lake. Kermes, a dye-stuff little known in this country but yet used in France, was known to and used by the Ancients, being undoubtedly already used in Egypt *tempore* Moses. Among the green paints the Ancients were only acquainted with some native green-coloured compounds of copper, and with the acetates of that metal; the number of green pigments discovered in modern times is very large, and need not be here alluded to. Of purple dyes known to and used by the Ancients, the celebrated Tyrian purple is here at length spoken of. Among the molluscs from which this dye was obtained is the *Janthina prolongata*, yet found in the Mediterranean, and a very common object in that sea near Narbonne (in this very ancient city there were Tyrian purple dye-works at least 600 years B.C.), where in our days some experiments have been made by Dr. Lesson which really prove that the mollusc just named yields, though only in very small quantity, an exceedingly beautiful purple. Dr. Bancroft was also acquainted with this fact, and made several trials for the purpose of ascertaining whether this dye-stuff might be again industrially applied.

Researches on Lydine.—P. Guyot.—A very beautiful violet colour known under the name just mentioned is prepared as follows:—Take 100 grms. of aniline, and dissolve it in 100 grms. of hydrochloric acid previously diluted with 120 c.c. of distilled water; pour this solution into a solution of red prussiate (ferricyanide of potassium) made of 90 grms. of the salt dissolved in 850 c.c. of water. The mixture is next boiled for an hour and a half, and then cooled.

Manufacture of Fatty Acids.—M. Bodisson.—The author has invented a process, not clearly described in this short notice—from which we only learn that a high temperature (300°) and a vacuum, at least exclusion of contact of air, are employed—by the application of which purer fatty acids and a greatly increased quantity (88 per cent from the tallow used) are obtained.

Polytechnisches Journal von Dingler, first number for September, 1871

The following original papers relating to chemistry and collateral sciences are published in this number:—

Galvanic Battery (Tauch Batterie).—MM. Keiser and Schmidt.—The description of an improved galvanic battery, but requiring the aid of engravings for proper elucidation.

Continuation of the Essay on the Blast Furnaces.—C. Schinz.—The headings of the sections of this portion are—Capacity of furnace; economic conditions; means for saving fuel; use of coal as fuel.

Quantitative Estimation of Nitric Acid.—Dr. A. Wagner.—After briefly referring to a former communication on this subject (see Chemical News, vol. xxiii., p. 261), the author now describes another process, based upon the decomposition of the nitrate at a high temperature, and calculating from the quantity of deutoxide of nitrogen the amount of nitric acid. The experiment is carried on as follows:—In a combustion-tube of hard glass is placed, first ¾ grm. of bicarbonate of soda, next the mixture of nitrate of potassa (about ½ a grm.) with chromic oxide and carbonate of soda. A gas conducting-tube is fastened by means of a perforated cork, the tube being placed in a furnace; that portion of it wherein the bicarbonate of soda is placed is first gently heated, so as to expel all air. The ignition to

bright redness of the portion of the tube containing the nitrate mixture is then proceeded with, and the gas collected in a graduated tube of at least 300 c.c. capacity, and standing in a mercury trough being partly filled with that metal, partly with a known quantity of a dilute titrated solution of caustic soda, while also 100 c.c. of pure oxygen occupy the upper part of the tube. The regenerated nitric acid is absorbed by the caustic soda, and this at the end of the operation titrated with dilute sulphuric acid. It is clear that an excess of oxygen is required, that the bicarbonate of soda has to be heated a second time to expel any remaining deutoxide of nitrogen, and that after the combustion has ceased the glass cylinder has to remain in the mercury trough for some time, and the contents of the cylinder gently shaken, so as to obtain a perfect reaction.

Estimation of the Non-Permanent Hardness of Water.—Dr. A. Wagner.—Reserved for full translation.

On some Applications of Sulphide of Carbon.—H. Haedicke.—This paper treats on the use of sulphide of carbon for the extraction of oils and fat by means of peculiarly-constructed apparatus, the arrangement of which is illustrated by engravings.

A Calorimeter.—H. Rheineck.—Illustrated with a woodcut.

Influence Exerted by Secondary Extract Formation in Fermenting Wort.—Dr. W. Schulze.—This lengthy essay bears entirely upon the particular subjects of brewing and grain-spirit producing.

Annual Consumption of Beer per head of Population in the Undermentioned Countries.—Dr. Dingler.—Bavaria, 80 maasz (=1·069 litre each maasz); England, 74; Belgium, 51; Würtemberg, 40; Austria, 16; France, 13; Switzerland, 12; Prussia, 10. While 7·5 per cent of the entire revenue of the United Kingdom is derived from the beer (malt) tax, this amounts, for Bavaria, to 15·5 per cent; for Austria, 2·9 per cent; France, 1·9 per cent; Prussia, 1·2 per cent.

Journal für Gasbeleuchtung und Wasserversorgung, Nos. 17, 1871.

The contents of this number only bear upon subjects strictly relating to gas- and water-works' engineering and management.

La Revue des Scientifique de la France et de l'Etranger, September 23, 1871.

This number does not contain any original papers relating to chemistry, but we call attention to the two following memoirs:—

Different Methods of Observation Employed in Stratigraphic Geology.—Dr. Bleicher.—An excellent essay, illustrated by several engravings.

Association of Commerce and Industry of Roubaix.—M. Féron.—Under the title just quoted, this paper contains an account of a lecture on the sorting of the impurities of wool, the means of cleansing that textile fibre, and on spinning, weaving, and dyeing it.

Biography of the Late E. Lartet.—G. de Mortillet.—This paper records the labours and the published works of a celebrated geologist and palæontologist.

September 30, 1871.

This number does not contain any original papers strictly belonging to chemistry, but we quote the title of an excellent essay:—

Absorption of Gases by Organic Liquids.—Dr. Gréhant.—Illustrated by a series of woodcuts. This essay is a portion of the author's published lectures on experimental physiology.

NOTES AND QUERIES.

Cement to Resist Sulphuric Acid.—(Reply to H. R. Yardley.)—Take caoutchouc: melt this by a gentle heat, add from 6 to 8 per cent of the weight of tallow, taking care to keep the mass well stirred; add dry slaked lime, so as to make the fluid mass the consistency of soft paste; and, lastly, add 20 per cent of red lead, whereby the mass, which otherwise remains soft, becomes hard and dry. This cement resists, according to Dr. Wagner, boiling sulphuric acid. A solution of caoutchouc in twice its weight of raw linseed oil, aided by heating, and the addition thereto of an equal weight of pipeclay, yields a plastic mass which also resists most acids.

Electro-Deposition of Aluminium and other Metals.—I see it stated in your "Notes and Queries" that aluminium has not yet been deposited on other metals by the battery. For more than two years I have been depositing aluminium daily on iron, steel, and other metals, and driving it into their surfaces at a heat of about 500° F., in the same way as I do silver and nickel. Also I have been doing the same with the alloy of aluminium called aluminium bronze, of various tints, from the palest lemon to the richest gold colour. I also deposit occasionally platinum, but it would not stand on iron and steel if deposited from the solution named by your correspondent, nor, in fact, satisfactorily on any metal which is not neutral in that solution.—J. Baynes Thompson, White Hall, Wraysbury, Staines.

NOTICE TO AMERICAN SUBSCRIBERS.

In answer to numerous inquiries, the Publisher begs to state that Subscribers in the United States can be supplied with the CHEMICAL NEWS from this Office, post free, for the sum of £1 2s. 4d. per annum payable in advance.

Chemical Technology, or Chemistry in its Applications to the Arts and Manufactures. By Thomas Richardson and Henry Watts. Second Edition, illustrated with numerous Wood Engravings.

Vol. I., Parts 1 and 2, price 36s., with more than 400 Illustrations.

Nature and Properties of Fuel: Secondary Products obtained from Fuel: Production of Light: Secondary Products of the Gas Manufacture.

Vol. I., Part 3, price 33s., with more than 300 Illustrations.

Sulphur and its Compounds: Acidimetry: Chlorine and its Bleaching Compounds: Soda, Potash: Alkalimetry: Grease.

Vol. I., Part 4, price 21s., 300 Illustrations.

Aluminium and Sodium: Stannates, Tungstates, Chromates, and Silicates of Potash and Soda: Phosphorus, Borax: Nitre: Gun-Powder: Gun Cotton.

Vol. I., Part 5, price 36s.

Prussiate of Potash: Oxalic, Tartaric, and Citric Acids, and Appendices containing the latest information and specifications relating to the materials described in Parts 3 and 4.

Bailliere and Co., 20, King William Street, Strand.

PRACTICAL CHEMISTRY.

Laboratory, 60, Gower Street, Bedford Square, W.C.

Mr. Henry Matthews, F.C.S., is prepared to give Instruction in all branches of PRACTICAL CHEMISTRY, particularly in its application to MEDICINE AGRICULTURE, and COMMERCE.

The Laboratory is open daily, except Saturday, from ten to five o'clock; on Saturday, from ten till one o'clock.

Mr. Matthews is also prepared to undertake ANALYSES of every description.

For Particulars and Prospectuses, apply to Mr. Henry Matthews the Laboratory, 60, Gower Street, Bedford Square, W.C.

BERNERS COLLEGE of CHEMISTRY.—EXPERIMENTAL MILITARY and NAVAL SCIENCES, under the direction of Professor E. V. GARDNER, F.E.S., &c.: of the late Royal Polytechnic Institution and the Royal Naval College.

The Laboratory and Class Rooms are open daily.

Especial facilities for persons preparing for Government and other examinations.

Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

For particulars, &c., apply to Prof. E. V. G., 44, Berners-street, W

North London School of Chemistry, Pharmacy, &c.—For Instruction in Practical Chemistry and Evening Classes for the Study of Chemistry, Botany, Materia Medica, &c. Conducted by Mr. J. C. BRAITHWAITE, *for thirteen years Principal Instructor* in the Laboratories of the Pharmaceutical Society of Great Britain, and Demonstrator of Practical Pharmacy, Pharmaceutical Latin, &c.

Mr. Braithwaite, having taken the premises adjoining his house, has been enabled *nearly to double the size of his Laboratories*, and, at the same time, procure a large piece of ground which *he has had laid out as a Botanic garden*. Every facility is, therefore, offered to Students desirous of acquiring a practical knowledge of this branch of their education.

The Session 1871—1872 will commence on the 2nd of October, when the Laboratories will re-open at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

THE CHEMICAL and TOXICOLOGICAL CLASS will meet as usual every Monday and Thursday evening, commencing October 2nd, at 8 p.m.

The LATIN CLASS for the reading of Physicians' Prescriptions, Cæsar's Commentaries, &c., every Tuesday and Friday evening, commencing October 3rd, at 8 p.m.

The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday evening, commencing October 4th, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will be continued every Saturday, until further notice, at 10 a.m.

Fee to either of the above Classes Half-a-Guinea per Month. Pupils can enter at any period.

Gentlemen Privately Prepared for the Examinations of the Pharmaceutical Society, and the "Modified Examination for Assistants," &c

All Fees must be paid in advance.

Letters of inquiry should be accompanied with a stamped envelope.

Mr. Braithwaite receives a few Pupils to Board in his house.

Address—54, Kentish Town Road, N.W.

Water-glass, or Soluble Silicates of Soda and Potash, in large or small quantities, and either solid or in solution, at ROBERT RUMNEY'S, Ardwick Chemical Works, Manchester.

THE CHEMICAL NEWS.

Vol. XXIV. No. 622.

A STUDY OF ALDEHYDE AND AMMONIUM COMBINATIONS.

By S. E. PHILLIPS.

Is there any evidence that certain hydrocarbons replace 2 atoms of hydrogen, others 3 atoms; and if so, would a tetra-atomic element or radical replace 4 atoms of H? I have looked with some amount of industry for many years at this problem, and now think that one of two things must subsist; either that the evidence is indeed very small, or such distinguished men as Berthollet and others, failing to see it, must have a vision distorted by preconceived hypothesis.

Admiring as I do the eminent abilities of the discoverer of sulph-urea, it is with much diffidence I moot, in regard to Mr. Reynolds's paper (Chemical News, vol. xxiv., p. 87) on this subject, that his point of view is contracted, and his main object in altering the formulæ presumptive.

More than twenty years ago I discovered, or pointed out, the "atmonia" type, or the doubly condensed ammonia of which urea is an illustration. I then assumed that wherever (CO) existed, (CS) might be found to replace it, but chemists held that the sulph-urea had no existence, until Reynolds realised the fact in such a masterly way as to command universal acceptance.

I now maintain that not only two aldehyde radicals (which he seems to deny) but three or more atoms may be introduced into the atmonial type, and that the two primary ureas alluded to involve no particular speciality to separate them from the vast generic group to which they belong. As a moot point for enquiry, I jot down a few particulars from the slender means just now at command.

Professor Andrews, as President of the Chemical Section of the British Association, has called attention to a group which associates ethylen with other monatomic bodies in a way that may be instructive herein; and in a paper on the Amides, referring to the hydramides, I have sought to trace analogies between ethylen or aldehyde and other aldehydes or aromatic oils, which, with ammonia, give corresponding atmonias (ureas).

3 Almond oil,	$3(C_{14}H_6O_2)+H_6N-6HO=$	$C_{14}H_5$		H_3,N_2
,, Oil of ants,	,,$(C_{10}H_4O_4)+$,,	,,	$(C_{10}H_3O_2)$	H_3,N_2
,, Cinnamon oil,	,,$(C_{18}H_8O_2)+$,,	,,	$(C_{18}H_7)$	H_3,N_2
,, Aniseed oil,	,,$(C_{16}H_8O_4)+$,,	,,	$(C_{16}H_7O_2)$	H_3,N_2
,, Acetone	,,$(C_6H_6O_2)+$,,	,,	(C_6H_5)	H_3,N_2
,, Aldehyde,	,,$(C_4H_4O_2)+$,,	,,	(?)	

By oxidation, the radical constituents of these hydramides pass into their acid forms, furfurine gives pyromucic acid $(C_{10}H_3O_2)O$, which crystallises in a form like benzoic acid out of amarine, &c.

Acetonine is a colourless alkaline liquid of urinous odour, of which I give two saltic forms:—$(C_6H_5)_3H_4N_2Cl+PtCl_2$ and $(C_6H_5)_3H_4N_2O+2C_2O_3$.

Carbo-thiacetonine is probably—

$$(C_6H_5)_3(CS)_2H_2,N_2S+HS.$$

Baeyer's synthesis of picoline is instructive; 2 acrolein + ammonia = picoline—

$$2(C_6H_4O_2)+H_3N-4HO=(C_6H_3)_2H,N.$$

M. Schiff's synthesis of coniine is still more so, as derived from the distillation of butyraldine—

$$(C_8H_7)_2H_2NO+HO-2HO=(C_8H_7)_2H,N.$$

Shröder gives us derivatives of valeraldehyde, thus:—

$$C_{10}H_{10}O_2 \text{ and } C_{10}H_{10}S_2.$$

		Density.	Wt.	
Valeraldine	$=C_{30}H_{31}S_4,N$	144·5″	289	
Carbo-valeraldine	$=C_{22}H_{22}S_4,N_2$	60·8	246	$=(C_{10}H_9)_2(CS)_2H_3,N_2S+HS$
Valeraldehyde ammonia	$=C_{10}H_{12}O_2N$	52·16″	103	$=(C_{10}H_9)H_3,NO+HO$

The analogy between acetonine, carbo-thiacetonine, and carbo-valeraldine is close, and peradventure gives us the very substitution Reynolds assumes not to exist, and from which non-existence he deduces the alteration of type or structure. Divested of their saltic types they become—

Acetonine	$(C_6H_5)_3 \quad H_3,N_2$
Carbo-thiacetonine	$(C_6H_5)_3(CS)_2H,N_2$
Carbo-valeraldine	$(C_{10}H_9)_2(CS)_2H_2,N_2$
Aldehyde urea	$(C_4H_3)(CS)_2H_3,N_2$

		Original.	Altered.
Do. (Reynolds)	CS″	$\begin{cases} NCH_4'' \\ NH \end{cases}$	$\begin{cases} NCH_4'' \\ CSH \\ NH \end{cases}$

It is no less amusing than instructive to compare these two forms with M. Schiff's notation of coniine—

$$\begin{array}{l} CH\text{—}\cdot\cdot\text{—}CH_2\text{—}\cdot\cdot\text{—}CH_2\text{—}\cdot\cdot\text{—}CH_3 \\ |\;\;| \\ \vdots\;\;\vdots \\ |\;\;| \\ CH\text{—}\cdot\cdot\text{—}CH_2\text{—}\cdot\cdot\text{—}CH_2\text{—}\cdot\cdot\text{—}CH\text{—}\cdot\cdot\text{—}NH. \end{array}$$

I cannot understand what aldehyde-ammonia is, or thialdine, or the homologous 2-vol. valeraldin! If the 4 vols. rightly bespeaks a saltic type for carbo-valeraldine, then it may happen that the corresponding carbo-thialdine has been the very non-existent substance alluded to by Reynolds, viz.—

Carbo-valeraldine	$(C_{10}H_9)_2(CS)_2H_3,N_2S+HS$
Carbo-thialdine	$(C_4H_3)_2(CS)_2H_3,N_2S+HS$
Sinapoline	$(C_6H_5)_2(CO)_2H_2,N_2$
Thio-sinnamin	$(C_6H_5)(CS_2)H_3,N_2$

M. Arzruni gives some forms of sulph-ureas:—

$$(C_{14}H_5O_2) \quad (CS)_2H_3,N_2$$
$$(C_{14}H_5O_2)(C_{12}H_5)(CS)_2H_2,N_2$$
$$(C_{14}H_5O_2)_2 \quad (CS)_2H_2,N_2$$

M. Schiff gives some atmonial forms with all the H constituents replaced—

Sal-hydrethylanilide $(C_{12}H_5)_2(C_4H_5)_2(C_{14}H_5O_2)H,N_2$.
Ethyl-sal-hydranilide $(C_{12}H_5)(C_4H_5)(C_{14}H_5O_2),N$
Ethyl-sal-hydrethylanilide $(C_{12}H_5)_2(C_4H_5)_3C_{14}H_5O_2,N_2$
Copper sal-hydranilide $(C_{12}H_5)_2(C_{14}H_5O_2)_2Cu_2,N_2$.

It should be understood that I attach no particular value to the notations employed. I have simply followed Liebig and others in regard to well-established radicals in contradistinction to such as are now so rife in the multitudinous forms of modern notation. Sometimes I think the aromatic oils are hydrides, $C_{14}H_5O_2,H$; at others they seem better regarded as of weak alcoholic types, $C_{14}H_5O+HO$. The ideas intended herein are probably both right, but with the ever-increasing knowledge of isomeric variation, it is most unwise to affect precision where all is shrouded in impenetrable darkness.

NOTES OF DEMONSTRATIONS ON PHYSIOLOGICAL CHEMISTRY AT ST. GEORGE'S HOSPITAL.

By S. W. MOORE.

I.

Animal tissues have ⅞ths of their weight as water; the percentage of ash varying, averaging 3·0 per cent. The elements in constitution of animals are about 17, some add Pb and As,—in all 19, viz., C, H, N, O, S, P, Cl, Fl, Ca, Mg, Al, K, Na, Fe, Mn, Cu, Si.

Metallic elements are best seen by spectroscopic demonstration after incineration of substance. The metals, with the exception of iron, are in the form of salts, as—

$$NaCl, Ca_3 2PO_4, \&c.$$

The elements occur in somewhat of the following order:—C, H, N, O, in most tissues; S in albumen; P in bone; Cl in juices as NaCl; in gastric juice as HCl; Fl and Si in teeth; the latter in bone also; Al, Ca, and Mg in teeth and bone; Na and K in blood; Fe in colouring matter of blood; Mn in hair; Cu in liver, bile, and gall-stones.

The non-metallic elements may be recognised as follows:—

C, by charring and formation of CO_2 when combusted; H, by formation of water; N, by heating with solid KHO and production of NH_3; S by combustion in pure $KClO_3$ is converted to K_2SO_4, test with $BaCl_2$; P, by similar treatment, test with $MgSO_4+NH_3$; Si by insolubility in acids; other elements are too indefinite to be recognised by simple testing.

These elements unite to form "proximate elements," which may be divided into two groups, nitrogenous and non-nitrogenous.

Albumen, with fibrin, casein, paralbumen, globulin, and vitellin, are the principle nitrogenous bodies, and have, according to Mulder, for their base a substance—protein, ($C_{18}H_{25}N_4O_5,H_2O$?)—which, he affirms, is free from sulphur, though hitherto it has not been so obtained.

It is worthy of remark that these compounds, which form the great bulk of our food, are richly charged with N. Albumen has a formula $C_{72}H_{112}N_{18}SO_{22}$, but in its soluble form is combined with Na, Gerhardt considering two atoms H displaceable, thus giving to white of egg the formula $NaHC_{72}H_{110}N_{18}SO_{22},H_2O$.

Soluble albumen is colourless, tasteless, glairy, and rotates to the left when polarised; evaporated at 50° C. it becomes a yellow, brittle, transparent mass; this, washed successively with alcohol, ether, and hydrochloric acid, to remove extract, fat, and salts, is pure albumen. Albumen coagulates at 60° C. The mineral acids, except trihydric phosphate, precipitate albumen; the organic acids, except tannic acid, do not precipitate it.

Alum, HgCl, $CuSO_4$, $Pb2C_2H_3O_2$, creasote, and alcohol, all precipitate albumen, but the most delicate test is potassic ferrocyanide in the presence of hydric acetate; HgCl detects 1-2000 in solution.

From the above data albumen is the best antidote for metallic salts when taken as poison. The S of albumen, during putrefaction, yields H_2S.

Protein is prepared by dissolving any albuminous body in KHO, and precipitating with hydric acetate. Hydric nitrate and protein produce xantho-proteic acid, a yellow inflammable body. Hydric chloride dissolves proteic compounds, producing a blue solution.

Protein and KHO, when boiled together, form carbonate and formiate of ammonia, leucin, &c.; boiled with H_2SO_4, leucin, tyroin, and other bodies are formed.

Albumen, boiled for some hours with water, is reduced to ammoniacal tritoxide of protein—

$$(H_3N,C_{36}H_{50}N_8O_{13},2H_2O?)$$

Paralbumen, globulin, myosin, &c., are modifications of albumen.

ON THE

DETERMINATION OF SMALL QUANTITIES OF MANGANESE.

By THOMAS M. CHATARD.

The delicacy of Crum's test for manganese is well known, but it is believed that no attempt has hitherto been made to employ it as a method of quantitative determination. The following work was, therefore, undertaken with that view.

A standard solution of ammonic oxalate was prepared, of which 1 c.c. = 0·0005467 grm. Mn. A sample of dolomite was taken, and four portions were weighed out. These were dissolved in nitric acid, and a small quantity of plumbic peroxide added to each. On boiling, the bright colour of hypermanganic acid appeared. The solutions were passed through small filters of asbestos with the aid of a Bunsen's pump, and the hypermanganic acid was determined by means of a standard solution of ammonic oxalate, with the following results:—

Grm.		C.c.	Mn. Grm.	Mn. Per cent.
3·1300	dolomite required	39·0	= 0·0216	= 0·069
2·781	,, ,,	33·2	= 0·0181	= 0·065
2·0998	,, ,,	24·5	= 0·0134	= 0·063
1·8671	,, ,,	23·5	= 0·0128	= 0·062

Mean = 0·065 p. c. Mn.

In a sample of limestone from White Horse, Chester Co., Pa. the analysis showed—

Grms.		C.c.	Mn. Grm.	Mn. Per cent.
3·4316	required	120	= 0·0656	= 1·92
2·2809	,,	83·5	= 0·04564	= 2·00
4·0697	,,	153·5	= 0·0838	= 2·05

Mean = 1·99 p. c. Mn.

But the method, though giving good results, where the percentage of manganese is small, fails when any large amount of that metal is present. Well dried manganous pyrophosphate was treated with sulphuric acid, as nitric acid, though dissolving it was found not to decompose it, little or no hypermanganic acid being formed when the plumbic peroxide was added. With sulphuric acid, the red colour of hypermanganic acid was produced, but it was found that not even long boiling sufficed for total oxidation.

This was also the case with an alloy of iron and manganese. The longer it was boiled, the more hypermanganic acid was formed, but there seemed to be no definite limit. No concordant results having been reached, and a well marked end reaction in such cases being hard to obtain, the method as applied to general analysis was given up.

There seems to be, however, reason to maintain that when the quantity of manganese is very small, the method will be found both easy and accurate. Perhaps by some modification of the process, it may be made to apply also to the cases in which large quantities of manganese are present.

In conclusion, I desire to acknowledge my indebted- to Dr. W. Gibbs for his careful supervision and many valuable suggestions.—*American Journal of Science.*

ON THE

MICROSCOPICAL EXAMINATION OF DUST BLOWN INTO A RAILWAY CARRIAGE NEAR BIRMINGHAM.*

By JOSEPH SIDEBOTHAM, F.R.A.S.

On the 24th May, 1870, while travelling by rail between Saltley and Camp Hill, I spread a paper on a seat of the carriage near the open window, and collected the dust that fell upon it. A rough examination of this with the two-thirds power showed a large proportion of fragments of iron, and on applying a soft iron needle I found that many of them were highly magnetic. They were mostly long, thin, and straight, the largest being about 1-150th of an inch, and, under the power used, had the appearance of a quantity of old nails. I then with a magnet separated the iron from the other particles.

The weight altogether of the dust collected was 5·7 grains, and the proportion of those particles composed wholly or in part of iron was 2·9 grains, or more than one-half. The iron thus separated consisted chiefly of fused particles of dross or burned iron, like "clinkers;" many were more or less spherical, like those brought to our notice

* Read before the Manchester Literary and Philosophical Society.

by Mr. Dancer from the flue of a furnace, but none so smooth; they were all more or less covered with spikes and excrescences, some having long tails like the old "Prince Rupert's" drops; there were also many small angular particles like cast-iron, having crystalline structure.

The other portion of the dust consisted largely of cinders, some very bright angular fragments of glass or quartz, a few bits of yellow metal, opaque white and spherical bodies, like those described by Mr. Dancer, grains of sand, a few bits of coal, &c.

After the examination of this dust, I could easy understand why it had produced such irritation; the number of angular, pointed, and spiked pieces of iron, and the scoriæ or clinkers, being quite sufficient to account for the unpleasant effect.

I think it probable that the magnetic strips of iron are laminæ from the rails and tires of the wheels, and the other iron particles portions of fused metal, either from the coal or from the furnace bars. The large proportion of iron found in the dust is probably owing to the metal being heavier than the ordinary dust, and accumulating in cuttings such as those between the two stations named.

If I had to travel much by railway through that district, I should like to wear magnetic railway spectacles, and a magnetic respirator in dry weather.

After the reading of the paper, Mr. Charles Bailey drew attention to some experiments which Mr. Charles Stodder, of Boston, U.S., had been making on the microscopic contents of the atmosphere of that city. Amongst other investigations he was led to examine a fine black dust from a beam in the polishing shop of the United States Armoury, at Springfield. He found it to contain a few vegetable fibres, some apparently organic fragments, and some broken crystals; but the great mass of it was made up of amorphous fragments of iron, of the 1-100 m.m. and upwards in size, as well as curved and irregular fibres and masses of iron with sharp jagged edges, from 5 to 15 m.m. in size; there were also some very minute perfect spheres, probably iron. In trying the effect of the magnet upon this dust, he found it removed it from a sheet of paper as completely as if had been swept off with a brush, and he concluded that the non-metallic portions adhered to the iron particles by the thin layer of oil with which all the particles of dust were coated.

To prevent this dust passing into the atmosphere of cities, Mr. Stodder recommended a plan which had been put in practice many years ago in this country, but abandoned from the indifference of the workpeople, viz., the fixing of magnets in the immediate neighbourhood of grindstones and polishing wheels.

In the same report, Mr. Stodder alludes to the labours of two members of this Society—Dr. Angus Smith and Mr. J. B. Dancer—in examining the contents of the air, and points out an important matter considerably affecting the results of such investigations, viz., the method employed for filtering the air through water. The usual method has been to place a small quantity of pure water in a large bottle, and shake it in the air under investigations, repeating the operations with renewed volumes of air in the same water; but Mr. Stodder shows how impossible it is to intercept all the foreign particles in the atmosphere in this way, inasmuch as the smallest bubbles of air which pass through the water very much exceed in size the particles of matter which are sought for, and myriads must elude observation. A greater difficulty, however, is to obtain absolutely pure water for such experiments, and whether filtered or distilled water was used, a drop evaporated on a glass slide always left a deposit of scaly and granular particles. This result, as Mr. Stodder justly says, puts an end to this mode of investigation, and throws a cloud of suspicion on all reported researches in this line, when water was the medium used.

Mr. Bailey stated that the information communicated above had been extracted from an official document emanating from the State Board of Health of Massachusetts, and he commended it to the Officers of Health and to the Corporations of Manchester and Salford, as an illustration of what is required in this neighbourhood. The document just issued gives a summary of the work done during the past year, and embraces reports upon Public Abattoirs; the Cattle Plague, and its Effect on Milk; an Outbreak of Typhoid Fever; the Overcrowding of Tenements and want of Clean Streets in Boston; Smallpox; Poisoning by Lead; Trichiniasis in Massachusetts; Health of the various Towns in the State; Homes for the People; Alcoholic Drinks; Mortality of the City of Boston; Ventilation of School-houses; Water Supply, and its Comparative Purity; Air, and some of its Impurities; Health of Children employed in the manufacture of Textile Fabrics; Effect of Sewing Machines on Health, &c., and all this at a cost of under £600 the year.

ON THE ADULTERATION OF FOOD,

PRINCIPALLY WITH A VIEW TO ITS DETECTION BY THE MICROSCOPE.*

By WALTER MORRIS.

Adulteration was defined as being the fraudulent addition to any substance of another, for the sake of increased sale or profit. There are several modes of accomplishing this end; the first, and the most common, is by the addition of some article to increase the bulk or weight, as when starch is added to mustard, and cheaper flours to wheaten flour; the second by improving the appearance and apparent quality, so as to sell an inferior article at the price of a better, as in the case of the artificial colouring of pickles made of stale vegetables to resemble fresh. One of the commonest apologies for these practices is that the public prefer the adulterated article to the pure; that, for instance, pure mustard "will not sell." This allegation is, however, hardly a fair one, as the pure article is never offered; and, doubtless, if the pure article were used as freely as the ordinary mixture, it would be found unexpectedly pungent. But the fallacy of such apologies has been exposed by the example of pickles, which under this plea used to be invariably coloured with an artificial and frequently poisonous pigment. The public eye was thus educated to expect them of a bright green; yet, since some manufacturers have exposed the fraud and sent out pure pickles, the public have completely turned round, and avoid any which show an unnatural colour.

The adulteration of bread and flour with alum, to make them look whiter and of a superior quality, has to some extent diminished; but that substance is often replaced by the still worse sulphate of copper, or blue vitriol, which was recently detected in sixteen out of twenty loaves tested. In this case the public has been led to suppose that the quality of bread is shown by its whiteness, whereas by taking out the bran a most valuable part of the grain, viz., its azotised or flesh-forming portion, is lost. Less dangerous admixtures are those of cheaper flours, such as barley, rice, and "cones" (the latter made from a species of wheat called revet), and even beans.

The adulteration of coffee with chicory, though so well understood, exists, especially in poorer neighbourhoods, to an extent hardly credible. Out of forty-seven samples, eighteen were found pure, the lowest price of which was 1s. 4d. per lb.; of the rest, most were half, and some were wholly, composed of chicory, which, being worth about 6d. per lb., was thus sold at 1s. and 1s. 4d. The difference can be readily detected by the microscope, the cells of chicory being much larger, and the cell walls much thinner, than those of coffee.

* Abstract of a Paper read before the Manchester Literary and Philosophical Society.

Even chicory itself is much adulterated; out of fifty-seven samples only about one-half were pure, the adulterants being roasted wheat, acorns, beans, carrots, and sawdust.

Tea is less subject to adulteration than many articles of food; such abominations as the celebrated Maloo mixture, consisting of old used leaves re-dried, willow leaves and twigs, and even iron filings, have been quickly detected and refused by the trade. The "facing," however, of green tea with poisonous colouring matter is both absurd and harmful: and it will probably be continued so long as the public are content to accept such a palpable imposture as "genuine green."

It is a matter of opinion whether cocoa as ordinarily sold is to be considered an adulterated or a manufactured article. It is seldom sold pure and alone; being usually mixed with starch and sugar—the term "pure cocoa" is, therefore, in most cases, intended to mislead. Some kinds have lard or suet admixed, and to others red ochre is added to bring up the colour, rendered pale by an excessive quantity of starch. The relative quantities of these component parts in any sample of cocoa may be readily ascertained by the microscope; that of starch may be roughly seen by shaking up some of the cocoa with water in a test-tube or tall bottle, breaking up the lumps, and then allowing all to settle; when the starch will sink to the bottom and form a white layer beneath the cocoa. On warming the water, the fat will of course float on the top, and the sugar will be dissolved. The sugar crystals and fat are also shown by re-drying the solution on a glass slide.

Sugar is mixed with inferior kinds of the same article, but not (as popularly believed) with sand; the chief impurities in raw sugar are cane fibre, accidental dirt, and the sugar mite or acarus. The latter exists in most raw sugars (out of 72 samples 69 contained mites); but more abundantly in the moderately brown kinds than in the darker. The insect is barely visible to the naked eye. To obtain specimens, the sample should be dissolved in tepid water and well stirred, then allowed to stand a few minutes, and the acari will be found as minute particles floating on the top. The process of refining entirely removes these and the other impurities named.

Mustard is invariably adulterated with flour, which forms one-half or three-fourths of the article as usually sold. It may be readily detected by the microscope, mustard itself containing no starch whatever. Turmeric is often added to bring up the colour after this wholesale admixture, and cayenne to give it strength.

Pepper may now be obtained pure of respectable dealers; but as regards the cheaper kinds, and in poor neighbourhoods, it is largely adulterated with meal or starch, gypsum, and dirt of any kind, to give bulk and weight. The starchy substances may be detected by the microscope, the earthy ones will be left as ash after burning, and their character may be ascertained by the polariscope. The particles of pepper itself are easily recognised by the characteristic stellate cells in the outer skin, and the hard angular ones of the inner part of the seed.

Many examples of the above and other kinds of adulteration, mounted for the microscope, were exhibited at the same time, for comparison with pure specimens.

NOTE ON THE SPECTRUM OF THE CORONA.

By Professor C. A. YOUNG.

In an article upon the Solar Corona, which appeared in the *American Journal of Science*, May, 1871, I wrote, "Very perplexing also is the fact that the faint continuous spectrum, which must be in part produced by this polarised component of the corona's light, shows no discoverable traces of the dark lines of the ordinary sunlight spectrum. Probably they exist, but are in some way masked so tha they are not easily detected."

On further reflection, however, I believe the matter is readily explained, and that, on the other hand, it would have been remarkable if we had been able to bring out the Fraünhofer lines.

The truth is that the reflected photospheric sunlight forms only one small fraction of the total coronal radiance, the other constituents of which so far preponderate that it becomes very difficult to detect in the general spectrum the characteristics of this reflected light.

The spectrum of the corona is, in all probability, composed of at least *four* superposed elements.

1. A continuous spectrum, without lines either bright or dark, due to incandescent dust—that is, to particles of solid or liquid meteoric matter near the sun. For although I am not able to admit with Mr. Proctor that the whole explanation of the corona is involved in the presence of such meteoric particles, yet it cannot be doubted that they are very numerous; and any that may come within 250,000 miles of the solar surface must become incandescent and give such a spectrum as described.

2. A true gaseous spectrum of the second order, consisting, like all such spectra, of a more or less bright continuous background with well marked maxima or bright lines. In this case one bright line (1474) certainly exists, and perhaps several. So far as the spectroscopic evidence goes, this gas may be simply the vapour of the meteoric dust above alluded to, liberated by the heat of the sun, as when powdered sodium is dropped into an alcohol flame; or it may be disengaged for the instant from the same particles by electric discharges between them, as when the bright lines of metallic vapour appear in the spectrum of the spark produced by an induction coil. But in my previous article I have stated reasons for believing that the gas is of a more permanent character—a solar atmosphere through and in which the meteoric particles move as foreign bodies.

3. A true sunlight-spectrum (with its dark lines) formed by photospheric light reflected from the solar atmosphere and meteoric dust. To this reflected sunlight undoubtedly is due most of the polarisation, and were it possible to separate the polarised component of the coronal light from the rest, we might perhaps hope to find in it traces of the Fraünhofer lines. It is by no means impossible, however, that the spectroscopic character of reflected light may undergo some change, such as a partial obliteration or degradation of its lines, when the reflecting particles are sufficiently minute—small, that is as compared with the dimensions of a wave of light, so that they do not merely reflect the undulation at their surfaces, but themselves enter into motion bodily. Experiments upon the spectrum of the light emitted by one of the so-called actinic clouds, would, perhaps, clear up the subject.

4. Another component spectrum is due to the light reflected from the particles of our own atmosphere. This is a mixture of the three already named, with the addition of the chromosphere spectrum; for while at the middle of an eclipse the air is wholly shielded from photospheric sunlight, it is of course exposed to illumination from the prominences and upper portions of the chromosphere. This light from the terrestial atmosphere, like that reflected by particles near the sun, is evidently partially polarised in radial planes.

And if there is between us and the moon at the moment of eclipse any cloud of cosmical dust, the light reflected by this would come in as *fifth* element. It would, however, only differ from that reflected by our own atmosphere by including a greater or less modicum of photospheric sunlight.

Furthermore, in instruments like those employed by Messrs. Abbay and Pye, the chromosphere spectrum overlies that of the corona, and increases the complication.

It would seem, therefore, that only a small percentage

of the light which falls upon the slit of the spectroscope during a total eclipse contains the Fraünhofer lines at all, and it ought not to be considered strange that they are not readily observed.

In the same article I have stated that the photographs taken by the American party in Spain appear to differ essentially from those obtained by Mr. Brothers in Sicily.

This statement was based upon a comparison instituted by Mr. Lockyer, Professor Winlock, and myself, between a copy of the American photograph and a drawing* of Mr. Brothers's photograph, which (drawing) he had himself sent to Mr. Lockyer.

There was a general and even striking agreement between the two in respect to the position of the gaps and the distribution of the luminosity, yet there certainly were, as Mr. L. pointed out, very noticeable and important differences, and of a character to suggest that the extensive outside radiance might probably be of a less permanent character than the leucosphere, and of a different origin.

But I understand that when photographic copies of Mr. Brothers's and the American negatives are made to a common scale then these differences disappear, and the agreement becomes nearly absolute in respect to all essential particulars. If this be so, it certainly bears very strongly in favour of those theories which assign a purely solar origin to the whole phenomena.—*American Journal of Science.*

REPORT ON THE

MOLECULAR DISSOCIATION BY HEAT OF COMPOUNDS IN SOLUTION.

By CHARLES R. C. TICHBORNE, F.C.S., M.R.I.A., &c.

Part I.

Introduction.

M. Deville's researches upon the dissociation of compounds by heat when converted into the gaseous condition, have brought prominently before us the antagonistic nature of thermal to chemical force.† We find that the antagonistic action of these forces is manifested when we are dealing with compounds in the liquid condition, or in the so-called solutions of solid substances. It is a commonly acknowledged idea that in such cases heat hastens and modifies chemical decompositions, but how it modifies them, and to what extent, are questions which are seldom clearly defined.

The main purport of this report is the application of such enquiries as those mentioned to the science of chemical geology. I may remark that some of the hypotheses mentioned in the course of my paper are generally acknowledged, some indirectly accepted, and some emanate from myself. Similar remarks will apply to the phenomena observed. To specify, or enter too fully into these niceties, would needlessly cumber my report with extraneous matter, and I have therefore determined to leave such points to the reader's discrimination, except in a few special cases.

We may have various phases of decomposition according to the force with which the molecular fragments of a compound are held together, and it is immaterial whether we consider such bodies as built up by the direct addition of molecules or by substitution. Compounds of a complex nature must be viewed as an aggregation of perfect entities, capable of having an individual existence, but these component molecules cannot be taken into account when we are considering the more complicated molecule, *e.g.*, morphia splits up on the application of heat into apomorphia and water. No one could for a moment suppose that the molecule H_2O existed as water in the morphia, as its removal radically changes all the properties of the resulting compound. The more complex molecule has peculiarities which are not common to its factors, and *vice versa.*

The importance of a study of such points in connection with chemical geology is almost self evident; but I may as well state that in this report the subject has been merely considered from a chemical point of view. The surface of the earth has been, and is, undergoing superficially a rapid change from its primitive condition of igneous construction. This change is continuously going on, and growing more and more profound. In this metamorphosis water may be considered as the prime mover towards the ultimate results of the chemical as well as the physical arrangement of our earth's surface. Such a line of study is as invaluable as it is difficult, and it will be my endeavour more to open up this line of research, than attempt to master even a moiety of such knowledge.

Compound molecules exist as solids, liquids, and gases, provided that the temperature necessary to convert them into these physical modifications is not above the temperature at which their components are dissociated. The application of heat to a molecule may be graphically, although perhaps rather fancifully, represented by Fig. 1.

Fig. 1.

Now we can easily conceive that a substance A may be of sufficient structural stability to pass through all the increasing vibratory action without dissociation of its component molecules, until it has passed through the solid liquid, and far into the vapourous condition, whilst a substance B has what I will call a thermanalytic point, or the point where the equilibrium upon such a line is broken. If it lies between A or B, we have dissociation in the liquid condition. A great number of compounds are dissociated above the point B (*e.g.*, anomalous vapour density of chloride of ammonium), whilst those dissociated between A and B are less common and are much less easy of observation.

Of course the following broad rules may be accepted. 1. The greater the temperature, the greater the number of molecules capable of dissociation, or the greater the tendency to dissociation. And on the contrary, the lower the temperature, the greater the molecular stability. 2. The more complicated the construction of the molecule, the lower the temperature at which dissociation commences; and after disruption, the higher the temperature necessary to carry on further dissociation of the residual molecule. 3. As a corollary, it follows that example of dissociation by heat in liquids, or of solids in solution, are comparatively uncommon, but that when such phenomena do occur, they materially affect ordinary reactions, and that, *cæteris paribus*, decompositions at one temperature will not of a necessity correspond with those effected at another temperature.

In aqueous solutions and at ordinary pressure all molecular dissociation must occur under 100° C., that is to say, within the boiling-point of the fluid in which the substance is dissolved. Under pressure, however, from the increased range of temperature, extraordinary phenomena may be induced, and thus heating in sealed tubes offers facilities for producing decompositions that cannot be brought about at ordinary temperatures.

Dissociation of compounds in solution, unless accompanied by some ocular demonstration, is apt to be overlooked, from the simple fact that the molecules rearrange themselves generally in the same form on cooling, and thus the change is transient. Frequently, however, both in mixtures and simple solutions, a dissociation is accom-

* I am not sure but we had a photographic copy of Mr. Brothers's drawing instead of the drawing itself; but we did not have a photographic copy of the original negative. No such copies had then been made.

† The modifications of force are for convenience considered in this paper as separate entities.

panied on cooling by a re-arrangement of the two or more groups of molecules according to the altered affinities. The statical condition having been once broken, a different arrangement may take place.

I may illustrate the phenomena to which I have referred in the introduction, by the consideration of a few of the most simple cases.

None are more common than dehydration. The molecules, H_2O, in such cases forming the crowning particles of complicated structures are held thereto with but a feeble force, and are easily dissevered even in solution. Lime-water is a familiar instance, and although it has not, that I am aware, been demonstrated, there can be little doubt that the precipitate got on boiling that fluid is due to dissociation of the molecule of water, or its dehydration, thus. The action of heat upon the hydrate of lime ($Ca''O$; H_2O) is to produce $Ca''O$ and H_2O, $Ca''O$ being insoluble in water, or very much less soluble than its hydrate. The first is probably what takes place. The insolubility is, however, concurrent with the rise in temperature.

As there do not seem to be any experiments extant except the original ones of Dalton, this subject was considered sufficiently important to verify, as they bear upon an investigation to be ultimately embodied in this report.*

Experiment 1.

A saturated solution of lime was formed in the following manner :—

Freshly burned lime was slaked and washed by decantation (distilled water being used), the residual lime was then digested with fresh water for twenty-four hours, with occasional shaking. This, on subsidence, constituted the lime-water used. It is hardly necessary to observe that all this manipulation was carried on in a stoppered bottle. The bright lime-water was poured off into a flask; this was brought quickly to the boil, and whilst boiling poured upon a filter arranged in the following manner :—

A glass funnel was placed inside a double funnel of tin, the outer space of this double funnel being filled with glycerine, which was kept as near the boiling-point as practicable (the boiling-point of "Price's Glycerine" is about 177° C. to 182°). By this means the lime-water is kept as near to the temperature of dissociation as possible during the whole of the draining and drying, which is only a matter of about half an hour. Hydrate of lime dried over sulphuric acid does not suffer loss on being submitted to a similar temperature. The precipitate was brushed into a platinum crucible and weighed; it was then ignited and the loss calculated.

In two determinations the weighings showed a considerable reduction, but in both cases this was much under the quantity required by a true hydrate.

Thus—

	Weight of precipitate.	Loss on ignition.	Percentage $Ca''H_2O_2$. Theory.	Practice.
1st determination ..	0·155 grms.	0·031	24·33	20·00
2nd ,, ..	0·131 ,,	0·023	24·33	17·56

It is curious to observe that the second determination gives the amount of loss required by the formation of a hydrate having the composition $3Ca'O$; $2H_2O$, viz., 17·64. This experiment was executed as rapidly as possible.

In the above determinations, the only point that was satisfactorily established, was the fact that a dehydration really does take place, and that the molecule H_2O is to a certain extent torn from its chemical position, even in the presence of an excess of water, and that it is not due to any specific insolubility of the hydrate at 100° C.

Experiments 2, 3, and 4, were to determine the solubility of lime at different temperatures. Chemically pure carbonate of calcium was prepared by dissolving the precipitated commercial preparation in hydrochloric acid, and by treating the resulting solution with sulphide of hydrogen and filtering. The filtrate was then allowed to digest with a slight quantity of ammonia, and again filtered after warming. A few drops of sulphuric acid were added, and it was allowed to stand twenty-four hours before filtering from the precipitated sulphates. From this solution the carbonate was prepared with the aid of carbonate of ammonium. The well-washed carbonate was ignited in a platinum crucible, until it no longer effervesced on the addition of dilute hydrochloric acid. Having procured what might be considered as pure lime, the next point was to determine its solubility at different temperatures in the following manner.

Expt. 2.—*Determination of the Solubility at* 15·5° C.

After standing upon an excess of lime for some days in a silver flask, a lime-water was procured by decantation. For twelve hours before pouring off it was rigorously maintained at a temperature of 15·5° C. 4000 grain measures were operated upon in each determination. In the two last determinations the lime-water was filtered in an apparatus by which as much as possible of the atmospheric carbonic anhydride was excluded. I am of opinion that these last determinations give the results as a little under the mark, but I am also of opinion that decantation probably gives it over; for these reasons the average of the three experiments have been taken. The estimation was made with a volumetric solution of sulphuric acid, 100 degrees of which would neutralise one equivalent of monovalent element.

	Degree of vol. solution.
1st determination (decanted)	20
2nd ,, (filtered)	19
3rd ,, ,, ...	18·9

Therefore, as $19·3 . \frac{Ca''O}{200} = 5·405$ grains of lime present in 4005, so 1 grain of lime, or its equivalent of hydrate, requires 741 grains of water at 15·5° C.

Expt. 3.—*Determination of the Solubility of Lime at* 100° C.

A small copper boiler was used in this experiment which was provided with a valve to regulate the pressure, and a thermometer to indicate the temperature in the interior.

Through the top of this boiler passed what may be described as a kind of "Beal's filter." It consisted of a glass tube bent at right angles, one of the ends of this tube being moulded into a bell-shaped mouth, which mouth was tied over with a piece of Swedish filtering paper, and over this again a piece of muslin, which might be also placed upon the other side if great pressure were going to be used. By this arrangement, although the orifice presented a perfect filtering medium, it would stand a considerable amount of pressure. This end was submerged about half way into the boiler, which was filled with pure lime-water procured as in the previous experiment. The other end of the tube was provided with a glass stop-cock. The stop-cock was closed, and the lime-water rapidly brought to the boil. On allowing the valve to exert a slight pressure in the interior, and opening the stop-cock slightly, the lime-water slowly flowed out, the

* The following quotations are taken from most of the recent authorities, and are all evidently based upon the original experiments of Dalton, published in 1810 ("A New System of Chemical Philosophy," part 11, by John Dalton, Manchester.) Dalton gives lime-water, formed at 60° F., as containing one grain in 778 grms. of water, and at 212 F., one grain in 1270. Watts's "Dictionary of Chemistry," vol. i., p. 718, says,—"Hydrate of lime is more soluble in cold than in hot water; hence, water saturated with lime, in the cold deposits the *hydrate when boiled*." Miller says, in his "Elements," part 2, p. 418, fourth edition, "Lime is soluble in about 700 parts of cold water. . . . . If lime water saturated in the cold be raised to the boiling-point, half the lime is deposited." Wurtz in his "Dictionnaire de Chemie," quotes Dalton's experiments, and says, "La chaux est peu soluble dans l'eau et elle présente cette particularité qu'elle l'est plus à froid qu'à chaud," &c.

pressure in the interior being just sufficient to force the lime-water through the bibulous paper, and up the capillary tube. The thermometer would occasionally go up a degree, but this was at once remedied by opening the valve. When a sufficient quantity of water had been collected in this manner the amount of lime was estimated as in the previous experiment.

In two determinations 3002 grains consumed 8 degrees of the vol. solution $8.\frac{Ca''O}{200} = 2{\cdot}24$ grains lime present, or 1 in 1340.

Expt. 4.—*Determination of Solubility at* 109° C.

This experiment was performed in exactly a similar manner to the previous one, except that the valve was so placed that it blew off at a pressure corresponding to a temperature of 109° C. 3000 grains obtained in this manner consumed six degrees of the volumetric solution of acid, $6.\frac{CaO''}{200} = 1{\cdot}68$ grains of lime in solution.

These results may be tabulated as follows:—

One part of water at	Takes up of Ca″O.:
15·5° C.	$\frac{1}{741}$
100° C.	$\frac{1}{1340}$
109° C.	$\frac{1}{1785}$

and so on, until a point would be reached at which lime would practically be insoluble.*

The dissociation of water from lime seems peculiar to many of its compounds, and seems connected with the dimorphism of carbonate of calcium (see "Calcite and Arragonite.")

The determination of the solubility of lime at different temperatures are of importance in connection with this report, because, independently of its geological bearing, it affords a simple but illustrative example of the dissociation of compounds generally when in solution.

In this example we have the combined molecule H_2O becoming separated in the presence of an overwhelming excess of water from the dissociative influence of heat.

The gradual character of the action is also strikingly illustrated, the dissociation being in ratio to the increment of temperature, and is, under ordinary circumstances, only stopped by having arrived at the maximum temperature of water at the pressure of the atmosphere.

The phenomenon, however, is capable of further extension under increased pressure *ad infinitum*. The laws of molecular dissociation by heat have been only studied as far as regards volatile substances, but these laws seem applicable to the solution of substances modified by the altered physical condition, and are in their phenomena very similar. Thus, in speaking of gaseous dissociation in connection with the laws of Avogadro and Ampère, M. Wurtz makes the following remarks:†—

"Un des meilleurs arguments qu'on puisse invoquer en faveur de cette interpretation est celui qui est tiré de la densité du vapeur du bromhydrate d'amylène. C'est une combinaison liquide du carbure d'hydrogène d'amylène avec l'acide bromhydrique. Portée à une température peu supèrieure à son point d'ebullition cette combinaison montre une densité de vapeur qu'on peut appeller normale, parce qu'elle repond à 2 volumes de vapeur pour 1 molecule. La vapeur est intacte à cette temperature, mais dès qu'on la chauffe, elle va éprouver une décomposition plus ou moins complète, suivant que la chaleur fournie aura été plus ou moins considérable. . . . . Mais cette décomposition est graduelle; elle ne s'achève pas à un degré fixe, mais entre des limites de température assez étendues, de telle sorte que la vapeur, intacte à un certain degré, se trouve melangée, à des degrés plus élevés, avec des portions de plus en plus notable de ses produits de décomposition, jusqu'à ce qu'enfin la temperature s'étant élevée encore, la decomposition se trouve achevée. A ce moment, la densité de vapeur est descendue á la moitié de ce qu'elle était d'abord. Peut on en conclure que le bromhydrate d'amylène offre deux densités de vapeur? Il est évident qu'il ne saurait en être ainsi, et il est naturel de penser que la vraie densité de vapeur est celle qui a été déterminée à une temperature assez basse pour qu'on soit en droit de supposer que la molécule est encore intacte. Que si cette densité décroit avec la température, cette circonstance est due a l'action de décomposition que la chaleur exerce sur la vapeur."

Again, in speaking of the exceptions to the laws of Avogadro and Ampère, he says—"Deux molecules, capables de prendre chacune la forme gazeuse, sont remises par l'affinité en une molécule plus complexe. Il peut se faire que le point d'ébullition de celle ci soit situé assez bas pour que la chaleur qu'elles avaient perdue en s'unissant; elles demeurent alors en combinaison. Mais peut on s'attendre à ce qu'il en soit toujours ainsi? E l' affinité de deux corps l'un pour l'autre ne peut elle pas être assez faible, ou le composè qu'ils forment assez peu volatil pour que le point de décomposition soit situé au dessous du point d'ebullition?"

Substances in solution must behave in a similar manner to those in a gaseous condition, except that in such cases it is only the more loosely combined molecules that are effected at ordinary pressure, but still we cannot conceive that there could be any limit to this decomposition under extraordinary pressure such as would be exerted frequently, subterraneously.

We know that compound structures are capable of being separated piecemeal—*e.g.*, a compound of alum. The molecules are removable, commencing with the water of crystallisation, and ending with its most ultimate molecules. Thus, let us take the trimethylamine alum† a well defined compound, exactly similar in general construction to ordinary alums ($C_3H_{10}N,Al'''$; $2SO_4.12H_2O$). We see at once the great number of molecular points of dissociation it is capable of being divided into, beginning with the first 10 molecules of H_2O that, according to Gerhardt, are removable at 120° C. or ending with—

$$\left.\begin{matrix}CH_3\\CH_3\\CH_3\end{matrix}\right\}N.$$

Hertwig says the molecules H_2O are removable in three instalments. How far the action of heat is capable of splitting up this structure when in solution resolves itself into a question of pressure, but it will be seen further on that on the application of heat to such a compound as an alum, it reacts upon all the more unstable parts exactly as if they were not grouped together in the first instance, and that the whole structure is, if anything, lowered as regards its thermanalytic point, and thus weakened by its complexity. As the components are removed the residue has more stability.

The molecules known under the terms "water of crystallisation" are but slightly removed from the water of "hydration," and but slightly removed from the water of

* Dalton's experiments upon this subject are in his "New System of Chemical Philosophy," Part 2; Manchester, 1810. They are as follows:—When water of 60° is duly agitated with hydrate of lime, it clears slowly, but a quantity of lime-water may soon be passed through a filter of blotting-paper, when it becomes clear and fit for use. I found 7000 grains of this water required 75 grains of test sulphuric acid for its saturation, consequently it contained 9 grains of lime. If a quantity of this saturated water, mixed with hydrate of lime, be warmed to 130° and then agitated, it soon becomes clear; 7000 grains of this water decanted require only 60 grains of test sulphuric acid. The same lime-water was boiled with hydrate of lime for two or three minutes and set aside to cool without agitation; it very soon cleared. 7000 grains being decanted require only 46 grains of test sulphuric acid to be neutralised, the test acid being as usual 1·134. Hence we deduce the following table:—

One part of water at	Takes up of lime:	Hydrate of lime:
60° F.	1-778	1-584
130° F.	1-972	1-729
212° F.	1-1270	1-252

† "Histoire des Doctrines Chimique," par Ad. Wurtz, p. 79.

† There being no practical line of demarcation between what is known as "organic substances" and "inorganic substances" as regards the laws of dissociation, examples taken from organic chemistry are *en rapport* with the objects of the paper.

solution; frequently the alteration of a few degrees of temperature are sufficient to convert one into the other, *e. g.*, sulphate of sodium and salts that dissolve in their own water of crystallisation.

The water in the salt seems to be in a crystalloidal condition, but as a colloid in the other case. The crystalloidal water, even in solution, frequently is capable of dissociation, and of apparently changing its condition. Such changes produce the phenomena of supersaturated solutions.

The phenomenon of solution is a demonstration of force and of actual combination between the molecules of water and the substance dissolved. But if the more intimate unions be taken, it is evident that in such cases as hydration or water of crystallisation the molecules that we recognise as H_2O are playing different formations, or are in a different condition to the water of solution.

In an octahedron crystal of ammonia-alum water is almost essentially the geometrical solid, and is as important as the alumina, ammonia, or other elements.

If this alum be dissolved by applying heat, it is split up into a substance which is no longer alum geometrically or chemically, although we have got conventionally into the habit of saying it has "dissolved in water," or it has "dissolved in its water of crystallisation," as the case may be. It is not only decomposed, but requires some little time for the molecules of water to regain their accustomed position or crystalloidal condition—so that they may be assimilated into the edifice—as illustrated by the following.

Experiment 5.

A saturated solution of the ammonia ferric alum was poured upon a small quantity of the crystals of the same salt, and a few drops of acid added to prevent the precipitation of a basic salt. It was quickly brought to the boil, and then allowed to remain at rest until it had regained the original temperature, 15° C. Although the solution had a thermometer frequently inserted and withdrawn, there was no indication of crystallisation until some three to four hours had elapsed. Now, under the ordinary rules of solubility these crystals should begin to form immediately that the thermometer reached 15° C. This phenomenon is exhibited by all the hydrated soluble salts in some degree; it is particularly the case with the alums.

A very interesting and remarkable group of molecules are the basylous trioxides—of which, however, we need only consider three. These three bases are $Al_2'''O_3$, $Cr_2'''O_3$, and $Fe_2'''O_3$, oxides which perform a very important part in our earth's crust, and possess well-known properties in common, The first and last alumina and ferric oxide are, perhaps, the most important of the mineral world, if we except silicon and lime. There is a wonderful analogy between all their compounds, and they all possess in common a less degree of molecular stability from complexity of construction, and *ergo* a corresponding susceptibility to the action of heat when in solution.

M. Debray has lately published some ingenious observations upon the action of heat upon one of these solutions, namely, the ferric salts.* As my own experiments, however, have led to rather different results, I have simply given my own experience, and feel less delicacy in doing so from the fact that my investigations in this direction were well known, and have a prior date to those of M. Debray. I exhibited some experiments upon the dissociating influence of heat on these solutions before the Dublin Chemical Club in 1867.†

This dissociation is well marked in the ferric salts by the colour of their solutions. All the ferric salts are nearly colourless, or possess a very faint lemon tinge. It is probable that if we could get the tri-salt in solution without decomposition, a perfectly colourless liquid would be the result.

* *Comptes Rendus*, April, 1869.
† *Minutes of the Dublin Chemical and Philosophical Club*, 1867.

Experiment 6.

Ferric chloride, obtained by passing chlorine over iron filings heated in a porcelain tube, was dissolved in a moderate quantity of pure water (free from ammonia). A dilute solution of hydrochloric acid was then added, drop by drop, until the minimum point of colouration had been obtained. The iron was then estimated by precipitation with ammonia, and the chlorine by nitrate of silver.

The following figures represent the results obtained:—

	Practice.	Theory, per cent.
Fe	33·91	34·46
Cl	66·09	65·54

This slight increase in the amount of chlorine is evidently due to the basylous action of the water, and chromatic neutrality of such salts is dependent upon the amount of dilution, and is, in a certain sense, independent of the chemical neutrality. A chemically pure salt when dissolved gives a slightly basic solution, depending upon the relative volume of the water it is dissolved in.

Experiment 7.

The further addition of acid produced a darkening of the solution which had previously been rendered as neutral as practicable. Therefore, both acidity and basicity produce colours in these solutions.

Heat applied to these solutions gives an intense darkening in ratio to the temperature employed. It is almost certain, as will be seen from the experiments detailed, that the first action of the heat is the dissociation of crystalloidal water, and then the splitting up of the structure into a basic salt and free hydrochloric acid; and that the dissociation may be carried ultimately so far as results in the total splitting up of the structure. These results do not, however, agree with M. Debray's conclusions. Presuming that there is no other disturbing cause, the molecules regain their original arrangement of structure on cooling; but time becomes an important element here, the time required being in ratio to the extent of dissociation. The preparation of the ferric salts used was effected in the following manner:—

A neutral persulphate was formed in the moist way, preference being given to this method to that first adopted, namely, that of making the chloride obtained by sublimation the starting-point.

To a weighed quantity of ferrous sulphate dissolved in water the requisite proportions of nitric and sulphuric acids were added by the aid of volumetric solutions, carefully adjusted. The salt was evaporated to dryness at about 80° C., and after powdering was kept for some days at a temperature of about 75° C. This powder when thrown into water slowly dissolved in the cold, giving a slightly tinged and basic solution, which required the cautious addition of weak sulphuric acid. The addition of chloride of barium to this salt in equivalent proportions gave also a neutral solution of ferric chloride, &c.

Experiment 8.

A concentrated solution of ferric sulphate was submitted to a temperature of 100° C., the solution gradually became darker during the increment of heat. But there was no evidence of precipitation.

Experiment 9.

The above solution was rather copiously diluted, and on being re-heated it gave a basic precipitate of a yellow character, which contained sulphuric acid. Placed under the microscope it was seen to consist of semi-transparent and crystalline masses. By long and continued boiling a precipitate was procured in a more concentrated solution.

Experiment 10.

The basic precipitate procured in the above experiment was sealed up in a tube with the liquid in which it was formed, and occasionally agitated. After the lapse of some

considerable time it re-dissolved, with the formation of the original salt. To ensure success it is necessary that the boiling in the first instance should not be carried too far, and that the fluid be not too much diluted. A similar tube tied upon the beam of a steam-engine to ensure constant and energetic agitation gave the same results in two days.

(To be continued).

CORRESPONDENCE.

VITALITY OF DISEASE GERMS.

To the Editor of the Chemical News.

Sir,—Allow me, in reply to a letter which has appeared in the Chemical News of the 20th inst., signed H. B. Yardley, to state that if that gentleman will kindly refer to my paper on the "Action of Heat on Germ Life Dried on Cotton Fabrics," which appeared in the Chemical News of September 22, he will find at page 138 an answer to the question he asks.

If there is still vibrio life at 300°, and the calico is rendered tender at that temperature, I cannot see what further light would be thrown on the subject by repeating the experiment at 330° as suggested by him.

Permit me to trespass further on your space by alluding to a serious omission which occurred in the printing of my paper on the "Estimation of Sulphur in Coal and Coke," published in your issue of 18th August last. The sentence as printed reads—"The finely pulverised coal or coke is boiled for about twenty hours with water containing an equal weight of coal or coke taken. It should have been—"The finely pulverised coal or coke is boiled for about twenty hours with water containing an equal weight of carbonate of soda with that of the coal or coke taken.—I am, &c.,

F. Crace Calvert.

Royal Institution, Manchester,
Oct. 24, 1871.

VITALITY OF DISEASE GERMS.

To the Editor of the Chemical News.

Sir,—The recent experiments of Dr. F. Crace Calvert "On the Action of Heat on Protoplasmic Life" published in this journal have confirmed my suspicions, that an ordinary amount of heat is not sufficient to destroy the virus of contagion, but I will make this proviso, *in the absence of disinfecting agents.*

I have devoted a considerable portion of time to the study of disinfectants—in fact, sanitary chemistry generally, and the fact struck me as soon as I entered the field that the miasm was not destroyed by the heat of most disinfecting chambers. In fact, in some, where the heat employed is very low, owing to a badly constructed oven, very little good can accrue from the baking process alone. At the Sanatorium attached to Eton College the beds from the scarlatina patients used to be baked at rather a high temperature, but owing to scorchings having taken place the temperature has been considerably reduced. The heat now employed, if used alone, is, in my opinion, only just enough to warm the disease germ and make it feel very comfortable. The heat cannot be raised too high owing to its irregular working, the temperature being sometimes 40 or 50 degrees higher than the thermometer indicates. In December, 1870, I found the heat was only got up to 120° F., but it was supposed to rise to 160° F. I gave as my opinion that the heat had very little action upon the disease germ, and proposed placing a vessel containing carbolic acid mixed with an equal volume of water in the hot chamber. I have now, since the appearance of Mr. R. Weaver's letter (Chemical News, vol. xxiv., p. 166), written to know whether the system proposed by me has been fully carried out. I find that for the last nine months, when articles have been placed in the disinfecting chamber, the heat has been averaging from 120° F. to 160° F., and a vessel of dilute carbolic acid (1 to 1) has been placed in the next compartment to the clothes. The vapour of the phenol has been carried over by the combined effects of heat and steam, and has saturated the clothing. This I consider a good method, certainly better than baking alone, for insuring complete destruction of any lower organism.

Previous to December, 1870, the method of disinfecting the patients' linen before washing, was to steep in solution of bleaching-powder, but owing to the solution being sometimes made improperly, holes were *burnt* in the clothing: I thereupon proposed a dilute solution of carbolic acid; it is easy to mix, perfectly soluble, and has no action upon fabrics in the diluted state.

I have just penned these few remarks as I hold the subject as one of the highest importance, and hoping it will raise a discussion in order to bring forth fresh facts.—I am, &c.,

George E. Davis.

Laboratory, R. Bealey and Co., Radcliffe.
October 16, 1871.

THE BESSEMER PROCESS.

To the Editor of the Chemical News.

Sir,—I have read with much interest the many excellent articles on the Bessemer process, which have of late appeared in the Chemical News. They convey much valuable information, but I cannot help thinking the well-known fact that the grey iron used for the Bessemer process is converted into white during the first period of the blow should have been noticed, more especially as the *full* carbon spectrum (from all I can gather) is not seen until this change has been effected.

Mr. Snelus's own analyses, also those of others, show that the graphite (in the grey iron) is gradually occluded or dissolved in the iron, and that the boil does not fairly commence until the change is complete. It is well-known the same change occurs in the refinery and puddling furnaces. In the latter I have noticed the boil does not commence until this point has been attained.

In many instances grey iron is passed through the refinery for this object alone, thereby greatly facilitating and shortening its subsequent puddling.

Further, I think it doubtful that graphite (as such) is burnt at all in the converter; it may be that it is unaffected by the blast, and is only oxidised after entering into combination with the iron.

I have one question to ask, to which I should like a reply from some of your correspondents whose chemical knowledge must, of necessity, be superior to mine. During the conversion of grey pig-iron into white as above, is there a decrease or increase of temperature in the fluid blown iron due to this cause alone? I have thought it probable the latter may occur.—I am, &c.

John Parry.

Ebbw Vale Iron Works, Monmouthshire.

THE AMMONIA PROCESS OF WATER ANALYSIS.

To the Editor of the Chemical News.

My attention has been called to a letter from Mr. Edward Nicholson, Assistant Surgeon R.A., Analyst of Waters Mysore and Ceder Districts, dated 18th August, 1871, and written in Bangalore. It was published in the Chemical News of the 13th inst.

In this letter Mr. Nicholson confirms my statement, that our ammonia process had been adopted by the sanitary officers of the Indian Government. He, however, gives his opinion that it was adopted rather too hastily, and says that in his own hands it has been a complete failure. I have to thank him for not resting satisfied with a summary comdemnation of our process, and for recording

the reasons why he condemns it. Among these reasons I observe that, in his hands, water to which quinine had been added failed to yield ammonia when subjected to our process. In answer, I beg leave to refer to some experiments published by Chapman and myself in the *Journal of the Chemical Society*, in the year 1868 (ser. 2, vol. vi., p. 165). From 100 parts of sulphate of quinine we obtained 4·5 parts of ammonia. Frankland and Armstrong have likewise published a determination of the amount of ammonia given by sulphate of quinine when it is submitted to the ammonia process, and even they so far agree with us as to exhibit a considerable yield of ammonia, viz., 3·64 per cent.

If any of your readers should be disposed to distrust the ammonia process on account of Mr. Nicholson's assertions respecting the working of it, I would recommend them to experiment on quinine before doing so.

Inasmuch as Mr. Nicholson failed to get ammonia from quinine, I am not surprised at his failing, in a general way, to obtain albumenoid ammonia from the waters of India, but I should hesitate to regard his failure to get ammonia as any reason for believing that it is not to be got when the ammonia process is efficiently worked.—I am, &c.,

J. Alfred Wanklyn.

ELEMENTS, COMPOUNDS, AND MIXTURES.

To the Editor of the Chemical News.

Sir,—It is the general teaching of works on chemistry that matter is divisible into *two* classes, *elements* and *compounds*. Is this teaching true? I incline to the opinion that it is not, one reason for which I will proceed to state. Let us admit, for the sake of argument, that the teaching is true, and then proceed to the examination of one of the most common substances—atmospheric air. Before commencing to experiment upon the atmosphere, we can at once say it is either an element or a compound. On making our examination, however, we find that it is not the former, for it consists of two elements—oxygen and nitrogen, and two compounds—water vapour, and carbonic anhydride; neither is it the latter, for these elements and compounds are not held together by chemical attraction, which is characteristic of a compound. Now, since it belongs to neither of these classes, we must conclude that there are *three* classes of substances—elements, compounds, and *mixtures*—and that of this third class the atmosphere is a typical member.

I shall be glad to see the matter discussed in the columns of the Chemical News, so that the indefiniteness which at present prevails in the teaching on this point—to my mind at least—may be cleared up.—I am, &c.,

W. H. Wood.

Halifax, Oct. 24, 1871.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, October 2, 1871.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Variable Aspect of the Protuberances and other Remarkable Portions Visible on the Sun's Surface; Classification of the Phenomena.—Rev. A. Secchi, S.J.—This very elaborate memoir is illustrated by a series of engravings.

Researches on the Reciprocal Conversion of the Allotropic States of Phosphorus.—(Second part.)—G. Lemoine.—It is not possible, owing to the great length of this memoir and to the fact that it contains a great many tabulated forms exhibiting results of experiments, to enter into details on the subject. The main results of the author's researches, while to some extent confirming the results of a very limited number of experiments made on this subject in 1865 by Dr. Hittorf (*Pogg. Ann.*, vol. cxxvi.), prove that the conversion of phosphorus is chiefly a phenomenon of tension of vapours.

Estimation of the Velocity of Light.—A. Cornu.

Spectra of Tin and its Compounds.—G. Salet.—The exhaustive description of the spectrum phenomena observed when tin compounds are volatilised in the flame of hydrogen. It appears that tin in this respect is a most curious substance, since its compounds yield each three different spectra, two of which belong to all, while the third spectrum is continuous.

Continuation of the Thermo-Chemical Researches on the Ammoniacal Salts.—Dr. Berthelot.

Composition of the Clays Belonging to the Coal Formation.—C. Mène.—In tabulated form the author exhibits the results of the analysis of thirty-seven different kinds of this clay as obtained in France, Belgium, England, and Germany. The determinations made are:—Water, lime, silica, alumina, oxides of iron, alkalies, carbonaceous matter, and sp. gr. The contents of this paper are valuable, but do not admit of reproduction.

Loss of Valuable Libraries.—From a short note we learn that the Préfet de la Seine and the Préfet de Police request the Academy to have the kindness to send any books it might be able to dispose of to the two authorities just named, the former asking for the once magnificent municipal library of Paris, and the latter for the once very good library of the Prefecture, both of which have been destroyed by fire during the late war.

Annalen der Chemie und Pharmacie, September, 1871.

The following original memoirs and papers are contained in this number:—

Studies on the Combinations of the Camphor Group.—J. Kachler.—The first instalment of an exhaustive essay on this subject, containing the following sections:—Oxidation of camphor; nitrocamphoric acid; acids obtained from the mother-liquor; bibasic salts; tribasic salts; oxicamphoronic acid.

Protein Compounds.—(First portion of essay.)—H. Hlasiwetz and J. Habermann.—This paper contains an exhaustive general introduction to this subject, setting forth a comparison between the carbohydrates and the protein compounds, as regards the products yielded by the action of various reagents and decomposition-inducing processes, such as, for instance, fermentation, nitric acid, action of nascent oxygen, sulphuric acid, fusing caustic potassa, and dry distillation. Next follows the detailed account of a series of experiments made with the view to ascertain with certainty the derivatives or decomposition-products of carbohydrates among the products of the decomposition of the proteine compounds.

Allantoine and its Derivatives.—Dr. E. Mulder.—This very exhaustive and lengthy memoir is divided into the following sections:—Preparation of allantoine according to Liebig's and Wöhler's method; nitrate of allantoine, $C_4H_6N_4O_3,NO_3H$; allanic acid, $C_4H_5N_5O_5$; allantusic acid, $C_7H_{10}N_6O_6$; allantoinic acid, $C_4H_8N_4O_4$; lantanuric acid, $C_3H_4N_2O_3$.

Conversion of Formic Acid into Methaldehyde.—Dr. E. Mulder.—After very briefly referring to his former researches on this subject, the author states that he has obtained a sulphur compound, CH_2S, which, however, was obtained in too small quantity to admit of further experimenting with it.

New Series of Aromatic Hydrocarbons.—Th. Zincke.—The contents of this paper are not suited for useful abstraction.

Bulletin de l'Academie Royale des Sciences, des Lettres et des Beaux Arts de Belgique, No. 7, 1871.

This number does not contain any papers relating to chemistry or collateral sciences.

Journal de Pharmacie et de Chimie, August, 1871.

This number contains the following original papers and essays:—

Researches on the Intimate Action of the Substances which Aid the Decomposition of Chlorate of Potassa while Employed for the Preparation of Oxygen.—Dr. E. Baudrimont.—This memoir is divided into the following chapters:—Action of heat on chlorate of potassa; decomposition of this salt under the influence of substances which do not act chemically upon it; study of the action which certain substances exert upon that compound; discussion of several theoretical matters relating to this subject.

Crystallised Aconitine.—Dr. Duquesnel.—A strictly pharmaceutical paper.

Peculiar and Extraordinary Alteration of the Bread intended for the Army.—Dr. Poggiale.—The contents of this paper bear upon the appearance in some of the bread alluded to of an *oïdium*, a cryptogamic vegetable the spontaneous origin of which in the bread is not quite satisfactorily accounted for, but appears to have been more than once, although at long intervals, observed in the extensive

military bakery at Paris. The development of the *oïdium* (*aurantiacum*) alluded to renders the bread unfit for use, and in some degree even poisonous.

Note on the Existence of Copper in certain Waters.—Dr. Roux.—This paper contains the results of some experiments, chiefly made at the request of the Maire of Saint-Jean-d'Angely (Charente Inférieure), bearing upon the question that some of the spring-water of that town had become impregnated with copper, owing to the waste water of a coppersmith's shop having found, by percolation through the soil, its way to the spring. The result of very minutely conducted assays of the soil, as well as of the water in the neighbourhood of the works, revealed the presence of copper, but only in very small quantity. Water from Rochefort, pumped up by the aid of copper pumps, contained rather more copper; but in neither case was the quantity of that metal found in the waters alluded to so large as to be capable of giving rise to any injury to health, the less so as the French, by daily using copper cooking-vessels, obtain from these a sufficient quantity of copper in their system to render the detection of that metal in their blood an easy matter.

La France Scientifique (*Ancien Cosmos*), October 1, 1871.

This number does not contain any papers relating directly to chemistry or collateral sciences, but we call attention to the title of the first part of an essay:—

The Three Ages of the Globe; Introduction to a Critical Study on Darwinism.—Dr. V. Meunier.

Moniteur Scientifique, Nos. 333 and 354 (double number), September 1 and 15, 1871.

This number opens with a valuable essay:—

Extracts of Meat Considered in a Physiological Point of View.—Dr. P. Müller.—We quote the headings of the different chapters:—On muscular liquid; on beef-tea and meat extracts; on the organic principles present in these substances; action of potassa salts. The following conclusions are drawn by the author from his researches, corroborated by those of a great many others, among these Liebig and Virchow:—Meat extracts are neither directly nor indirectly food, for they do not contain albuminoid matter, neither do the nitrogenous principles which they contain arrest dis-assimilation, that is, they do not prevent the waste of the organic matter which composes the body. In small doses, these extracts are useful by the stimulant action of the potassa salts, which promote digestion and circulation; in strong doses—too large quantity at once—these substances may have a very injurious effect. When given to convalescents from serious diseases, especially if the system is exhausted by prolonged abstinence, the potassa salts present in these extracts in large quantity will act more injuriously because the system has lost a great deal of chloride of sodium; instead of then promoting the nutrition these substances will interfere with it—(1) by the direct action of the potassa salts on the blood globules, whereby the absorption of oxygen of these globules is greatly decreased; (2) by the predominance of such salts in the serum of the blood which only physically dissolve carbonic acid and do not allow the normal quantity of that gas to be exhaled, and thus impede the access of oxygen. Medical men should bear in mind that if given alone these extracts, and the same applies to beef-tea, are no nutriment, and only tend to keep the convalescents weak and not only ill fed but not at all fed.

The following original papers relate to chemistry and collateral subjects:—

The First Idea of a Dial Telegraph.—Dr. Quesneville.—The author quotes a few curious lines taken from a work—"Récréation Mathématicque Composée de Plusieurs Problèmes Plaisantes et Facétieux," edited by Jean Leurechon, e S.J., Anno 1624, at Pont-à Mousson—the main gist of which is that the *savant* just named, while speaking of the magnet (loadstone), suggests that if a person, A, had a powerful stone at Paris, and was provided with a dial plate upon which the figures of the alphabet were engraved and to which a movable magnetised needle was adapted, and a person, B, being at Rome, was provided with a similar apparatus, these parties might, by previously agreeing to enter into conversation with each other at a certain hour of the day, so arrange as to be able by the aid of a strong magnet to converse with each other; it appears that there was added to the original text an engraving representing the dial and needles alluded to. The work just spoken of has been re-published in 1626 and in 1629 (printed at Rouen by Ch. Osmont). The passage alluded to also occurs in a work edited in 1636 by Wijnant van Westen, a mathematician at Nymegen (Netherlands) under the title "Mathematische Vermaeckelijkheden;" this work is an improved Dutch translation of the work of Leurechon, who used to write under the pseudonym of H. van Etten.

On Leukaniline.—O. Follenius.—The body just named, $C_{20}H_{21}N_3$, is the product of the reduction of rosaniline, and best obtained in pure state by boiling a solution of fuchsine with pulverised zinc until the liquid has become colourless; from the filtrate, leukaniline in crystalline state separates on cooling; but in order to obtain this substance quite free from rosaniline the residue on the filter should be digested with alcohol, and this solution, after filtration, treated with from four or five times its bulk of distilled water, whereby the leukaniline is precipitated. After having been collected on a filter, washed with cold water, and dried, the body is obtained in a pure state. Oxalate and acetate of leukaniline are briefly described; the first named of these salts becomes after a while red-coloured.

Researches on the Artificial Alizarine of Gessert Brothers, Eberfeld (Rhenish-Prussia).—F. Reverdin.—The substance alluded to is met with in commerce in the shape of a thickish yellow-coloured liquid, which was found to contain 10 per cent of colouring matter, consisting partly of alizarine, and partly of a pale orange-coloured crystalline substance, of which too small quantity was obtained to admit of its being analysed, but the author could ascertain that it was not anthraquinone; purpurine was not found in the material. The results of the dye-tests made with the commercial product and the substances obtained therefrom by chemical analysis proved that in every case this artificially-produced material is of first rate quality.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, October 5, 1871.

This number contains the following original papers:—

Comparative Experiments Made with Dynamite and Ordinary Blasting-Powder in Working Quarries and Mines.—F. Hamel.—The first instalment of a paper on this subject. This portion contains a review of the history of discovery, properties, and application of nitro-glycerine and of dynamite.

Description of a Magneto-Electric Machine which Produces a Constant Current.—M. Gramme.—Illustrated by woodcuts. The machine is made and sold by M. Bréquet, 39, Quai de l'Horloge, Paris.

October 12, 1871.

This number contains the following original papers:—

Comparative Experiments Made with Dynamite and Blasting-Powder.—F. Hamel.—Continuation of the treatise on this subject, belonging more to mining and quarrying than to chemistry.

Studies on the Dissociation of Chemical Bodies.—C. Mène.—The continuation of an essay on this subject.

Continuation of the Tabulated Review of the Composition of Fertilising Substances which may be added to Manures, or are fit for use as such by themselves.—C. Mène.

Les Mondes, October 5, 1871.

The greatest part of this number is devoted to an elaborate and valuable paper:—

Geology of the Alps and the Alpine Tunnel.—Professor Sismonda and Dr. Elie de Beaumont.—Illustrated by a lithographic plate.

Quantity of Wood Required for Working a Beet-Root Sugar Manufactory.—M. Simirenko.—The contents of this paper relate especially to Russia.

October 12, 1871.

The only original matter contained in this number relates to some recently-published scientific books of which we quote the following:—

La Chimie Nouvelle ou le Crassier de la Nomenclature Chimique de Lavoisier Déblayé.—C. E. Julien.—This work is written by a well-known engineer, and according to what is stated in the above-named periodical is a production which contains a great deal of valuable matter especially in reference to iron and steel.

Recherches sur les Meilleures Conditions de Construction des Electro-Aimants.—T. du Moncel.

Le Moniteur des Produits Chimiques pour l'Industrie, les Sciences et les Arts et du Matériel de ces Industrie Publié par une Société de Chimistes et d'Industriels, October 10, 1871.

In addition to some very elaborate and important papers bearing on political economy, this number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Chemical Products of Italy.—E. Rousset.—This paper, a continuation of former papers on this subject, contains the following sections:—Tallow candles; stearine candles; glue-boiling.

The Lucifer-Match Industry at Marseilles.—P. Bosc.—As an instance of the importance of this industry we quote the following:—One firm employs 600 hands, and consumes annually for the production of matches:—2·5 tons of phosphorus; 7 tons of chlorate of potassa; 1·5 tons of colouring matter; 8 tons of red lead; 16 tons of refined sulphur; 50 tons of stearine; 25 tons of spun cotton wicks; more than 50 tons of Japan wax; and 100 tons of wood. There is annexed to this factory a chromolithographic printing establishment capable of printing two, three, or six colours, and consuming annually 2000 reams of paper at 500 sheets to the ream.

Engraving on Glass.—A. Ae. Wilbaux.—By the use of types made of an elastic material the author prints on glass fluoride of calcium incorporated in printing ink; the glass thus printed on is next treated at a suitable temperature with sulphuric acid, and after having been washed with water contains in indelible engraving the figures of the types.

Chlorine Preparation.—Tessié du Motay.—The author first prepares chloride of manganese, and heats this in earthenware retorts, admitting at the same time steam and a sufficient quantity of either air or oxygen, but in that case there is also formed hydrochloric acid; if, however, air, or preferably oxygen only, are passed over the red-hot chloride of manganese, chlorine is given off and peroxide of manganese

reproduced. If over this material, heated to redness, a mixture of hydrochloric acid gas and air or oxygen is passed, chlorine is continuously produced and peroxide of manganese regenerated.

Gazzetta Chimica Italiana, 1871.

We have received the first volume (Nos. 1 to 7 inclusive) for this year of this newly-commenced publication, which augurs well for that country which was the land whence science and art spread over Europe, and which now exhibits in every part of its territory a revival of scientific applications and the development of the manifold natural resources. The original papers and memoirs met with in the earlier numbers of this work (a monthly periodical) have been almost simultaneously published in either German or French scientific periodicals, and have been quoted in our columns; but of the original papers, subsequently published, we shall give short abstracts.

Journal für Gasbeleuchtung und Wasserversorgung, Nos. 18, 1871.

The contents of this number bear strictly on matters relating to gas- and water-works' engineering and management.

Bulletin de l'Académie Impériale des Sciences de St. Petersbourg, Vol. xvi., No. 2, 1871.

This number contains the following original paper relating to chemistry:—

Action of Zinc upon Quadri-Chloro-Benzyl and upon some other Bromated and Chlorated Compounds.—N. Zinine.—The compounds of chlorine and bromine with the hydrocarbons formed by the direct addition of the haloids to the hydrocarbon are violently acted upon by the zinc, the result being the reproduction of the hydrocarbons they are derived from, but the haloid compounds of the hydrocarbons formed by substitution are not thus acted upon by zinc. Quadri-chloro-benzyl, the elementary composition of which corresponds to quadri-chloro-tolan, $C_{14}H_{10}Cl_4$, is acted upon by zinc (the compound being placed in hot alcohol), so that half the chlorine is withdrawn and the quadri-chloro-benzyl split up into two compounds, which although of the same elementary composition, $C_{14}H_{10}Cl_2$, exhibit very different physical properties. One of these substances is a crystalline solid body, fusing at 153°, and difficultly soluble in boiling alcohol; the other is nearly soluble in boiling alcohol in every proportion, is also a solid body, has a different crystalline form, and fuses at 63°. Both of these substances are soluble in ether and acetic acid, and not further acted upon by zinc, but by the action of sodium amalgam both these bodies are, when dissolved in alcohol, converted into tolan; at 150°, the two bodies referred to are not acted upon by alcoholic solution of potassa.

No. 3, 1871.

Hydrological Researches,—Dr. C. Schmidt.—This very elaborate and exhaustive essay contains the following sections;—Water of the Glacial Sea, taken at 69° 55′ N. lat. and 49° 30′ E. long. from Greenwich; water of the Peipus Lake and of the rivers which feed it. This essay is copiously filled with the results of a large number of analyses of the waters alluded to, and these results are carefully compared with a lengthy series of results of analyses of fresh and salt waters made by other authors.

Eatable Earths from Lapland and Southern Persia.—Dr. C. Schmidt.—Dr. A. Göbel, while travelling in the summer (1870) in Northern Europe (67° 5′ N. lat. and 41° 12′ E. long. from Greenwich), obtained at Ponoi, a village situated on the White Sea, an earthy material which is used by the inhabitants as an addition to flour in bread-baking. A sample of this substance having been forwarded to the author for analysis gave the following percentical results:—Water driven off at 100°, 0·26; water driven off at low red heat, 0·885; alumina, 40·797; peroxide of iron, 0·310; magnesia, 0·618; lime, a trace; soda, 1·829; potassa, 9·845; silica, with a trace of fluorine, 45·506. From this result, as well as from the microscopical examination, the author concludes that this material is not fit for digestion at all. The Persian material was found in the district of Kirman, at 5000 feet above sea-level (30° 10′ N. lat. and 58° 10′ E. long. from Greenwich), The substance locally known as "G'hel i G'iveh" is met with in the shape of lumps of the size of an apple, is converted by the action of water into a soft slimy mass, and is very readily soluble in dilute acids, even in dilute acetic acid. The percentage composition of this substance was found to be:—Carbonate of magnesia, 66·963; carbonate of lime, 23·634; chloride of sodium, 3·542; sulphate of soda, 0·293; carbonate of soda, 0·598; hydrate of magnesia, 1·311; peroxide of iron, 0·092; alumina, 0·227; silica, 0·765; water of combination driven off at 120°, 1·153; hygroscopical water, 1·422. Since the inhabitants of the country here alluded to bake bread from flour which is fermented so as to become sour, the addition thereto of some of the powder of the mineral here alluded to will have the effect of a kind of baking-powder, and at the same time neutralise the acid.

On some of the Properties of Trimethyl-Carbinol.—Dr. A. Boutlerow.—Notwithstanding the high scientific value of this exhaustive memoir, its contents are not well suited for any useful abstraction; an observation equally applying to the following papers, which would also require the reproduction of very lengthy and complex formulæ:—

On Triethyl-Carbinol.—Dr. A. Nahapetian.

Dimethyl-Pseudo-Propyl-Carbinol.—J. Prianichikow.

On a New Body Isomeric with Amylen.—M. Ermolajew.

No. 4, 1871.

The original papers and memoirs contained in this number do not relate to chemistry or collateral sciences.

NOTES AND QUERIES.

A Curiosity in Water Analysis.—The following amusing analysis of the "Chalybeate Springs" appears in page 10 of the "Concise Guide to Tunbridge Wells and Surrounding Neighbourhood," recently published, and sold everywhere in the town:—"The water is clear, bright, and colourless; the taste savours strongly of steel, but is not disagreeable, and it has scarcely any smell, though sometimes in a dense air its ferruginous exhalations are very distinguishable. When first taken up in a large glass, its particles continue at rest till it is warmed to nearly the heat of the atmosphere, when some airy globules begin to separate and adhere to the glass, and in a few hours a light copper-coloured scum begins to float on the surface, whilst an ochreous sediment settles at the bottom. From the experiments of different physicians, it appears that the component parts of this water are steely particles, marine salts, an oily matter, an ochreous substance, a volatile spirit too subtle for analysis, and a simple fluid." Perhaps some one of your readers could manufacture an artificial mineral water from the above analysis for the benefit of those unable to visit the springs!—J. J. M.

MEETINGS FOR THE WEEK.

Monday, Oct. 30th.—London Institution, 4. Prof. Huxley, LL.D., F.R.S., on "Elementary Physiology (I.)."

Thursday, Nov. 2nd.—London Institution, 7.30. Dr. J. H. Gladstone, F.R.S., on "Michael Faraday: the Story of his Life."

— Chemical, 8. W. H. Perkin, F.R.S., on "Anthraflavic Acid."

TO CORRESPONDENTS.

*** Vol. XXIII. of The Chemical News, containing a copious index, is now ready, price 11s. 4d., by post, 12s., 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. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxiv. commenced on July 7th, and will be complete in twenty-six numbers. Reading Cases, price 1s. 6d. each, post free, may also be obtained at the Office.

J. C.—Single numbers of the foreign journals cannot often be purchased, so that no object would be gained by our adopting the course you propose. A foreign bookseller will give you the subscription prices.

J. Instone.—You will find full particulars about testing carbolic acid in "On the Application of Disinfectants in Arresting the Spread of the Cattle Plague," by William Crookes, F.R.S. The price is 1s.; it can be had on application to our publisher.

BOOKS RECEIVED.

An Introduction to Practical Chemistry, including Analysis. By John E. Bowman, F.C.S., late Professor of Practical Chemistry in King's College, London. Edited by Charles L. Bloxam, F.C.S., Professor of Chemistry in King's College, London.

Report on Spiritualism of the Committee of the London Dialectical Society. London: Longmans and Co.

A Systematic Handbook of Volumetric Analysis. By Francis Sutton, F.C.S. Second edition. London: J. and A. Churchill.

On the Relative Powers of Various Substances in Preventing the Generation of Animalculæ, or the Development of their Germs, with Special Reference to the Germ Theory of Putrefaction. By John Dougall, M.D. London: J. and A. Churchill, New Burlington Street.

Sixth Report of the Quekett Microscopical Club, and List of Members.

New Remedies. A Quarterly Retrospect of Therapeutics, Pharmacy, and Allied Subjects. Edited by Horatia C. Wood, jun., M.D. New York: William Wood and Co.

Lecture on the Analysis of Coal-Gas. By Henry Letheby, M.B., M.A., &c. Delivered before the British Association of Gas Managers. London: William B. King.

The Use of Gas in the Laboratory.

NOTICE TO AMERICAN SUBSCRIBERS.

In answer to numerous inquiries, the Publisher begs to state that Subscribers in the United States can be supplied with the CHEMICAL NEWS from this Office, post free, for the sum of £1 2s. 4d. per annum payable in advance.

THE CHEMICAL NEWS.

Vol. XXIV. No. 623.

ON CERTAIN REACTIONS OF THE SULPHO-CONJUGATED ACIDS OF PHENOL.

By C. GIRARD and G. DE LAIRE.

More than a year ago, Messrs. Dusart and Bardy patented a process for the preparation of certain secondary monamines of the aromatic series. The process, which, according to its authors, was a general one, consisted in submitting a primary aromatic monamine to the action of the sulpho-conjugated acids of phenol. They quoted in particular the production of diphenylamine by the action of phenol-sulphuric acid or a phenol-sulphate upon aniline at a temperature of 200° to 230° C. According to these chemists the phenol loses its hydroxyle, the phenylic residue replacing one of the atoms of ammoniacal hydrogen of the aniline.

This reaction is in contradiction to what is known of the constitution of phenol and its sulpho-conjugated derivatives, and, moreover, we endeavoured some years ago, and always without success, to replace the available hydrogen in aniline by the phenyl radical contained in phenol.

The unexpected result announced by Messrs. Dusart and Bardy has induced us to undertake further experiments on this subject.

(1). We heated for two days in a closed tube at 250° to 280° one molecule of phenol-sulphate of sodium and one molecule of aniline. The tube contained at the end of the experiment a liquid and a solid portion. On opening it there was no evolution of ammonia; we observed only the characteristic odour of sulphurous acid. The liquid portion contained aniline and unaltered phenol; the solid portion was composed of sulphate, sulphite, and sulphide of sodium. We could discover no diphenylamine whatever, and with the exception of an insignificant loss of 2 or 3 per cent, the whole of the phenol corresponding to the phenol-sulphate was recovered.

(2). We repeated the previous experiment under the same conditions of time and temperature, but employing an *excess* of aniline, 2 or 3 molecules of aniline for 1 molecule of phenol-sulphate. On opening the tube there was a considerable evolution of ammonia and a strong smell of sulphide of ammonium. The contents of the tube were partially liquid and partly solid. The former was composed of aniline, phenol, and diphenylamine. The solid portion contained sulphate, sulphide, hyposulphite, and sulphide of sodium. These experiments, several times repeated, show clearly that the formation of diphenylamine is not due to the substitution of the phenylic residue in phenol for the ammoniacal hydrogen of the aniline, but simply to the action of aniline upon one of its salts.* This was to be expected on theoretical grounds, and has been thoroughly confirmed by experiment.

ON THE ESTIMATION OF ANTIMONY, AND THE SEPARATION OF ANTIMONY FROM TIN, FROM ARSENIC, FROM TIN AND ARSENIC, AND FROM THE OTHER METALS, BY MEANS OF A NEW PRECIPITATING REAGENT OF ANTIMONY.

By HUGO TAMM.

With the exception of sulphuretted hydrogen, there is no real precipitating reagent of antimony known to chemists; for although the number of reagents, both organic and inorganic, which precipitate this metal is very great, in every instance known the precipitation is incomplete, and a very large proportion of the metal remains in solution, so that all those reagents are unfit for the estimation of antimony.

It is a great pity, for some of them, such as water or oxalic acid, would be admirably adapted for this purpose. But analysts must submit to the whims of nature, over which they have no command whatever, and it is only by patient labour, untiring perseverance, and, above all, luck, that they can overcome practical difficulties.

One method being always insufficient for the estimation and the separation of a substance in all cases, if I propose a new process for the estimation of antimony it is not in view of substituting it to the method which has rendered such great services to analysis, but, on the contrary, to strengthen it by means of a powerful auxiliary, for accurate estimations and neat separations leading to trustworthy results and to complete analysis can only be obtained by the judicious use of several methods.

The process which I am going to describe will be found most useful in most cases, and sometimes absolutely indispensable.

It was neither chance nor analogy which led me to discover it, but I was sensible to the defects of the old methods, and thoroughly disgusted with the clumsy and generally difficult processes hitherto proposed for the separation of antimony from tin and arsenic, and I resolved to find out some simple means of estimating antimony, and of separating it from tin and from arsenic.

After a careful investigation of the precipitating properties of all the substances of which I could lay hold of, and which were likely to effect the object I had in view, luck pointed out to me the following method:—

Estimation of Antimony in the State of Bigallate of Teroxide of Antimony.

When a neutral and concentrated solution of terchloride of antimony is mixed with a slight excess of gallic acid, all the antimony is precipitated in the state of a double gallate of teroxide of antimony and water, or, to use the ordinary notation, as bigallate of antimony, or antimonious bigallate.

A neutral or slightly acidulated solution of terchloride of antimony, corresponding, in fact, to strongly acidulated solutions of ordinary metals, the precipitation of antimony takes place in a regularly acidulated liquor, since besides the free hydrochloric acid present, all the combined hydrochloric acid is liberated by gallic acid.

In this acidulated liquor, bigallate of antimony is almost completely insoluble, and in the liquor separated by filtration from the precipitate, sulphuretted hydrogen reveals but a minute quantity of antimony which can be neglected for most practical purposes.

In those conditions, antimony is the only metal precipitated by gallic acid. All the other gallates, even those which are insoluble in water, are extremely soluble in the liquor from which antimony has been precipitated, and, consequently, gallic acid affords an easy means of separating at once antimony from the other metals.

It follows, also, that gallic acid is a very perfect precipitating reagent of antimony; in fact, it has only one defect, it is a non-volatile organic acid, and as such, it alters the behaviour of some metals with some of their precipitating reagents, so that after the separation of antimony, it is sometimes necessary to precipitate by sulphuretted hydrogen or by sulphide of ammonium the metals left in the solution. But as this operation would, in many cases, have to be performed for convenience sake, it matters but very little. On the other hand, most metals can be precipitated, even in presence of an excess of gallic acid, by means of appropriate reagents, and I shall carefully indicate when and how this can be done, and when, on the contrary, the metals must be precipitated as sulphurets.

* French Patents; Girard and De Laire, March 21, 1866. *Moniteur Scientifique*, April 1, 1867; Feb. 1, 1868; Sept. 15, 1869.

Precipitation of Bigallate of Antimony; Washing, Drying, Weighing, Behaviour, and Composition of this Precipitate.—On a New Phenomenon called Hygraffinity.

As I have stated above, the solution of terchloride of antimony must be neutral or only slightly acidulated, and what is most important, the solution must be concentrated. The reason of this is obvious, for bigallate of antimony is partially or in totality soluble in hydrochloric acid, according to the quantity of this acid present in the liquor, and as it is well known, the weaker a solution of antimony is, and the more acid is required to keep it clear, while the more concentrated the solution of antimony is, and the more neutral it can be obtained.

After that a strong and neutral solution of terchloride of antimony has been prepared, only a slight excess of gallic acid should be added. To ascertain this, the following test is employed:—

After the addition of a quantity of gallic acid apparently sufficient to precipitate all the antimony, the precipitate is allowed to subside. A glass rod is dipped in the supernatant liquor, and a drop of this liquor is placed on a piece of white paper. To this a drop of ammonia is added, and the slightest excess of gallic acid present is indicated by the nice pink colour which appears.

If too much gallic acid had been used, this excess of acid would in no way impair the accuracy of the estimation of antimony, and if it is recommended not to use more of this acid than is required for the complete separation of antimony, it is chiefly to simplify the separations and estimations of the metals left in solution.

The solution of gallic acid used for the precipitation of antimony must be quite recently prepared; for in a solution of some days standing, gallic acid is altered by a peculiar phenomenon of hydratation, whereby it becomes unfit for the complete precipitation of antimony. That this alteration in the composition and the properties of gallic acid is only due to hydratation is proved by the fact that the solution evaporated to dryness leaves a residue of gallic acid, which, when re-dissolved in water, is perfectly fit for the complete precipitation of antimony. This phenomenon of hydratation is analogous to the phenomena exhibited by phosphoric acid.

Bigallate of antimony is a very white precipitate, somewhat bulky, but which settles very rapidly. It cannot, however, be washed on the filter, not even on a double filter, for it invariably passes through the filter as soon as the acidulated mother-liquor has been washed away. But as it settles very rapidly in liquors, the mixed mode of decanting and filtering must be resorted to, and in this instance this process presents no inconvenience and no difficulty. The only disadvantage is that more washings are obtained than would be the case with simple filtration. For this purpose, the precipitate is allowed to settle, the liquor is poured on the double filter and decanted as closely as possible from off the precipitate. This done, the flask holding the precipitate is re-filled with hot water, the precipitate is allowed to settle once more, and once more the supernatant liquor is filtered and decanted as closely as possible from the precipitate. The same operation is repeated three or four times; the precipitate is then placed on the filter, where it can be washed once or twice with safety.

The tedious description of this tedious operation has its importance, as, by following to the letter the indications here given, much trouble and inconvenience will be avoided.

The drying of gallate of antimony, with the usual precautions, is very easily effected in the water bath at the temperature of 100° C., and the formula of the precipitate thus thoroughly dried is then $SbO_3(C_7HO_3)_2 3HO$, and it contains exactly 40·85 per cent of metallic antimony.

In the estimation of antimony, the dried bigallate should be weighed as soon as it has cooled, or, better still, shortly after it has been left to cool in a dried atmosphere, for it has a great affinity for water, which it absorbs rapidly from the air.

When bigallate of antimony, dried at 100°, is left exposed to the air for a few hours, it is found to absorb exactly two equivalents of water, and its formula is then identical with that of bigallate of antimony dried at the temperature of 80° C., and which is represented by—

(1.) $SbO_3(C_7HO_3)_2+3HO$. (2.) $SbO_3(C_7HO_3)_2+5HO$.

This new bigallate of antimony is the normal compound; it contains exactly 38·77 per cent of metallic antimony, and it could be used as well as the other one for the estimation of antimony, but there is evidently no advantage in so doing.

When the bigallate of antimony dried at 80° C. is placed in the water-bath and dried at 100° C., it loses two equivalents of water, but on being left exposed to the air for some time it re-absorbs those two equivalents of water, which it loses by another desiccation at 100° C., and which it re-absorbs once more by a fresh exposure to the atmosphere.

This curious experiment can be repeated indefinitely with the same success, and this fact is so very remarkable that although I have the strongest objection to the introduction of new words in science, I have no alternative but to give a name to this extraordinary phenomenon, and I shall call it, for convenience sake, *Hygraffinity*, or *Chemical Hygrometry*, to distinguish it from physical hygrometry, as it is observed in artificial silica, oxide of copper, and a number of insoluble substances.

I believe that bigallate of antimony affords the first example of an insoluble precipitate exhibiting such a powerful affinity for water. I cannot believe that this example is unique, and I trust that it will be the basis of an interesting investigation of similar phenomena not yet observed in insoluble compounds, and I have no doubt that it will be among the organic insoluble compounds of metals that the most interesting facts connected with this phenomenon will be discovered.

The estimation of antimony in the state of bigallate dried either at 80° C. or at 100° C. is very accurate indeed when the precautions indicated have been observed. But it is not absolutely necessary to estimate this metal in this state, even after it has been separated as bigallate, for, as I have stated before, bigallate of antimony is extremely soluble in weak hydrochloric acid, so that, after it has been placed on the filter, it is only necessary to dissolve it in hydrochloric acid, to wash well the filter with dilute hydrochloric acid, and to precipitate the solution thus obtained by sulphuretted hydrogen, to be enabled to estimate antimony as usual in the state of tersulphide. The sulphide of antimony obtained in these conditions is chemically pure, and all that is required to apply it to the estimation of antimony is to wash it well until the washings mixed with a little ammonia exhibit no pink colour indicative of the presence of gallic acid.

On the whole, it is, perhaps, best to follow, as a rule, this last process, but it must be resorted to when the analyst has not got at his disposal the proper appliances for drying and for cooling the bigallate of antimony.

Remarks.—When antimony has been estimated as bigallate, or separated in this state from metals insoluble in sulphide of ammonium, an excellent precaution to take to ascertain the perfection of the separation is to dissolve the bigallate of antimony which has been used for the estimation of antimony in an excess of sulphide of ammonium.

There ought to be no residue of black sulphides insoluble in this reagent.

Preparation of the Solutions of Terchloride of Antimony required for the Separation and Estimation of Antimony in the state of Bigallate.

Were it not for the remarkable reaction which I am going to describe, gallic acid could be used only in very limited instances,—in those only in which the antimonial

compound dissolved in hydrochloric acid gives at once a solution of terchloride of antimony, for solutions of perchloride of antimony are quite unfit for the estimation of this metal by gallic acid, and most reducing reagents act very indifferently on perchloride of antimony, or do not act at all, or are the means of introducing in the solution substances difficult of separation, and which, as a rule, disturb known reactions, and prevent, in most cases, neat separations and accurate estimations. But when a solution of perchloride of antimony, slightly acidulated with hydrochloric acid is mixed with iodide of potassium, two equivalents of chlorine combine with two equivalents of potassium; two equivalents of iodine are liberated and the perchloride of antimony is reduced to the state of terchloride, $SbCl_5 + 2KI = SbCl_3 + 2KCl + 2I$.

This important reaction will prove most useful, as by its means perchloride of antimony can, at will, be converted into terchloride with the utmost facility, by the introduction of two substances, one of which, iodine, is evolved, the other, potassium, remaining in the liquor, and aiding, as I will show, to the accuracy of the estimation. Consequently, whenever there is the slightest doubt about the composition of a solution of antimony obtained by some means or other, it is only required to heat the solution with a slight excess of hydrochloric acid and a little powdered iodide of potassium. When no iodine is evolved, it is because the whole of the antimony exists in the state of terchloride; when, on the contrary, iodine is evolved, it is because part or the whole of the antimony exists in the state of perchloride, and it is only necessary to add iodide of potassium little by little until no more free iodine is evolved to be certain that the whole of the antimony is reduced to the state of terchloride.

In general it is useless, and it may sometimes be inconvenient, to add more iodide of potassium than is required for the complete reduction of perchloride of antimony, but with a little experience nothing is easier than to judge when the proper quantity of iodide of potassium has been added. This is invariably the case when the clear liquor freed from iodine and mixed with a little more iodide of potassium remains clear, is not deeply coloured, or evolves no more free iodine.

The solutions of terchloride of antimony thus prepared and properly concentrated by slow evaporation are then quite ready to be precipitated by gallic acid.

Estimation of Antimony in Native Sulphuret of Antimony.

The estimation of antimony in this important mineral is very easily effected by means of gallic acid, and its complete and accurate analysis, which was very difficult and almost impossible by the old methods, has become quite simple by the gallic acid process.

Twenty grs. of the powdered mineral are treated by a slight excess of hydrochloric acid, and the mixture is gently heated until the whole of the sulphuretted hydrogen disengaged is thoroughly evolved. The solution is then filtered, the filter and matrix are washed with dilute hydrochloric acid, and the solution is slowly evaporated in the flask until it is conveniently concentrated and freed from the excess of hydrochloric acid.

In this solution the whole of the antimony exists in the state of terchloride, a slight excess of a recently prepared solution of gallic acid is added, with the precautions already indicated. Hot water is then added, and the precipitate of bigallate of antimony is washed, dried, and weighed, as has already been stated. Antimony may also be estimated as sulphide after having been separated as bigallate.

Twenty grs. of this mineral are quite sufficient for the estimation of antimony, but in the complete analysis it would be inconvenient to operate upon more than 50 grs. as the precipitated bigallate of antimony is very bulky.

Antimony being separated as above, iron, lead, copper, silver, arsenic, and sometimes zinc, cobalt, and other metals remain in solution.

Arsenic exists much less frequently than is generally supposed, and I really do not know to what to attribute the universal belief that arsenic follows antimony everywhere, except to the imperfect or difficult methods hitherto employed for their separation, leaving a wide scope to the imagination of analysts.

Copper, on the contrary, is very often present. It can be estimated here with the greatest accuracy, as the whole of it exists, or may be made to exist, in the filtrate. By the old methods, on the contrary, it was constantly hidden by antimony which it followed in the successive operations of the analysis, since it was precipitated along with antimony, and nearly all taken up by the sulpho-antimoniate of ammonia formed by treating sulphide of antimony by sulphide of ammonium.

Although it was then possible to detect copper by attacking sulphuret of antimony by nitric acid, a large portion of copper was maintained in an insoluble state by the antimonic acid formed, so that it was not possible to estimate it with anything like accuracy.

The analysis of the filtrate is proceeded with as that of an ordinary liquor containing the metals mentioned. The only metal which cannot be properly estimated in this liquor is iron, the presence of gallic acid preventing its precipitation, even by means of sulphide of ammonium, but its complete separation from antimony is so simple by the known methods that I need only mention this fact, remarking, at the same time, that in this, as in most instances, one method is insufficient, and that correct analyses can only be made by the judicious use of several appropriate methods.

Estimation of Antimony in the Artificial Sulphide of Antimony in the Course of Analyses.

In the course of a complicated analysis, it is oftentimes absolutely necessary to obtain antimony first in the state of a sulphide of antimony mixed with a large quantity of sulphur, and contaminated with small, or, as the case may be, large, proportions of sulphides of copper, arsenic, or tin.

The gallic acid process affords a simple means of carrying out a careful analysis in this part of the operation, and of estimating antimony by a direct process.

For this purpose the collected mixture of sulphur, sulphide of antimony, &c., &c., wet or dried, is first of all treated by hydrochloric acid, and when the action has ceased a little chlorate of potash is added, to attack any copper or arsenic which might have escaped the action of the acid. The solution thus obtained decanted from off the residue of sulphur is evaporated, reduced by iodide of potassium, and precipitated by gallic acid. In all this the mode of proceeding is identical with the process fully explained in the next example.

(To be continued)

REPORT ON THE

MOLECULAR DISSOCIATION BY HEAT OF COMPOUNDS IN SOLUTION.

By CHARLES R. C. TICHBORNE, F.C.S., M.R.I.A., &c.

(Continued from p. 203).

Experiment 11.

The addition of alkaline salts to the ferric compounds determines more easily the precipitation or dissociation. Therefore, the iron alums, either with the ammonia or potash base, exhibit this phenomenon in a marked degree. These alums, which show a beautiful but very faint amethyst tint, gave on solution in the cold a slightly coloured liquid, made paler on the addition of a very dilute solution of sulphuric acid. The gradual increase of temperature brought about all the reactions and phenomena

observed in the above experiments, only in a much more marked and decided mannner, whilst, again, this lowering of the thermanalytic point was even more evident with the potash alum.

It is unnecessary to detail the experiments performed with the solutions of ferric chloride, because the results were almost the same. I would wish, however, to observe, that even on prolonged boiling there seems to be no loss of HCl *at ordinary atmospheric pressure.*

It having been determined that the first results of the continuous boiling of a neutral ferric salt is the precipitation of a basic salt, containing a part of the stylous element, further experiments were performed to determine how far these acid molecules were removable at ordinary atmospheric pressure, by the combined and continuous action of water and heat.

Experiment 12.

A large quantity of a dilute solution of ferric sulphate was submitted to continuous boiling until a considerable precipitate was obtained. This precipitate was collected upon a filter, washed once and dried at 100° C. 0·219 grm. gave 0·141 of ferric oxide when dissolved in HCl, precipitated with ammonia, and weighed after ignition. This corresponds to 64·4 per cent of ferric oxide. A portion of this precipitate before drying was placed in a considerable body of water, and again submitted to a temperature of 100° C. for two hours. After this treatment the appearance was much changed; the colour which was originally of a light ochrey yellow, had been changed to a reddish-brown, whilst the precipitate became much denser. 0·388 grm. now gave 0·32 grm. on precipitation, as in the previous estimation, and therefore corresponds to 82·5 per cent; it, however, still contained a trace of the basic salt. The further action of heat upon these basic salts will be found described in Experiment 16.

It must be borne in mind that all the above experiments had been performed with what we might call chemically neutral salts, but it is probable that from a geological point of view there would be formed $Fe_2'''^{\frac{2a}{3}}$, or a deficiency of one-third of the acid, *e.g.*, from the oxidation, for instance, of iron pyrites. In such a case we would have to start with a basic solution, the first result of the oxidation of the pyrites being a ferrous salt, which ultimately becomes oxidised into the ferric.

Experiment 13.

To a weighed quantity of pure crystallised ferrous sulphate a quantity of pure nitric acid was added, sufficient to exactly oxidise the ferrous salts to its higher term. The acid was allowed to remain in contact with the powdered salt without the addition of water, until on dissolving a portion, and after warming and testing with ferricyanide of potassium, all trace of the magnetic salt had nearly disappeared. This product was then diluted with 50 times its weight of water: such a solution is perfectly clear, and will remain so for some little time, but ultimately it decomposes spontaneously at ordinary temperatures, the time being determined by the amount of dilution and temperature. When diluted so as to represent 0·5 per cent, a given volume (a) of this liquid gave on precipitation with ammonia and on ignition 1·557 grms. of ferric oxide. In a second determination, the solution was brought to 100° C., and maintained at that temperature for some time; the precipitate that fell was separated from the liquid by filtration, washed with a small quantity of water, and dissolved in hydrochloric acid, and the oxide estimated in this solution with ammonia, as in the first instance. 0·559 grm. was procured, which is over the amount of base really in excess of the acid present, $\frac{a}{3}$ = 0·519 grm. The filtrate again on dilution and boiling gave a precipitate representing 0·049 grm. of oxide. The filtrate again on dilution and boiling became opaque, but it was not necessary to follow out this experiment further, it being evident that there was no actual limit. It is probable that many of the ores, such as hæmatite, brown iron ore, bog iron ore, ochres, &c., are formed in somewhat a similar manner to that detailed, and it is curious to observe that sulphuric acid is seldom absent from such hydrated minerals and frequently in much larger quantities than the published analyses would lead one to suppose (*vide* Analyses).

We have now to consider the action of heat upon such fluids under pressure.

Experiment 14.

A solution of ferric sulphate was placed in a tube of hard German glass* and hermetically sealed. This tube was then placed in a gun-metal apparatus, capable of bearing a considerable pressure, a little water being placed in the apparatus to equalise the pressure outside the glass tube, the heat was gradually raised until a thermometer, the bulb of which was placed in a cavity outside the apparatus, marked 177° C. The whole apparatus was maintained at this temperature for two hours. On cooling and taking out the tube, it was seen that a similar decomposition had taken place as that obtained under ordinary atmospheric pressure, only in a more marked manner. At the bottom of the tube there was a considerable precipitate of an ochry nature, consisting of basic sulphate; but at the surface of the fluid there was an incrustation composed of red oxide of iron, adhering to the side of the tube in the form of a ring.

Experiment 15.

This was a modification of the previous one, but in this case a more volatile stylous element was chosen, and although it was placed in a tube, as in the previous experiment, the orifice was left unsealed. We were, therefore, on placing it in the apparatus described above, submitting the fluid to the action of a considerable volume of steam, at a pressure of nine atmospheres. After two and a half hours' digestion the contents of the tube presented a remarkable appearance. The greater part of iron lay at the bottom of the tube, not in the form of a basic precipitate, but as a dark and heavy oxide of iron. Thin layers of this oxide adhered to the tube at the surface of the fluid, which, when examined by the microscope were seen to be transparent and brilliantly red; by reflected light they possessed a blackish metallic lustre. The tube still contained an acid salt of iron, which, however, no longer acted upon the enclosed oxide; the latter seemed anhydrous.

In the first experiment (Expt. 14) there can be no doubt that a similar change had partially taken place, but only to a slight extent; it was the limited volume of steam generated in the tube reacting upon the surface of the fluid that formed the ring of ferric oxide. Certain specimens of specular ore (Analysis 4) are formed in this manner. They are simply pseudomorphs of the sublimed and anhydrous ferric chloride, produced by volcanic agency, and ultimately submitted to the action of high pressure steam.†

Experiment 16.

The basic precipitate procured upon boiling a solution of ferric sulphate at ordinary temperatures, was next placed in a tube with a little water, and submitted to the action of steam for two and a half hours, at a temperature of 177° C. The result was the gradual conversion of the basic precipitate, which lay at the bottom of the tube to the extent of about 15 millimetres, into a bright red and dense precipitate, which, however, gradually assimilated its original appearance until, at the depth of 6 millimetres, it appeared to have retained its primitive

* It is necessary in these experiments to have a good glass, as some specimens of lead glass seem to be rapidly acted upon at high temperature by some of the solutions used.

† In speaking upon this subject in his Lectures on Chemical Geology, Dr. Percy says, "Supposing we have the vapour of sesquichloride of iron, there is no difficulty in accounting for the formation of this sesquioxide in volcanic regions. If that vapour be brought in contact with the vapour of water, we get a deposit of crystallised sesquioxide of iron, with the formation of hydrochloric acid."

composition and ochry appearance. Some considerable proportion of this precipitate seemed to have been carried up the side of the tube. At the line of juncture of steam and fluid, this precipitate was converted into anhydrous oxide of iron ; above this the basic salt was intact, except that it seemed to be perfectly dehydrated and white, and it was not until it had been in contact with the fluid contained in the tube that it seemed to regain its original appearance. It is evident, therefore, that as regards the more fixed and non-volatile acids no dissociation is effected at the temperature tried, except in the presence of condensed water, but that the steam is capable of removing water of hydration under such conditions.

Before disposing of these experiments I should wish to draw attention to some speculations upon this subject which have been promulgated by Dr. Percy in his lectures on Chemical Geology.* "It" (ferric oxide) "is found pseudomorphous after iron pyrites. It is a puzzle to know exactly how this pseudomorphism has taken place. "If iron pyrites is exposed to the weathering action of the air, it is converted, and must be converted first of all into a common sulphate of protoxide of iron, that becomes oxidised by exposure to the air, passing to the state of a sulphate of sesquioxide of iron. That sulphate of sesquioxide of iron, by the action of water, decomposes into two salts—an acid salt which will dissolve away, and a more basic salt which would remain. We can easily understand the transformation of iron pyrites, under these conditions, into a highly basic sulphate, and even into hydrated sesquioxide, because we have only to call into our aid bicarbonate of lime, which frequently occurs in mineral waters. The trace of sulphuric acid might be easily removed, and the gypsum formed washed away, leaving nothing but hydrated sesquioxide of iron in the manner described, and then exposed to a certain degree of heat whereby the water of the hydrate may be expelled, and the red oxide left. But that theory will not suffice, because we find certain crystals of hydrated sesquioxide of iron which are partially converted on the outside into red oxide of iron. It is perfectly evident that the temperature sufficient to decompose the hydrate could never have existed when such crystals were formed, because if it had, it is impossible to conceive that any nucleus of hydrated sesquioxide of iron should remain. The formation of this anhydrous sesquioxide of iron in nature is yet unexplained satisfactorily. We can produce it readily enough in our laboratories by means of heat, but there is no reason for supposing that in the condition in which it has been produced in nature, a high temperature has prevailed, or, at least, that remark applies to many cases of the formation of that mineral."

As regards the ultimate removal of the sulphuric acid, it would seem from the experiments detailed, that it is not absolutely necessary to call in the aid of a second base, such as lime, it being quite possible and probable that the same results may be obtained, under the laws of dissociation, by the aid of immense pressure and a long period of time, such as would be procured in geological changes.

Again, as we see that we can have perfect dehydration even in the presence of water or steam, the second difficulty which presents itself in the crystals of anhydrous oxide containing the nucleus of hydrate is disposed of.

The chromic oxide behaves exactly in a similar manner, except that, *cæteris paribus*, the point of dissociation is higher, and therefore it requires more careful investigation to observe the changes produced by heat upon its compounds in solution, which so far have escaped observation or have been misconstrued.

It is well known that the ordinary chromic salts present a "peach blossom" colour when in solution, convertible by heat into green solutions. The most rational of the many explanations given of this phenomena is one of dehydration, but there is something more than this. Theoretically, it would seem that the chromatic change was due to basicity of the solution as in the ferric salts, and that it was only necessary to increase the boiling-point of the solution by pressure, or to increase the condition of basicity by the volume of water to obtain similar results to those obtained with iron. This was satisfactorily verified with many experiments, a few of which will suffice to illustrate this part of my subject.

Experiments 17 *and* 18.

Solutions of chromic sulphate and potassio-chromic alum, when submitted in tubes for the space of two to three hours in the pressure apparatus, gave, in each case, basic precipitates, the temperature being 177° C. The precipitate in the last-named substance being very voluminous, I did not succeed in procuring anhydrous chromic oxide corresponding to the ferric oxide, but look upon its consummation as merely a matter of pressure.

Experiment 19.

A dilute solution of any chrome alum, if dropped into a flask of boiling water, is instantly dissociated. The contents of the flask become quite opaque, and the basic precipitate is palpable to the eye. This precipitate is re-dissolved on cooling, and even during boiling if the solution of chromic alum is gradually added.

If we accept the theory, of which there can be little doubt, that there can co-exist a base and an acid salt in solution, this explains at once the change of violet salts of chromic oxide into green solutions on boiling. Any neutral salt of chromic oxide dissolved in the cold gives a violet colour contaminated with green ("peach blossom"?). This, as in the iron salt, is due to the basylous action of the water. The cautious addition of dilute sulphuric acid converts it into nearly a pure violet. It is converted into the green solution either by the addition of an alkali, by the addition of water, or by heat. In other words, the green colour in chromic salts is due to the basylous condition. In the case of heat, the green solution regains, after some time, its original condition, but only slowly. Many explanations have been given of this phenomenon, and it seems almost strange that one so simple should have escaped observation.

The aluminic oxide also obeys the same law of dissociation, only in a still less marked manner. It was evident that from analogy this should be so, although at the first glance it would appear that such was not the case. But, on taking into consideration the relative atomic position of the elements concerned, it would be seen that dissociation could be only exerted at ordinary pressures to a very limited extent as regards this base ; thus there is no evidence of decompositions in solutions of any considerable strength on boiling, but if a very considerable proportion of water is there to the amount of salt, a basic compound thereof is precipitated at 100° C. This is best seen by passing a beam of electric light through the flask, as the precipitate formed is almost optically invisible in daylight. A beam of electric light impinging upon the light flocculent precipitate at once reveals its existence. It is almost absolutely necessary to use some such light when operating upon chloride of alumina, but an aluminic alum, by virtue of the extra play of affinities brought to bear, gives a reaction easy of observation by the eye : these precipitates re-dissolve on cooling. As regards the effects of extraordinary heat procurable under pressure, we find that alumina behaves in a similar manner to the other members of this group, which the following experiments will illustrate.

Experiment 20.

The ammonia and potash alums were placed in separate sealed tubes, and submitted for 2½ hours to a temperature of 177° C. White crystalline precipitates were produced, varying in composition, but containing sulphuric acid. They represented the greater part of the alumina present

Experiment 21.

An open tube containing a solution of chloride of aluminium was placed in the same apparatus (described in

* Chemical News, vol. ix., p. 147.

the iron experiments) and submitted for some hours to a temperature of 177° C. At the line of juncture of fluid and steam a white colloidal substance was deposited, which seems to consist of a mixture of hydrated and anhydrous alumina. This experiment may throw some light upon the formation of corundum. Sapphire, ruby, and topaz have been formed artificially with perfect success by Ebelmen, Deville, and others; all these artifical processes, however, have been igneous ones. In nature, however, it is evident that the corundum is not always, if it is ever, formed in this manner. It frequently contains from 3 to 4 per cent of water, and is also associated with diaspore and other hydrated minerals.

Before concluding this part of my report, I will consider for a moment the results of these experiments collectively. It would seem that the compound molecules of aluminic, chromic, and ferric oxides are dissociatable in ratio to their atomic weight; or, we may say, as regards this group, that their basylous position is in ratio to their dissociatability. Thus, although compound alumina molecules are dissociatable at ordinary temperatures when insufficiently dilute the decomposition is not so well marked until we get an extraordinary pressure, and the corresponding increase in the range of temperature. Again, that in the presence of other compounds of basylous elements they are more easily dissociated from the introduction of a second basylous molecule reacting upon the acid. The following series of experiments upon the alums and simple salts will place what is stated in a clearer light. Some of them were performed by taking very diluted but standard solutions of the typical salts and adding, degree by degree, to them, whilst in a state of ebullition, water until the thermanalytic point was reached; they were so arranged that the evaporating water was re-condensed and flowed back into the flasks. The water was distilled twice, the first time from a small quantity of acid sulphate of potassium to render it free from all trace of ammonia. The flasks were made of hard German glass, and were digested with dilute hydrochromic acid for some time before they were used. It was found impossible to obtain water by filtration through paper that would stand the test of a beam of the electric or lime-light. The clearest water was obtained by subsidence after distillation from a silver retort. Except in a few cases, most of the experiments can be followed by performing them by gas-light. The flasks must, in this case, be carefully cleaned, and a powerful gas-flame be placed opposite the manipulator and behind the flask. The faintest precipitate will be perceived by this means on holding the flask close to the eye, providing it is not of that peculiar transparent and colloid nature sometimes observed in modifications of alumina and silica.

The solutions used were weak, but were so proportioned that each contained an equivalent quantity of the trioxide to correspond to 1 grm. of chloride of aluminium dissolved in the ½ litre of water; the exceptions were in two of the iron experiments. The following were the results:—

Expt.	Salt used.	Weight used, or equivalent to 1 grm. of $AlCl_3$ in ½ litre H_2O.	Temperature at which dissociation sets in.	Degrees c.c. of dilution required to produce decomposition with 1 grm. $AlCl_3$ and its equivalent.
			Degrees C.	C.c.
22.	$FeNH_42SO_412H_2O$	3·597	53·5	9·5
23.	—	with 1 vol. more H_2O	48	—
24.	—	with 2 vols. more H_2O	43	—
25.	$FeK_2SO_412H_2O$	3·753	50	8·0
26.	—	—	43	—
27.	—	—	42	—
28.	$CrCl_3$	1·186	—	55001
29.	$CrK_2SO_412H_2O$	3·727	—	2751
30.	$AlCl_3$	1·000	—	56251
31.	$AlNH_42SO_412H_2O$	3·384	—	31260

The observations recorded in these experiments can only be considered exact from a relative point of view, as there were too many contending influences to warrant the figures being taken as individual observations. They, however, conclusively prove the following points:—The relative position that the molecules, ferric, chromic, and aluminic oxides, hold, as regards dissociation, also the laws that govern their dissociation in the presence of other salts. Thus, the alums of the ferric oxide which have been chosen to determine this point are seen to obey the chemical laws of affinity. As regards the disturbing molecule introduced, its power of substitution determines the lowering of the thermanalytic point. Also the basylous power of this atom determines the amount of decomposition. Where the trioxides alone replace the hydrogen in the acid, the molecules are held together with a force in ratio to the relative affinities, but when a second molecule comes into play, a power of determining or lowering the thermanalytic point is found in the disturbing basylous element introduced. Thus we find in the alkali group, potash acts more forcibly than ammonia; in fact, they act in this respect according their power of substitution.

As before stated, the ferric salts have been experimented upon by M. Debray*.

That experimenter says—"Je ne suppose pas que le chlorure de fer se dédouble en acide chlorhydrique et en chlorure basique, parce que l'existence de ces composés basique soluble, en tant que composés definis, en parait peu conciliable avec le fait de leur decomposition par le filtre dans l'appareil dialyseur, ou par le sel marin qui en precipite de l'oxyde de fer pur. Il en parait plus natural de considerer ces composes comme des dissolutions de l'oxide colloidal de fer dans l'acide chlorhydrique ou tout au moins dans le sesquichloride de fer ordinaire." Now, although M. Debray's views are in the main correct, we cannot conceive that the *action of the dialyzer* can have anything to say to the actual condition of the solution before dialysis. Immediately that we bring a *septum* into play we introduce another decomposing influence to bear and entirely modify the balance of the forces at work. I hope shortly to be able to demonstrate that not only the oxides of the group, we have been considering are capable of existing in either the colloidal or crystalloidal condition, the modifying agent appearing to be, in some instances, the combined water. There can be little doubt that at elevated temperatures we get a partition of the acid, so arranged as to give an acid salt and a basic salt, and that the amount of basicity is dependent not upon temperature, which only determines a constant decomposition for each degree, but upon relative volume of water, and, when we come to extraordinary pressure, relative volatility of the stylous molecules in the presence of steam. M. Debray again says—"Le chlorure de fer se dédouble donc à une temperature de 70 degrees en acide chlorhydrique et en sesquioxide de fer soluble dan l'eau," &c. All through his paper he speaks of this thermanalytic point, as I will call it, as a constant quantity for the same salt under all conditions. Now this involves a principle, and I have proved this point at a given pressure is entirely dependent as regards this group (and therefore as regards M. Debray's experiments with ferric oxide) upon the relative volume of water.

So sensitive is the potassio-ferric alum that a fine amethyst-coloured crystal obtained by crystallising it at a low temperature, when placed upon the palm of the hand, first becomes white and after a short time yellow. This salt is, of course, the most sensitive of all the group mentioned in this paper.

It may be well to point out that these experiments can only determine the laws of dissociation practically to a limited extent. We must build upon them, and conceive in our mind's eye the enormous results that are attainable with the aid of unlimited time and pressure.

* "Note sur la Décomposition des sels de Sesquioxide de Fer," par M. Debray.—*Comptes Rendus.*

We are compelled to bring into play the "scientific use of the imagination" and bridge over the long gap that lies between our mimic results and those consummated in the laboratory of nature, and by this means to mentally extend our experience. The results are here, but the *modus operandi* is absolutely a sealed book.

I propose to reserve the consideration of the element silicon, more particularly in connection with the bases dealt with in this paper. This will form a second part, as I wish in an immediate one to consider the conversion of these molecules from the crystalloidal to the colloidal condition.

(To be continued).

A NEW METHOD OF QUANTITATIVE CHEMICAL ANALYSIS.*

In comparing together the results of a large number of chemical analyses it is seen that the numbers obtained vary between 99·17 to 100·67, giving a difference of about 1·5 per cent, or, supposing a quantity of 1·500 grms. of substance has been taken and the weighings carried to 0·0001 grm., a difference of 225 units. The analyses here alluded to are by no means those which would be called bad or indifferent, but are such as have been made and published by eminent chemists. It ought further to be remembered that very many analyses yield results varying from 97 to 102 per cent, instead of 100, whilst the really bad ones never see the light at all. Under ordinary circumstances slight differences do not usually affect the result of an analysis, but if it is desired to employ the sum of the substances found to control the results, an incorrect total fails to serve this purpose, as there is no means of knowing upon which of the substances the error really falls. Moreover, in many instances, only small quantities of material are available. A more accurate and improved method of analysis would admit of the employment of smaller quantities as well as effect a great saving of time and labour.

It would appear that neither the methods and processes in use nor the impurities of reagents are greatly at fault, because it is found that, when the same substance is analysed under exactly the same conditions, the results often differ. It would, therefore, appear that accuracy depends chiefly upon the manipulations, among the most dangerous of which may be mentioned decantation, the removal of substances from a filter, the ignition of the filter-paper, and the calculation of the ash; the employment of a great number of vessels may either add something to solutions or withdraw something therefrom.

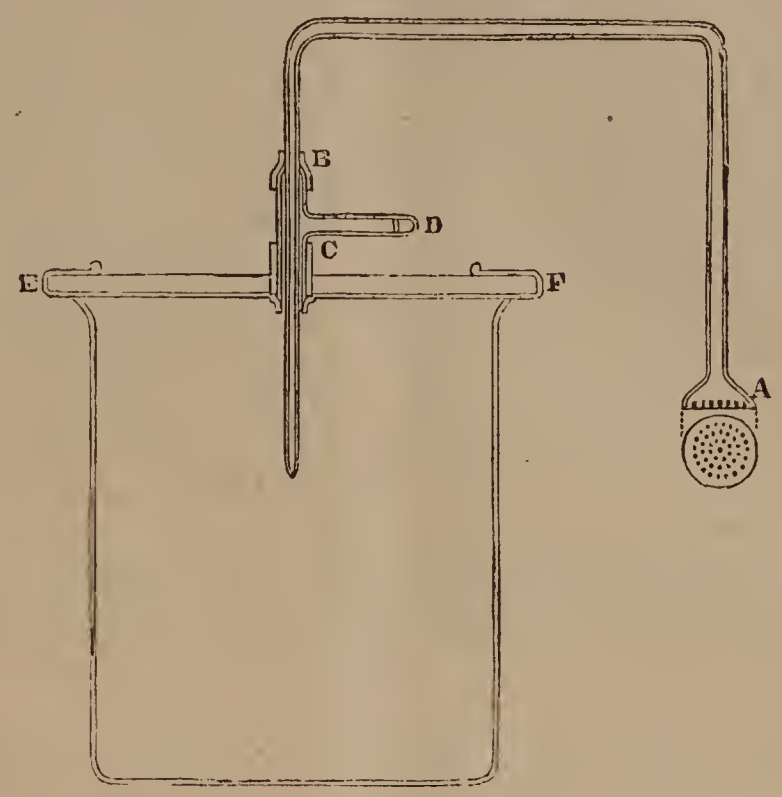
Dr. H. Carmichael has proposed a very ingenious apparatus for overcoming these difficulties. His apparatus is represented in the accompanying cuts.

Fig 1, represented one-fourth of its natural size, consists of a doubly bent glass tube, with a funnel-shaped widening at one of its ends, the wider part being perforated with a large number of small holes; the other bend of the glass tube is fitted in the T-shaped tube, B C D, closed air-tight at B, by means of a vulcanised india-rubber ring; the tube is fastened in the glass plate, E F, and fitted air-tight by means of a similar contrivance to the one just mentioned; E F is covered with a cap made of vulcanised caoutchouc, while between B and C a tube is fitted laterally, bent at D, at right angles (this part is not represented in full in the cut) and fitted with a small bored vulcanised india-rubber tube closed by a spring clamp. The cap and the ring, B, should be touched with some grease. The edges of a beaker can be readily rubbed on a piece of fine grained and thoroughly smooth and level sandstone, to take off the vitreous glaze, so that a plate of ground glass may fit quite tight thereon; this having been done the cover, E F (a ground glass plate), may be fitted so tightly that it is possible to keep in the interior of the beaker-glass as good a vacuum as in the receiver of an air-pump.

The filtering bulb, A (Fig. 2), being the most essential portion of this apparatus, its construction requires the greatest possible attention, and should be managed as follows:—

Take a glass tube having an inner bore of 2 m.m., blow at one end a thick bulb (see A, Fig. 1), flatten the bulb

Fig. 1.



at the bottom, keep this bulb so hot that the glass is only slightly soft, and while in that condition make holes in it by means of a white-hot steel wire; these holes should be close together, and not larger than 0·7 m.m. The width of the edge, *a b* (Fig. 2), differs according to the kind of filtering-paper which it is intended to use. For ordinary filtering-paper the width should be 3 m.m., for Swedish paper a width of 2 m.m. is sufficient; the perforated glass knob thus obtained is also ground slightly on sandstone.

Fig. 2.

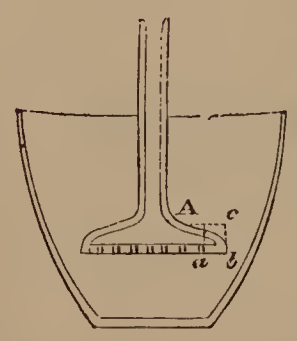


Fig. 3.

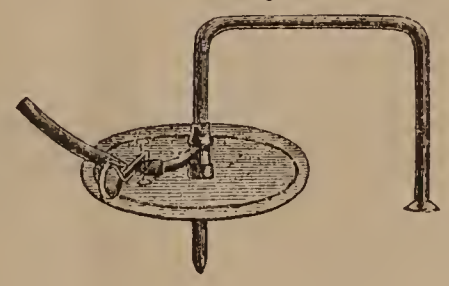
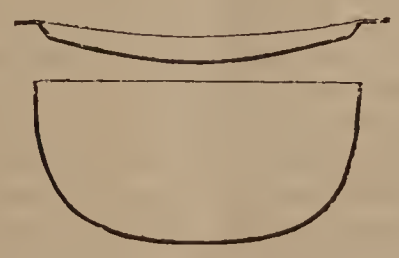


Fig. 4.



The tube to which the bulb is blown should be so bent as to make the leg B somewhat longer than the leg A; the height of the bulb must not be great, that is to say, it should be sufficiently flat to carry along with the air at the end of the filtration all the liquid into the beaker. The most suitable diameter of the bulb for general use is 2·5 c.m., the number of holes ought to be 50, but a smaller number will do when the holes are connected together by means of small channels cut in the glass by means of hydrofluoric acid. The apparatus is connected with an air-pump by means of a strong india-rubber tube. The

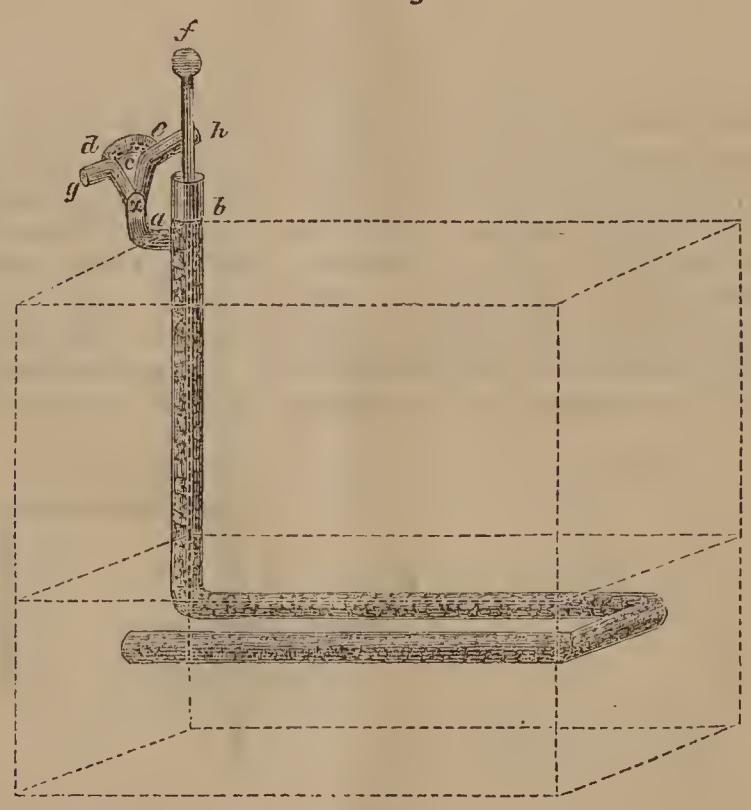
* From "Select Methods in Chemical Analysis," by William Crookes, F.R.S., &c. London: Longmans and Co.

best air-pump is formed by the human lips, but direct experiments have proved that the power of suction of men varies from 10 to 695 c.m. of mercury, that is to say, from $\frac{1}{70}$ to $\frac{9}{10}$ of an atmospheric vacuum. When the operator cannot suck above $\frac{1}{2}$ atmosphere, or when disagreeable gases are to be worked with, the Sprengel pump or the aspirator should be used. Even when full atmospheric pressure is on, the thinnest filtering-paper will not be broken.

In order to use the apparatus the air is pumped out, water being poured simultaneously on A. The rapidity of the current thus called into play effectually removes all impurities, and the water serves also to clean the beaker. This having been done, a circularly cut piece of filtering-paper, of the same diameter as A, is pressed against A. It remains fixed there, even when the apparatus is blown into; a vacuum is again made while the filtering disc is placed in the solution of the substance to be analysed, care being taken not to let the disc touch the bottom of the vessel in which that solution is contained; as soon as the solution is filtered off from the sediment, some pure water is added, the vacuum being still maintained, after which the apparatus, with the precipitate adhering to it, is removed from the vessel in which the solution was contained, while any sediment therein remaining is transferred by careful manipulation into a previously tared crucible.

Fig. 3 exhibits the mode of the connection of the apparatus with the air-pump. The bulb is placed in the vessel, and distilled water added for the purpose of washing the

Fig. 5.



sediment thoroughly, the water running into the beaker (the vacuum being kept on) for the purpose of drying the precipitate by the current of air. This may be carried so far as to cause even gelatinous precipitates to shrink together. The spring clamp now being opened, air is admitted to the beaker, and the filtering tube removed from the crucible as well as from the cover, E F. If the operation has been properly managed, the disc of filtering-paper remains on the top of the precipitate, the upper surface of the bulb remains clean, while only a very thin and small ring of the substance adheres to the lower edge of the bulb; this substance is removed by carefully holding a piece of filtering-paper flat in the hand and pressing it gently against the bulb; turn the latter gently so as to rub all the substance on the paper, which, with the substance thus fastened to it, is thrown into the crucible. This having been done, the crucible covered with its lid, is placed in an air-bath and heated to 105°. At this temperature the precipitate becomes readily and rapidly dry, without any danger of spirting; after which the crucible is ignited, first without the cover, until the very small quantity of paper is consumed, and afterwards with the lid on.

Although a bulb of the size above named is sufficiently large for many substances, it is preferable to have another bulb of 3·5 c.m. diameter for use with such gelatinous precipitates as alumina and peroxide of iron. Instead of the platinum crucibles in ordinary use, it is for this purpose preferable, though not indispensable, to use a platinum dish and cover, shaped as shown in Fig. 4, and weighing about 28 grms.

As the rapidity of the operations by this method makes it desirable to heat several crucibles at a time to 105°, and since this requires an air-bath with a really good gas regulator, those hitherto contrived being either of no use or somewhat expensive and too complicated, Dr. Carmichael has contrived the apparatus shown in Fig. 5. Anyone who has acquired some practice in glass-blowing may make it for his own use. Take a glass tube, 40 c.m. long and 0·6 c.m. interior diameter, bend it as shown in the woodcut so as to admit of two of the bends being placed below the false bottom of the air-bath, and the third, the vertical bend, to pass through an opening out of the bath, but so as not to touch the metal the bath is made of; at A, a glass tube of 2 m.m. interior diameter is melted on the wider tube, and shaped as shown at *c*; this narrower tube is branched off into two parts, each so bent as to be on a level together. At *d* and *e* holes are made in these branches in such a manner as to form small nipples towards the outside, which are next nearly closed, and then connected together by means of an india-rubber tube; the lower end of the wide glass tube is sealed, and the top opening closed with a cork, into which, through a carefully made hole, a thin and long glass rod is fitted; the cork should extend to *a b*, so as to exclude air. This contrivance is entirely filled with mercury, and next freed from any adhering air and moisture by heating over a spirit flame; one of the open tubes at *h* and *g* is in connection with a gas supply-pipe fitted with a tap, the other open glass tube with a burner, while the openings at *d* and *e* are so small that the gas which may pass through them is too small in quantity to heat the bath to any extent, whilst, at the same time, these openings serve to prevent the sudden extinguishing of the flame by the rapid expansion of the mercury.

The apparatus is used in the following manner:—

The bath is heated by a gas burner, until the thermometer connected with the bath indicates nearly the requisite temperature; this having been reached, the glass rod, *f*, is pressed down into the mercury contained in the wider tube, until the mercury at *a* nearly touches the part *c*, which should be made as straight (not rounded) as possible. The sensitiveness of this contrivance depends, of course, upon the quantity of the mercury and its adjustment of surface; but if the apparatus is made with care, according to the directions just described, the bath remains to a fraction of a degree at a constant temperature, even in a draught of air or with a change of pressure of gas. The cooling of the mercury in the narrow tubes prevents oxidation of the metal anywhere in the tube.

The following advantages are obtained by the use of the filtering bulb:—

1. The decantation of liquids is avoided.

2. The washing, ignition, and calculation of the filter-ash is entirely dispensed with. For, since the quantity of ash contained in a filter made of the best paper, and of 12 c.m. diameter, amounts to 0·0005 grm., the ash contained in a disc of filtering-paper, as used with this apparatus, would only weigh 0·00002 grm., and even if the paper were of a commoner quality it would make no difference.

3. The velocity of filtration is very great; the water flowing into the beaker in so uninterrupted a current that it appears as if no paper disc were present. When precipitates are to be filtered off, the velocity is somewhat less;

but it is then far more rapid than by the ordinary plan, and not less rapid than by Bunsen's method.

4. Since the filtering-tube dips under the fluid, no air can pass through the precipitate until it has been completely washed.

5. When a mineral has been dissolved, or when two substances have to be separated from each other, instead of, as is done by the ordinary method, placing them in a beaker to be further treated, the precipitate by this method remains in the crucible, and can be ignited directly after filtration.

6. This apparatus serves as a filtering-stand, and also as a syphon and pipette.

7. The whole apparatus may be readily kept from dust, and, if required, any gas can be readily admitted to protect a fluid to be filtered from contact with air, while a boiling solution can also be readily filtered.

8. Even so small a quantity of substance as a couple of milligrammes is sufficient for analysis. With so small quantities the entire precipitate remains fixed to the filtering disc, and may be burnt on the lid of a crucible, while any other very small portion of the substance which may adhere to any part of the apparatus may be readily removed and estimated.

9. The use of this apparatus, and the employment of small quantities of substance for analysis, occupy only about one-third of the time as compared with that required for analyses done by the ordinary plan. As an instance of the advantage of employing this method of analysis, the author quotes the following:—

A mixture was taken of magnesia, chloride of potassium, and common salt, adding thereto some hydrochloric acid so as to convert the magnesia into chloride, expelling any excess of that acid by a gentle heat. The dry saline mass was re-dissolved in water, and oxide of mercury added. The mass was next gently heated in a covered crucible, until all the mercury was volatilised, and the dry residue again treated with water and filtered by means of the filtering-tube above described, by which operation the magnesia was left behind in the crucible. It was then dried in the air-bath and ignited. The solution of the alkalies was next treated in the usual manner with chloride of platinum and alcohol, and the platino-chloride of potassium, after having been separated from the fluid by the filtering-tube, dried at 105°. The small filtering-paper disc, to which hardly a particle of the salt adhered, was removed, and the platino-chloride of potassium, first ignited by itself alone, and afterwards with the addition of the paper disc; the result being that the organic matter of the paper was sufficiently large to cause the reduction of the platinum to the metallic state. The materials left in the crucible were washed with hydrochloric acid to remove any trace of magnesia, and again ignited; the platinum in the filtrate was also reduced to metal, and the chloride of sodium present determined in the usual way, care being taken to remove and estimate the very small quantity of magnesia by means of phosphate of sodium, and to deduct the weight of the magnesia thus estimated from the weight of the chloride of sodium.

The results were as follows:—

	Quantities taken.	Quantities found.
MgO	0·0690 grm.	0·0688 grm.
KCl	0·1873 ,,	0·1852 ,,
NaCl	0·0876 ,,	0·0900 ,,
	0·3439	0·3440

It appears that the chloride of magnesium was completely converted into magnesia again, notwithstanding the small loss of this substance due to the solubility of some of it in the alkalies present; that the quantity of the potassium salt found was deficient is accounted for by the fact that the salt was only washed with dilute alcohol, without any addition of ether to lessen the solubility of the platino-chloride of potassium. The author analysed twice a portion of a mineral, skolezite, from Scotland, taking in the first case 0·985 grm. of substance, and in the other 0·0807 grm., the result being that the percentage composition of the substance was found to be:—

	I.	II.
Silica	46·20	46·35
Alumina	26·28	26·21
Lime..	9·22	9·17
Soda..	5·16	5·10
Water	13·25	13·45
	130·11	100·28

In reference to the difference of the quantity of water, the author observes that the substance had been kept for several months under a desiccator. It is clear that the principle of the apparatus above described may be applied to qualitative analysis, and also in technology on a larger scale, for which purpose a porcelain plate perforated with small holes may be used with a disc of filtering-paper.

CORRESPONDENCE.

WATERING THE STREETS WITH SALINE SOLUTIONS.

To the Editor of the Chemical News.

Sir,—On page 968 of the *Journal of the Chemical Society* for October there occurs the following, taken from *Dingler's Polytechnical Journal*. I will quote the entire abstract:—

"In Hamburg a road-space of 1500 square metres was watered with 5000 lbs. of water, holding in solution 250 lbs. chloride of calcium and 250 lbs. common salt. The surface was well wetted all over. A strong smell of ink was developed, and the road did not remain moist for a perceptibly longer time than when sprinkled with pure water, nor was the formation of a crust to be observed. As the application of a sufficient quantity of salt to a large surface would be costly, and as it would require to be renewed after every heavy rain, it does not appear that the process would be of much value, even if it fulfilled the purpose intended, of absorbing water enough from the air to keep the dust laid.—C. H. G."

I am not aware that any chemist has ever disputed that strong saline solutions do not evaporate so rapidly as common water, or that a very strong solution of chloride of calcium absolutely refuses to dry up at the ordinary temperature of the atmosphere. Most chemists are, indeed, in the habit of observing how, for instance, the lump of chloride of calcium exposed in the balance-case does not become drier but wetter, and, bye and bye, liquefies in the water it absorbs from the atmosphere. The above-recorded observation, viz., that a solution containing 10 per cent of mixed chlorides of calcium and sodium dried up as rapidly as water is obviously false; and it appears rather strange that so sensible a man as Mr. Gill, who made the abstract, and who was for a long time Professor Williamson's assistant, did not append a note to it.

The untrustworthiness of many of these so-called practical facts is notorious, and is occasionally very curiously exemplified.

In the course of last summer a surveyor in one of the London districts observed that the addition of deliquescent salts *accelerated* the drying up of the water!

I wish to place on record in your columns the results of long-continued practice in Westminster—not, indeed, with the object of proving that solutions of deliquescent salts evaporate slower than water, but that the skilful application of deliquescent salts to streets is economical.

The facts are in brief these. In the summer of 1870 and 1871, the Westminster district was watered with a solution of Mr. Cooper's salts, and in both seasons the saving in expense was sufficient to pay for the salts, and to leave a considerable profit to the patentee and to the vestry. Before the salts were used, twenty-two water carts were required to water Westminister; now eleven carts do the work, and the streets of Westminster are in a better condition than before.—I am, &c.,

J. Alfred Wanklyn.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, October 9, 1871.

The only paper met with in this number bearing upon chemistry is:—

Water of the Artesian Well at Rochefort, Charente Inférieure.—Dr. Roux.—This paper contains a detailed account of several geological matters observed by the boring of the deepest Artesian well in existence, viz., 856·78 metres, while those of Grenelle and Passy (Paris) do not quite reach 700 metres. Among the notable observations recorded in this paper we notice the curious fact that the bore-rods used in this work (commenced in 1831 and finished on September 20, 1866) became highly magnetic. The well yields about 3 litres of water per second of time; the water on first reaching the surface is clear, but becomes turbid on standing, owing to loss of free carbonic acid and hence precipitation of earthy salts. The average temperature of this water is 40·6°; its sp. gr. = 1·0053; 1 litre contains:—Nitrogen (reduced to 0° and 760 m.m.), 17·11 c.c.; free carbonic acid (reduced as N), 2·54 c.c.; weight of these two gases together, 0·00504 grms.; free sulphuretted hydrogen, 0·00067 grms.; sulphate of soda, 2·55005; sulphate of lime, 1·80956; sulphate of magnesia, 0·46560; chloride of sodium, 0·77894; chloride of magnesium, 0·03155; chloride of ammonium, 0·00968; bromide of sodium, 0·00392; iodide of sodium, 0·00113; bicarbonate of lime, 0·11057; bicarbonate of magnesia, 0·02699; bicarbonate of protoxide of iron, 0·05066; bicarbonate of protoxide of manganese, 0·00015; arseniate of protoxide of iron, 0·00067; silicate of potassa, 0·00421; silicate of alumina, 0·00720; traces of silicate of lithia, of phosphate of protoxide of iron, and of copper; organic matter (akin to crenic and apocrenic acids), 0·00067; combined water, 0·10200; chloride of calcium, 0·01720; loss, 0·01000; total, 5·98606 grms.

Bulletin Mensuel de la Société Chimique de Paris, January, February, and March (one number), 1871.

Although this small volume is published, as indicated on the title-page, for the months above named, it contains the *extraits* from the *procès verbaux* of the meetings of this society held in June, July, and August last, from which we quote the following particulars:—

Contribution to the History of the Saccharine Substances.—Dr. Maumené.—The author states that large and well-defined crystals of the combination of sugar and chloride of sodium may be obtained by first evaporating on a water-bath a syrup which, upon 100 parts of sugar, contains 13 parts of common salt. The crystalline mass is then put into a funnel, and the mother-liquor several times poured back on the solid substance; by this operation there will be obtained in the filtrate large-sized prismatic crystals, the composition of which is $C_{24}H_{22}O_{22}NaCl+4HO$. The rotatory power of the sugar thus combined is not altered, and by treating the compound with nitrate of silver the sugar is regenerated.

Influence of the Variation of Temperature upon the Mode of Decomposition of Explosive Compounds.—Dr. Jungfleisch.—Alluding to Professor Abel's explanation respecting some of the phenomena of the explosion of detonating compounds, the author states that from his experiments on this subject he is inclined to infer that the phenomena are due to the degree of temperature to which the substances are submitted. This opinion is also shared by Drs. Berthelot and Maumené, who brought the following instances in support of their views:—When nitrate of ammonia is suddenly heated it yields, in addition to water and protoxide of nitrogen, also binoxide of nitrogen and nitrous acid; while, when upon nitrate of potassa kept fused at 337° a piece of the charcoal is placed, it remains black, deutoxide of nitrogen being evolved; but a slight increase of temperature produces a sudden decomposition attended with deflagration.

Polariscopic Rotatory Power of the Alcohols of the Amylic Series.—Dr. Ribau.—A tabulated form exhibiting the amount of rotatory power expressed in degrees of arc of the liquids alluded to.

Experiments Made with the View to Ascertain whether the Two Chlorinated Propylens Derived from the Methyl Chloracetol and the Chloride of Propylen are Identical.—Drs. Friedel and Silva.—As regards the main point, the authors conclude that identity exists; they incidentally observe that the action of chlorine upon propylen is considerably modified by the action of direct sunlight, since in diffused light or complete obscurity a substitution product is formed, viz., a compound, $C_3H_4Cl_2$, boiling at 92° and absorbing bromine with great avidity, forming a chlorobromide, $C_3H_4Cl_2Br_2$, boiling at 205°; in direct sunlight, chlorine is simply fixed without evolution of hydrochloric acid and formation of terchloride, $C_3H_5Cl_3$, boiling at from 122° to 124°; the chlorinated propylen derived from the chloride of proplen is similarly acted upon.

Relation Existing between Tannic and Gallic Acids.—Dr. H. Schiff.—Tannic acid is digallic acid according to the author, the gallic acid yielding by oxidation ellagic acid and another substance endowed with all the properties of tannin. This substance is termed digallic acid, $C_{14}H_{10}O_9=2C_7H_6O_5-H_2O$; by the action of sulphuric acid the digallic acid is converted into rufigallic acid, which on being distilled with zinc-dust yields anthracen.

The original papers and memoirs published in this number, having been also published in other periodicals which we received at an earlier date, have been already referred to.

Les Mondes, October 19, 1871.

This number opens with the announcement of an honour conferred upon the excellent editor, who has received from the Pope the honorary degree of Doctor of Theology, a very high distinction indeed, and the more so as the Apostolic brief (of which the Latin text and a French translation are reproduced in full) intimates that this honour is conferred on Monsieur l'Abbé F. Moigno on account of his scientific labours.

Among the original papers contained in this number we notice the following:—

Unity of Matter.—Dr. Lamy.—The first instalment of a series of papers on chemical philosophy; this portion treats on the formula of acetic acid.

Use of Felspar as Manure.—Rev. Mouzot.—This paper gives a short account of the results obtained by the use of felspar where that mineral abounds and is physically so constituted as to be readily disintegrated, even when being crushed or pulverised previous to being applied to the soil. The felspar contains, as is well known, potassa, and may therefore be useful to the soil, but, as herein stated, the effect upon the vegetation is slow, and the quantity of this mineral to be used per acre rather large.

Obituary.—Under this heading we regret, in the first place, to have to record the death of Dr. Barreswil, well and deservedly known both as an excellent scientific chemist and one of the most eminent technologists of France, the author of the well-known titration process of sugar testing, and, as we learn from the brief notice, also a sound and active philanthropist. Another well-known person, whose death, at the age of 55 years, is here announced is the eminent sugar-refiner, Constant Say, the nephew of the celebrated economist, J. B. Say, and the cousin of the present Préfet de la Seine. The large sugar-refinery founded by the deceased is capable of working 280,000,000 kilos. (280,000 tons) of sugar annually; during the late siege of Paris, that place was supplied by the water from the Artesian well bored at this refinery, the yield of water of that well surpassing that of any known well of the kind. France loses in M. Say one of its most eminent industrial men, and one also who with his immense wealth did a very great deal of good.

Polytechnisches Journal von Dingler, second number for September, 1871.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

On a New Steam-Gauge.—Dr. C. V. Zenger.—After pointing out the defects of the different gauges now in use for ascertaining the pressure of steam in boilers, the author describes at great length and illustrates with engravings an instrument which, while simple in its construction, is undoubtedly free from the defects alluded to and inherent to the gauges in general use; moreover, this instrument may be arranged for vacuum guage and for measuring the force of wind.

Continuation of the Studies on the Blast-Furnace and Iron Manufacture.—C. Schinz.—This portion contains the following sections:—Ferrie's auto-coking furnace at the Monkland iron-works; pressure of the blast; what quantity of air is really required. To be continued.

Areometrical Analysis of Beer.—A. Metz.—The description illustrated by a series of algebraical formulæ, of a process of determining in beer—after having been as much as possible deprived of the carbonic acid it contains—by means of a very sensitive areometer, the quantity of extract and alcohol it contains.

General Exhibition at Vienna, 1873.—Dr. von Schwarz-Senborn.—From this paper we quote the following particulars respecting the size, in square metres, of the following Exhibition buildings:—London

(1851), 81,591; Paris (1855), 103,156; London (1862), 186,125; Paris (1867), 441,750; intended building at Vienna, now in course of construction, 2,330,631; the length of the main building will be 950 metres, more than half an English mile.

Bayerisches Industrie und Gewerbe Blatt, July, 1871.

Among the official communications published in this number we briefly notice the following:—

Establishment of a Course of Lectures on Statistics at the Royal Bavarian Ministerial Department of Commerce and Public Works.

Police Regulations on Steam-Boilers for Germany.

Petition Addressed to the German Imperial Parliament for the Introduction of a General Patent Law for Germany.

This number further contains the following original matter relating to chemistry and collateral sciences:—

Description of a Washing Apparatus.—M. Neubecker.—The apparatus herein described and illustrated with engravings appears to possess decided advantages over those in general use.

Method of Coating Metallic Objects with a Very Durable Black-Brown Varnish.—C. Puscher.—On the bottom of a cylindrical cast-iron vessel, 18 inches high, is placed a layer, ½ inch thick, of coal-dust; upon this is placed an iron grating, and thereon are put the iron, steel, or other metallic objects intended to be coated with the varnish. The vessel, having been first closed with a well-fitting lid, is next placed on a bright coke fire, and heated for about a quarter of an hour just to incipient red heat. The vessel is then removed from the fire, and on the lid being removed, after about ten minutes, the metallic objects will be found coated very uniformly with a good and durable varnish, which resists bending, as well as a high temperature, without cracking or coming off. Very small objects, such as hooks-and-eyes for instance, are better placed along with some coal-dust in a coffee-roasting apparatus, and this turned, as is usual in the roasting of coffee, until the metallic objects have obtained the desired depth of colour and are uniformly coated with the varnish.

La Revue des Scientifique de la France et de l'Etranger, October 7, 14, and 21, 1871.

These numbers do not contain any original papers relating to chemistry and allied sciences.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 14, 1871.

This number contains on the title-page a polite request of the Treasurer of this Society, reminding members who have hitherto forgotten to pay their contributions to do so without delay. For the members resident in the United Kingdom, Messrs. Hopkin and Williams, 5, New Cavendish Street, London, W., are the parties to whom payment can be made; the Treasurer at Berlin is Dr. E. Schering, 21, Chaussestrasse.

The original papers contained in this number are the following:—

Calculation of the Heat Evolved by Decomposition.—A. Naumann.

On Melolonthin, a New Crystalline Nitrogen- and Sulphur-Containing Material met with in the Animal Organism.—P. Schreiner.—The substance just named has been found, along with leucin, sarkin, traces of xanthin, large quantity of urates and of oxalate of lime, in the body of the *Melolontha vulgaris*, cockchafer. The insects having been crushed and exhausted with water, this liquid is first boiled, in order to eliminate albumen compounds; after filtration, the previously somewhat evaporated and thereby concentrated liquid is precipitated with acetate of lead, again filtered, and the filtrate treated with sulphuretted hydrogen. The sulphuret of lead having been removed by filtration, the filtrate is again evaporated, so as to allow of the urates being precipitated. After having been further concentrated, the author observed, first separate crystals of leucin, and then another body, which, having been purified by re-crystallisation from its aqueous solution, was obtained in well-defined hard glossy crystals, difficultly soluble in cold, more readily so in hot water, also difficultly soluble in ordinary alcohol, and quite insoluble in absolute alcohol and ether, but readily soluble in some of the caustic and carbonated alkalies, in sulphuric, nitric, hydrochloric, and tartaric acids, and also in water containing a small quantity of ammonia; acetic acid dissolves this substance difficultly. The aqueous solution of melolonthin does not affect vegetable colours; when a solution of melolonthin is boiled along with a solution of oxide of lead in caustic potassa, sulphuret of lead is formed. The elementary composition of melolonthin is $C_5H_{12}N_2SO_3$. From 30 lbs. of the insects the author only obtained 1·56 grms. of melolonthin.

On a New Phosphorus Oxychloride, the Pyrophosphoric Acid Chloride.—A. Geuther and A. Michaelis.—After observing that of the chlorides of phosphoric acid only that of the ordinary phosphoric acid, $POCl_3$, is known, while the chlorides of the metaphosphoric acid, PO_2Cl, and that of the pyrophosphoric acid, $P_2O_3Cl_4$, are, or as far as the latter is now concerned were, unknown, the authors proceed to describe at length the method by which they succeeded in preparing the last-named compound. The preparation, which requires some caution, consists mainly in treating terchloride of phosphorus with nitrous acid. The product resulting from that reaction is rectified by distillation at from 210° to 215°, yielding a colourless fluid which cannot be distilled without partial decomposition; the vapours of this body are akin to those of anhydrous sulphuric acid, and destroy corks; sp. gr. of the liquid, viz., $P_2O_3Cl_4$, at 7° = 1·58. Addition of water to this body decomposes it at once, heat being evolved and hydrochloric acid and ordinary phosphoric acid; the rational formula of this phosphorus oxychloride is—

$$\overset{v}{P}\overset{O}{\underset{Cl_2}{O}} - - -\overset{v}{P}\begin{smallmatrix}O\\Cl_2\end{smallmatrix} \text{ or } \overset{v}{P}OCl_2 - - - O - - - \overset{v}{P}OCl_2.$$

Capability of Crystallisation (Krystallisations Fähigkeit) of the Ordinary Oxychloride of Phosphorus and of the Oxybromochloride of Phosphorus.—A. Geuther and A. Michaelis.—The authors have found that the ordinary oxychloride of phosphorus when cooled to −10° remains fluid, but solidifies at once when touched with a glass rod, yielding long-sized needle-shaped crystals, which melt at −1·5°. The oxybromochloride of phosphorus when cooled down below 0° also yields crystals, which melt again at +11°.

Detection of Phenol and Bodies related thereto by means of Bromine-Water.—H. Landolt.—While engaged in testing a well-water contaminated with gas-liquor (ammoniacal water of a coal-gas work), it occurred to the author to try to detect phenol in the well-water. After having vainly tried some of the more ordinary reagents of phenol, bromine-water was employed, and observed to yield, when added in excess to a portion of the well-water, at once a yellowish-white coloured precipitate of tribromphenol, which, being insoluble, is a very characteristic, and, as found by expressly-made experiments with pure phenol, renders 1 part of that substance distinctly discernible in 437,000 parts of water. 1 part of phenol in 571,000 parts of water does not yield immediately a precipitate upon the addition of bromine-water, but after standing some time a crystalline substance, tribromphenol, makes its appearance. Phenol may be detected by the peculiar odour it has when 1 part of that body is present in 2800 parts of water. The author states that bromine-water may be used for the quantitative estimation of phenol, by collecting the precipitate of tribromphenol upon a previously-weighed filter, and drying it over sulphuric acid. The molecular weight of tribromphenol, $C_6H_3Br_3O$, is 331. In order to test whether a precipitate obtained by bromine-water is due to phenol, collect the sediment upon a filter, wash it with water, and then place the precipitate along with sodium amalgam and some water in a test-tube; after the application of a gentle heat the fluid is poured into a small evaporating basin, and sulphuric acid added, whereby the characteristic odour of phenol is emitted, and small drops of that substance may be seen floating in the fluid. As the best means to test any well-water suspected to contain traces of gas-liquor, the author advises that a larger quantity of the water should be first acidulated with sulphuric acid, then submitted to distillation, and the first quantity collected in the well-cooled receiver should be treated with bromine-water. The remainder of this very exhaustive paper is devoted to the description of the reactions which many substances, such as, for instance, aniline, toluidine, quinine, &c., yield with bromine-water.

Difference of Energy (Energie Differenz) Displayed by Phosphate af Soda Containing a Different Quantity of Water of Crystallisation.—L. Pfaundler.—Notwithstanding the high scientific value of this paper, treating on a subject bearing upon the mechanical theory of caloric, its contents are not suited for useful abstraction.

On Sulphobromide of Phosphorus.—A. Michaelis.—The substance referred to (discovered by Baudrimont and described by him in the *Comptes Rendus*, i., pp. 111, 517) has been studied anew by the author, who states that it crystallises in octahedra, gives off an aromatic but very pungent smell, fuses at 35°, is readily soluble in ether, sulphide of carbon, and bromide of phosphorus, and is not so readily decomposed by water as might be expected. The products of this decomposition are sulphuretted hydrogen, sulphur, phosphoric and phosphorous acids. In contact with ammonia, the sulphobromide of phosphorus is slowly decomposed in the cold, more rapidly when heat is applied; the products of this decomposition are the same as those formed by the action of water. When sulphobromide of phosphorus is prepared, according to Baudrimont's process, by the reaction of sulphuretted hydrogen upon superbromide of phosphorus, the product should be first heated with water for eliminating non-decomposed superbromide, next the substance is placed between folds of blotting-paper, and then dissolved in sulphide of carbon; the adhering water having been withdrawn by fused chloride of calcium, the sulphide of carbon leaves after its evaporation the sulphobromide of phosphorus in crystalline state.

Note on Artificial Alizarine.—R. Bœttger and T. Petersen.—This paper is illustrated with a spectrum absolutely required for the due understanding of the contents.

Tension of Dissociation of Carbaminate of Ammonia.—A. Naumann.—The contents of this lengthy and highly valuable essay, elucidated by several tabulated forms, are not suited for abstraction.

Behaviour of some of the Diazo-Compounds with Alkaline Sulphites.—A. Strecker.—The following compounds are mentioned in this essay:—Combination of diazo-benzol with sulphite of potassa (formula of the salt dried at 120°, $C_6H_7N_2SO_3K$), contains 7·4 per cent of water of crystallisation driven off at 120°; the salt is insoluble in alcohol, and very difficultly so in water; when heated with soda-lime, neither N nor aniline are evolved. Diazo-benzol-sulpho acid, forms when acted upon by sulphite of potassa a solid crystalline mass, readily soluble in boiling water, slightly soluble in alcohol; solutions exhibit acid reaction to test-paper; formula of the compound, $C_6H_8N_2SO_3$. This paper also contains some theoretical views on the constitutional formula of the diazo-compounds, illustrated by a series of complicated formulæ.

On Fore-Run.—G. Krämer and A. Pinner.—This essay is mainly written in defence of the papers published by the authors on this matter (relating to the by-products of the distillation of spirits) against the views held on this subject by Dr. Kekulé.

Chemistry at the Forty-Fourth Meeting of German Natural Philosophers and Physicists at Rostock (Mecklenburg-Schwérin), September, 1871.—V. Meyer.—This extensive paper contains a report of the proceedings of the Chemical Section of this association, which section was presided over by Dr. Schulze, Professor of Chemistry at the celebrated and ancient University of Rostock (a town of some 30,000 inhabitants). The savant just named exhibited the formation, by direct oxidation of carbon (pure), of an acid which has been provisionally named anthraconic acid, but which in many of its reactions and combinations appears to be, if not quite identical with, at least akin to mellithic acid. Owing to the importance of this subject, the author, assisted by Drs. Carstanjen and Baeyer, performed at a later meeting a series of experiments which leave no doubt whatever that pure carbon may be made to yield by its oxidation mellithic acid, which, on being distilled along with soda-lime, gave benzol, and this, having been nitrated, yielded after reduction aniline. Mellithic acid occurs now and then native in brown-coal deposits. The same author describes a modification of Schlösing's method of the estimation of nitrates in potable water, which consists in the use of a peculiarly constructed flask wherein the water to be tested, after previous concentration on a water-bath, is first boiled, and a partial vacuum having been produced, a mixture of hydrochloric acid and perchloride of iron is introduced into the flask, whereby, if nitrates are present, deutoxide of nitrogen is formed, which is collected in a graduated tube made on purpose for this use by M. Giessler, at Bonn. The small quantity of air carried over with this gas is, before measuring its bulk, absorbed by a solution of protochloride of iron. It is not practicable to enter here into further details on the subjects which were *viva voce* and briefly treated of at this meeting, and are here only cursorily mentioned. The speakers all intend to publish their researches in this or other periodicals.

La France Scientifique (Ancien Cosmos), October 8, 1871.

In addition to subject-matter more particularly bearing upon and of interest to France, this number contains an excellent original paper:—

On Comparative Geology.—Dr. S. Meunier.

October 15, 1871.

This number does not contain any original papers or memoirs relating to chemistry or collateral sciences.

October 22, 1871.

The only original paper more strictly relating to exact sciences published in this number is:—

Social Philosophy of Sciences.—Dr. V. Meunier.

NOTES AND QUERIES.

Lute.—Can any of your readers acquaint me with a cheap and effective lute for wood retorts? It would have to resist the vapour of crude wood or acetic acid.—W. S.

Purifying Coal-Gas.—Can any of your readers give me the best way, on a small scale, of freeing coal-gas from impurities for laboratory use, or when heating, not illuminating, power is necessary?—M. H.

MEETINGS FOR THE WEEK,

Monday, Nov. 6th.—London Institution, 4. Prof. Huxley, LL.D., F.R.S., on "Elementary Physiology (II.)."
—— Royal Institution, 2. General Monthly Meeting.

TO CORRESPONDENTS.

A. E. Reed.—Your letter has been handed to the writer of the article. Professor Abel's address is Woolwich Arsenal.

Alpha.—Apply to Kuhlmann and Co., Lille, France, for commercial information on all compounds of baryta.

E. R.—Cooley's "Cyclopædia of Practical Receipts."

J. Higgin.—Schützenberger's "Traité des Matières Colorantes Comprenant leurs Application à la Teinture," &c. 2 vols; Paris: Victor Masson. The Editor's work on the subject is in the press.

J. M. Merrick.—The paper was published in our issue of October 13, No. 620.

Dr. W. M. Watts, Marshall Hall, J. E. Wright, R. Routledge, T. Fletcher.—Received with thanks.

NOTICE TO AMERICAN SUBSCRIBERS.

In answer to numerous inquiries, the Publisher begs to state that Subscribers in the United States can be supplied with the CHEMICAL NEWS from this Office, post free, for the sum of £1 2s. 4d. per annum payable in advance.

PRACTICAL CHEMISTRY.

Laboratory, 60, Gower Street, Bedford Square, W.C.

Mr. Henry Matthews, F.C.S., is prepared to give Instruction in all branches of PRACTICAL CHEMISTRY, particularly in its application to MEDICINE, AGRICULTURE, and COMMERCE.

The Laboratory is open daily, except Saturday, from ten to five o'clock; on Saturday, from ten till one o'clock.

Mr. Matthews is also prepared to undertake ANALYSES of every description.

For Particulars and Prospectuses, apply to Mr. Henry Matthews, the Laboratory, 60, Gower Street, Bedford Square, W.C.

BERNERS COLLEGE of CHEMISTRY.—EXPERIMENTAL MILITARY and NAVAL SCIENCES, under the direction of Professor E. V. GARDNER, F.E.S., &c.: of the late Royal Polytechnic Institution and the Royal Naval College.

The Laboratory and Class Rooms are open daily.

Especial facilities for persons preparing for Government and other examinations.

Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

For particulars, &c., apply to Prof. E. V. G., 44, Berners-street, W.

North London School of Chemistry, Pharmacy, &c.—For Instruction in Practical Chemistry and Evening Classes for the Study of Chemistry, Botany, Materia Medica, &c. Conducted by Mr. J. C. BRAITHWAITE, *for thirteen years Principal Instructor* in the Laboratories of the Pharmaceutical Society of Great Britain, and Demonstrator of Practical Pharmacy, Pharmaceutical Latin, &c.

Mr. Braithwaite, having taken the premises adjoining his house, has been enabled *nearly to double the size of his Laboratories*, and, at the same time, procure a large piece of ground which *he has had laid out as a Botanic garden*. Every facility is, therefore, offered to Students desirous of acquiring a practical knowledge of this branch of their education.

The Session 1871—1872 will commence on the 2nd of October, when the Laboratories will re-open at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

THE CHEMICAL and TOXICOLOGICAL CLASS will meet as usual every Monday and Thursday evening, commencing October 2nd, at 8 p.m.

The LATIN CLASS for the reading of Physicians' Prescriptions, Cæsar's Commentaries, &c., every Tuesday and Friday evening, commencing October 3rd, at 8 p.m.

The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday evening, commencing October 4th, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will be continued every Saturday, until further notice, at 10 a.m.

Fee to either of the above Classes Half-a-Guinea per Month. Pupils can enter at any period.

Gentlemen Privately Prepared for the Examinations of the Pharmaceutical Society, and the "Modified Examination for Assistants," &c

All Fees must be paid in advance.

Letters of inquiry should be accompanied with a stamped envelope.

Mr. Braithwaite receives a few Pupils to Board in his house.

Address—54, Kentish Town Road, N.W.

ANALYTICAL LABORATORY AND SCHOOL OF TECHNICAL CHEMISTRY.

7 and 9, HACKIN'S HEY, LIVERPOOL.

Conducted by A. NORMAN TATE, Analytical and Consulting Chemist, and Chemical Engineer.

Established for Educational Purposes connected with Chemistry in its practical Applications to Manufactures, Commerce, &c.; for the performance of Analyses, Assays, and Chemical Investigations; and for affording information respecting the construction, &c., of Chemical Manufactories, and the conduct of Chemical Manufacturing Processes.

The Course of Instruction, in addition to the ordinary Chemical studies, comprises, as far as possible, all such other subjects as are necessary to give the scientific and practical information required in the Arrangement, Construction, and Management of Chemical Manufactories, and in the Application of Chemistry to Industrial Pursuits.

Students' Fees may be known on Application.

Plans, &c., for Chemical Apparatus and Manufactories are supplied, and the Erection of Plant and Buildings is superintended when required.

Water-glass, or Soluble Silicates of Soda and Potash, in large or small quantities, and either solid or in solution, at **ROBERT RUMNEY'S, Ardwick Chemical Works, Manchester.**

THE CHEMICAL NEWS.

Vol. XXIV. No. 624.

NOTES OF

DEMONSTRATIONS ON PHYSIOLOGICAL CHEMISTRY AT ST. GEORGE'S HOSPITAL.

By S. W. MOORE.

II.

Casein is a variety of albumen contained in milk, not coagulable by heat, but readily with acids. To obtain it, evaporate milk to dryness, digest with ether to remove fat, dissolve in water, and precipitate with alcohol.

It is supposed that the solubility of casein is due to free alkali, and its spontaneous coagulation to the neutralisation of this with lactic acid generated by decomposition; it is not known how rennet acts when coagulating milk.

$MgSO_4$ + milk + heat, produces a pasty mass. Human milk contains about 3·0 per cent of casein; the ash of casein varies considerably. Mulder, 3·8 per cent; F. Simon, 7·0 per cent.

Cheese is impure casein, milk curdled by rennet, and pressed; flavour of cheese dependent on decomposition, the products being NH_3, valerianic and butyric acids; old cheese is thus the most highly flavoured.

Cheese + CaH_2O_2 produces a tenacious paste.

Gelatinous Substances.

These substances do not exist in the body, but are formed by the action of boiling water. The tissues from which they are obtained are identical in composition with gelatin. Gelatin and its allies are derivatives of albumen, and are not to be obtained from any but structures serving a mechanical purpose; structures, as muscle, which are converted into force yield albumen (fibrin). Gelatin not existing in actively vital tissues does not minister to the support of the animal economy; this is proved to be correct by experiments on dogs, &c.

Gelatin is insoluble in cold water, freely soluble in hot; a solution containing 1 per cent solidifies on cooling.

Isinglass, glue, and size are modifications of gelatin. It is precipitated from solution by alcohol, HgCl, and tannin. Chlorine gas precipitates gelatin freely.

Ca_32PO_4 is readily dissolved and taken up by gelatin; this is admirably exemplified in bone.

H_2SO_4 dissolves gelatinous bodies, and converts them into glycocin (glycocoll) and leucin. KHO also produces leucin amongst other things during decomposition.

Chondrin contains less oxygen than gelatin, and differs on being precipitated by $C_2H_4O_2$, alum, and plumbic acetate.

By oxidation converted to gelatin, it is found in the permanent cartilages, also in fœtal cartilage before ossification has commenced.

So-called Bases of Animal Origin.

These are mostly the result of the disintegration of force-producing tissues. They all contain N in large quantities, and are found mostly in the excreta.

Urea (CH_4N_2O); colourless, crystallises in prisms, deliquescent; contains more N than any other definite compound; it seems to be the means of carrying most of the waste N out of the system.

It occurs most abundantly in the urine; it is excreted from the blood by the urine to the extent of 1¼ ozs. daily. The urine of carnivora contains it more largely than that of other animals.

Urea is metameric with NH_4,CNO; and may be formed from it by evaporating a solution to dryness over a water-bath.

Heated to 120° C. urea melts; at a somewhat higher temperature decomposes; NH_3 and cyanate and carbonate of ammonium being formed, cyanuric acid is left in the retort; the temperature being raised, melanuric acid is formed, and this, at a still higher temperature, is converted to mellon (C_9N_{13}), familiar to us as the yellow coating of Pharaoh's serpents. Biuret is obtained by heating urea at 170° C.; this body is very stable, it may be dissolved in concentrated mineral acids without decomposition.

Urea combines both with acids and bases; in one case forming such bodies as nitrate of urea, and in the other such as its mercuric salt ($2CH_4N_2O,3HgO$). Some remarkable and interesting bodies known as compound ureas are formed by substitution of various radicles for H.

Kreatin and kreatinin are compounds similar to urea; they are found in urine, the juice of muscle, &c. Kreatin, $C_4H_9N_3O_2,H_2O$, about 5 grs. in 1 lb. of flesh; cod-fish contains more than other flesh.

Kreatinin, $C_4H_7N_3O$, occurs with kreatin, but may be formed by boiling the latter substance with HCl. Sarkosin and guanin are similar but unimportant bodies.

There are three bodies which are closely allied in properties forming homologous acids when acted on by nitrous acid; these are glycocin, alanin, and leucin. Glycocin, or glycocoll, the result of boiling gelatin in H_2SO_4, gives glycolic acid. Alanin gives lactic acid.

Leucin (obtained by fusing cheese with KHO, dissolving in hot water, supersaturating with $C_2H_4O_2$, filtering, evaporating mother-liquor, and crystallising) gives leucic acid.

Glycocin,	$C_2H_5NO_2$	Glycolic,	$HC_2H_3O_3$.
Alanin,	$C_3H_7NO_2$	Lactic,	$HC_3H_5O_3$.
Leucin,	$C_6H_{13}NO_2$	Leucic,	$HC_6H_{11}O_3$.

NOTE ON THE CHROMIUM OXYCHLORIDE DESCRIBED BY HERR ZETTNOW

IN

"Poggendorff's Annalen der Physik und Chemie," No. 6, 1871.

By T. E. THORPE, F.R.S.E.

In the above-mentioned number of *Poggendorff's Annalen*,* Herr Emil Zettnow describes an oxychloride of chromium to which he assigns the formula $Cr_2Cl_4O+4CrO_3$. It is obtained by heating potassium chlorochromate—

$$K_2Cr_2O_6Cl_2$$

with strong sulphuric acid, and after a somewhat tedious course of preparation appears as a brownish black, brittle, amorphous substance, exceedingly hygroscopic, and giving up its chlorine with great ease. Herr Zettnow's analytical results and the numbers required by his formula are—

	Found.	Calculated.
Cr	47·28	47·23
Cl	22·31	21.42
O	—	31·35
		100·00

In the *Proceedings of the Literary and Philosophical Society of Manchester* for November 2, 1869† I described a solid chromium oxychloride obtained by simply heating chromyl dichloride in a sealed tube, and which, on completely freeing from the latter body, "appears as a black non-crystalline powder, which, when exposed to the air, rapidly deliquesces to a dark reddish-brown syrupy liquid which smells of free chlorine (*loc. cit.*). These properties,

* See also Chemical News, vol. xxiv., p. 133.

† Chemical News, vol. xx., p. 245. *Zeitschr. für Chemie*, Jan. 1870, p. 95.

it will be observed, are precisely those which Herr Zettnow describes as belonging to his chromate of chrom-oxychloride. On analysis it yielded as the mean of four determinations made on different preparations:—

Cl	21·06
Cr	48·91

numbers approximating to those obtained by Herr Zettnow. To this compound I was induced, for reasons which I need not here reproduce, to give the formula—

$$ClCrO_2.O.Cr''O.CrO_2Cl,$$

and to regard it as the chromium term of a series of salts a few members of which had already been described by Peligot, viz.:—

Potassium chlorochromate	$ClCrO_2.O.K_2.O.CrO_2Cl$
Sodium ,,	$ClCrO_2.O.Na_2.O.CrO_2Cl$
Ammonium ,,	$ClCrO_2.O.(NH_4)_2.O.CrO_2Cl$
Magnesium ,,	$ClCrO_2.O.Mg.O.CrO_2Cl$
Calcium ,,	$ClCrO_2.O.Ca.O.CrO_2Cl$

The above formula for the chromium chlorochromate requires—

Cl	21·86
Cr	48·54

From the close agreement in the analytical results and correspondence in their physical properties, I am inclined to believe that Herr Zettnow's compound is identical with mine. Potassium chlorochromate heated with sulphuric acid yields, among other products, chromyl dichloride, and, doubtless, Herr Zettnow's compound has been derived from this body under circumstances analogous to those in which I have already operated.

As my little notice on this matter has evidently not come under Herr Zettnow's observation, he may be interested to learn that the six or seven weeks time which he finds necessary to give to the preparation of this rather uninteresting compound may be considerably shortened by simply heating the chromyl dichloride in a closed vessel, when, in a few minutes, it may be transformed in any wished for quantity almost completely into the chromium chlorochromate and free chlorine.

ON THE

ESTIMATION OF SULPHUR BY BARIUM.

By R. GLENDINNING and A. EDGER,
Newcastle-on-Tyne.

Owing to some delay we did not receive the Chemical News of the 13th ult., until a week after its publication, and were thereby late in seeing the remarks of Messrs. Teschemacher and Smith upon our paper on the above subject.

They quote from our article, "We attribute this (film) to sulphate of iron." Now the above quotation taken by itself is calculated to destroy the meaning of our explanation of the cause of the "film" of sulphate of baryta.

To save our readers the trouble of reference, we beg to lay before them the passage to which Messrs. Teschemacher and Smith have taken particular exception:—

"The fact that sulphate of baryta is gradually deposited when the clear filtrate and washings are allowed to stand for some time, will admit of a different explanation than that offered by them, that (sulphate of barytes is noticeably soluble in hot and but moderately diluted hydrochloric acid). We attribute this to sulphate of iron, which is invariably carried down with the sulphate of barytes, and which appears on treatment with hydrochloric acid after the precipitate has been freed from chloride of barium."

The natural inference to be drawn from the above remarks by any one at all familiar with chemical reactions, would be that, on the sulphate of iron in the acid washings coming in contact with the chloride of barium in the filtrate, a precipitation of sulphate of barytes would result.

We did not deem it necessary to take up the valuable space of the Chemical News by entering into such superfluous explanations. The object of our paper was simply to state facts which our long experience in the testing of sulphur ores had brought under our notice, not to excite the animosity of Messrs. Teschemacher and Smith. It is to be regretted that our having ventured to disagree with these gentlemen should have caused them to show their disapproval in such strong terms.

REPORT ON THE

MOLECULAR DISSOCIATION BY HEAT OF COMPOUNDS IN SOLUTION.*

By CHARLES R. C. TICHBORNE, F.C.S., M.R.I.A., &c.

(Concluded from p. 213).

Addendum.

On the Transition of Compounds from the Colloid to the Crystalloid Condition.

In part 1 of this report reference has been frequently made to the fact that ferric, chromic, and aluminic oxides and their compounds are capable of taking the colloidal form. It may be necessary to explain what the author means in reference to this point.

Now there is a peculiar character of crystallisation discerned in minerals which is always indicative that the constituents had been previously in this colloidal condition, and had afterwards become crystalloidal. In most cases, this change proceeds from assimilation of water of crystallisation, but not necessarily so. The characteristic which I wish to specify is where the crystals radiate from a centre and form in the aggregate what may be termed the radial spherical system. It includes many of the forms technically known as nodular, mammellated, botryoidal, and reniformed masses. Such minerals are formed in most cases from aqueous solutions, which had evidently been at one period under the dissociating influence of heat. The iron, manganese, and lime minerals, and also the zeolites, exhibit these peculiar forms most strikingly, but none more so than that beautiful mineral wavellite. The mode by which this form of crystallisation is produced cannot be more strikingly exhibited than by an organic salt which I described some years ago, viz., chlorate of quinia. Although this substance is organic the formation can be more easily observed in such a case than in the minerals, where time and pressure are such important elements that it is not capable of experimental verification.

If a very strong and boiling solution of chlorate of quinia be allowed to cool, we find that when the solution arrives at a temperature of about 47° C. the salt begins to fall out, but not in a crystalline form. On examination with a magnifying lens it will be seen that it is separating in globules, which, from the natural laws of fluids floating in fluids, take the shape of perfect spheres. There is generally one large sphere surrounded by a number of small ones which frequently coalesce, showing that they are simply obeying the ordinary laws of gravity of mass. The colloid spheres after some time become crystalline. Thus, starting from the centre, crystals shoot out to the periphery and produce those elegantly arranged masses so well shown in wavellite. Indeed, the salt chlorate of quinia, when viewed in the vessel in which it is crystallised, bears such a wonderful resemblance to that mineral that this salt might be aptly termed organic wavellite. If we make a section of one of the globes of wavellite, we shall generally find that

* Read before the Royal Irish Academy, April 24, 1871.

outside of the general mass is a layer of crystals which are evidently a distinct supplementary formation. This would seem to be a further formation of the mineral after it had ceased to be deposited in the colloid spheres, or, perhaps, the alteration in character of the mineral from a change in the temperature at which the mineral was no longer deposited in its colloidal condition. Two conditions of deposition are likewise observed in the organic salt. This outside layer generally forms but a small proportion to the mass of the sphere in the mineral. The conversion of the compounds of the trioxides into the colloidal state on heating their solutions is rendered probable by their slowness in crystallisation, and from the spherical form of crystallisation so frequently observed in the minerals of this group. Many of their salts also exhibit this phenomenon. Thus, if a solution of hydrated ferric chloride is crystallised by slow evaporation, distinct and well-formed crystals of the salt are produced; but if it is evaporated by heat to a strong solution to such a point that there is a limited amount of available water, it crystallises by re-absorption of atmospheric moisture in the spherical form,* from the radii striking out to what must evidently have been the periphery of colloidal separations.

ON THE ESTIMATION OF ANTIMONY,

AND THE

SEPARATION OF ANTIMONY FROM TIN, FROM ARSENIC, FROM TIN AND ARSENIC, AND FROM THE OTHER METALS, BY MEANS OF A NEW PRECIPITATING REAGENT OF ANTIMONY.

By HUGO TAMM.

(Concluded from p. 209).

Estimation of Antimony in Antimony Regulus.

Twenty grs. of the metal finely powdered are attacked by hydrochloric acid, to which powdered chlorate of potash is added little by little until all the metal is taken up. Aqua regia might be used instead of the former mixture, but chemists could not be warned too much against using this double acid when the gallic acid process is employed.

In these operations, antimony is of course dissolved in the state of perchloride, which is, even in solution, a very volatile substance.

By reason of a phenomenon not well studied yet, it is only with an extreme difficulty that the nitro-chlorinated fumes evolved by aqua regia can be made to leave perchloride of antimony, with which they appear to form a combination remarkable for its stability. Indeed, it is almost impossible to free perchloride of antimony from these fumes without volatilising part of it.

By using chlorate of potash, on the contrary, the solution of perchloride of antimony obtained can be freed from the chlorine evolved with the utmost facility and at a low temperature. Besides, the chloride of potassium formed during this operation combines with perchloride of antimony, and gives stability to this compound, which can be handled at a much higher temperature than the simple chloride, without incurring the risk of any loss of antimony by volatilisation.

As soon as all the antimony is dissolved, and the last traces of chlorine are disengaged, powdered iodide of potassium is added, little by little, until no more iodine is evolved. If it is necessary, a little excess of hydrochloric acid is added to assist the reaction.

This operation can be conducted with safety at a temperature near that of the boiling-point of the liquor. At that temperature iodine is freely volatilised, and any loss in antimony is completely prevented by the presence of chloride of potassium.

As soon as a slight excess of iodide of potassium dissolves in the clear liquor without deepening its colour or evolving iodine, the reduction of the perchloride of antimony is complete. If the solution is too acid, it is evaporated to the proper degree of concentration, and it is then precipitated by gallic acid.

All the metals alloyed with antimony will be found in the liquor separated by filtration from gallate of antimony, where they can be separated from each other and estimated by the usual methods. Iron forming an exception, it must be estimated in a special operation,—in that in which the alkaline metals which might be alloyed with antimony would be determined.

Estimation of Antimony in Antimonial Fumes, and in Artificial and Native Oxides of Antimony.

The estimation of antimony in native oxides of antimony has become of late an important operation, owing to the discovery of large deposits of this substance, constituting the best ores of antimony known to metallurgists.

The native oxides of antimony, as well as the calcined oxides of antimony, are generally insoluble in hydrochloric acid, and formerly it was necessary to fuse them first with carbonate of potash, or a mixture of carbonate of potash and sulphur in order to dissolve them.

But this operation, one of the most tedious in analysis, has been entirely superseded by the method which I am going to describe, and which answers admirably the purpose.

Iodide of potassium not only reacts on solutions of perchloride of antimony, but, in presence of hydrochloric acid, it reduces both antimonious and antimonic acid to the state of teroxide of antimony soluble in hydrochloric acid, with formation of terchloride of antimony. Iodine is evolved.

This interesting reaction takes place according to the following formulæ:—

$$SbO_4+4HCl+KI=SbCl_3+4HO+KCl+I.$$
$$SbO_5+5HCl+2KI=SbCl_3+5HO+2KCl+2I.$$

Consequently to analyse or to assay any of the oxides of antimony, whether artificial or native, they are first of all finely powdered; 20 grs. of the oxides are mixed with hydrochloric acid; the mixture is heated, and iodide of potassium is added until no more iodine is evolved, this being the best indication that all the oxide of antimony is dissolved. The solution is filtered in order to separate it from any insoluble residue, and the filter is washed with dilute hydrochloric acid; this solution is then evaporated to the proper point and precipitated by gallic acid.

The complete analysis may be conducted on 50 grs. in the same way as above, and native oxides will be found in general remarkably free from arsenic and from metals.

Fifty grs. more are dissolved by hydrochloric acid and iodide of potassium, and the solution is precipitated by sulphuretted hydrogen in order to estimate iron and the earthy metals.

When, as frequently happens, the ore to be tried is formed of a mixture of sulphuret of antimony and of oxide of antimony, the ore is dissolved first in hydrochloric acid, the solution is poured off the insoluble residue, which is next dissolved in hydrochloric acid and iodide of potassium. The two solutions mixed together are evaporated and precipitated by gallic acid.

Oxides of antimony, from whatever source they come, being dissolved by hydrochloric acid or by a mixture of hydrochloric acid and iodide of potassium, the estimation of antimony in these compounds has thus become one of the most simple operations in analysis.

Separation of Antimony from most Metals.

Gallic acid effects with the greatest perfection the separation of antimony from most metals, when the

* $Fe_2Cl_6 6H_2O$ (Mohr).

general ways of proceeding and the general precautions as above explained are applied to the analysis of alloys and compounds of antimony. The immense advantage of the gallic acid process is, that by its means antimony is both separated and estimated in one operation, while by the sulphuretted hydrogen process the sulphide of antimony obtained in most cases is of an unknown composition, even when free from other metals, and that it cannot be used for the direct estimation of antimony.

However, sulphuretted hydrogen must remain the standard precipitating reagent of antimony, and its standard separating reagent from all the metals which are not precipitated by sulphuretted hydrogen; and in the analysis of alloys and other compounds of antimony the simultaneous use of both methods ought to be recommended.

By the gallic acid process antimony is separated and estimated in the state of bigallate of antimony, while all the other metals are left in the solution, from which they may all be precipitated (with the exception of iron) either by sulphuretted hydrogen, sulphide of ammonium, or by the successive use of both reagents.

By the sulphuretted hydrogen process, on the contrary, iron which cannot be estimated properly by the gallic acid process, and all the metals not precipitated by sulphuretted hydrogen, remain in solution, so that by the judicious use of these two methods most perfect and elaborate analyses of antimony compounds may be obtained.

It would be tedious, and, on the whole, useless, to describe with more detail the separation of antimony from each metal, but it is, on the contrary, most important to know how the gallic acid method answers for the separation of antimony from the metals which are precipitated with antimony by sulphuretted hydrogen.

Separation of Antimony from Silver, Mercury, Bismuth, Cadmium, Copper, and Lead.

Whenever a clear solution of chlorides can be obtained after the successive use of hydrochloric acid, chlorate of potash, and iodide of potassium, and providing the solution is not too acid, it may be successfully treated by gallic acid, and antimony will then be separated with the greatest perfection from either silver, mercury, bismuth, cadmium, copper, lead, or from a mixture of these metals.

When, on the contrary, the quantity of silver or lead is so great that the compound cannot be dissolved by hydrochloric acid and chlorate of potash, another method must be resorted to, the sulphide of ammonium process being the best.

In alloys or compounds of antimony and copper no better method than the gallic acid process can be used, especially when there is more antimony than copper. The separation is quite perfect. In the liquor separated by filtration from bigallate of antimony, copper may be precipitated in the state of sulphocyanide by means of the copper reagent* and any other metal may be estimated afterwards.

Type metal and other alloys of antimony with lead and other metals can be most successfully analysed by the gallic acid process.

The alloy reduced to a fine state of division is attacked by hydrochloric acid and chlorate of potash; the produce, which at this stage of the operation may not be clear, but milky, is reduced by iodide of potassium; a clear liquid is obtained, which is precipitated by gallic acid. The separation is complete, and in the solution lead may be thoroughly precipitated by sulphuric acid, and afterwards any metal which may be present.

I will not insist further on the analysis of compounds of antimony and silver, mercury, bismuth, cadmium, copper, and lead. From the general statements contained in this paper, it must be quite evident that whenever it is possible to use it all the advantages are in favour of the gallic acid process.

* Chemical News, vol. xxiv., p. 91.

Separation of Antimony from Arsenic.

The separation of antimony from arsenic, which was, until lately, a delicate as well as a difficult separation, has been wonderfully simplified by the application of the gallic acid method to the separation of those two congener substances.

Iodide of potassium, which, in presence of hydrochloric acid, reduces peroxide of antimony to the state of teroxide with evolution of iodine, reacts in a similar manner on arsenic acid, which it reduces to the state of arsenious acid—

$$AsO_5+2HCl+2KI=AsO_3+2HO+2KCl+2I.$$

So that whenever arsenic and antimony co-exist in an hydrochloric solution, by the addition of a sufficient quantity of iodide of potassium, an hydrochloric solution of terchloride of antimony and of arsenious acid is obtained. Now this is very fortunate, for the separation of antimony from arsenic by gallic acid is especially neat and easy when antimony existing as terchloride, arsenic is present in the state of arsenious acid.

The chief products containing both antimony and arsenic which it is important to analyse are compounds of oxides of antimony with arsenious or arsenic acids, the mixtures of sulphurets of antimony and arsenic obtained in the course of a great number of mineral analyses, and lastly alloys of antimony and arsenic. The mixture of oxides of antimony and arsenic has only to be treated by hydrochloric acid, to which iodide of potassium is added until no iodine is evolved, to give hydrochloric solutions of teroxide of antimony and arsenious acid quite ready to be precipitated by gallic acid. The mixture of sulphurets, or the alloys of antimony and arsenic, after being reduced to a very fine state of division, are attacked by hydrochloric acid and chlorate of potash. The solution is freed from chlorine by heating for a short time at a low temperature, and then reduced by means of a slight excess of iodide of potassium until no more iodine is evolved. If the solution is too acid, it is evaporated until crystals of iodide of antimony begin to appear, and it is then precipitated by gallic acid.

The filtering and washing of the precipitate of bigallate of antimony are conducted exactly as in the previous separations.

Antimony is estimated either as bigallate or as tersulphide, and arsenic is precipitated from the filtrate by means of sulphuretted hydrogen in the state of tersulphide.

When there is more antimony than arsenic in the compound to be analysed, 20 or 25 grs. is a sufficient quantity to operate upon; but when there is a great deal more arsenic than antimony, it is advisable to operate upon 50 grs.

There is no peculiarity to be noticed in the separation of antimony from arsenic by the gallic acid process. The general considerations given above apply here, and with a little care and a little experience very accurate results are obtained.

Separation of Antimony from Tin.

Iodide of potassium has no reducing effect upon hydrochloric acid solutions of perchloride of tin, but when an excess of iodide is introduced in the solution a double decomposition takes place, and the liquor consists of an hydrochloric acid solution of periodide of tin. This reaction is important, as experience has proved that gallic acid separates much more easily teroxide of antimony from biniodide of tin than from the bichloride of the same metal.

The most important compounds containing antimony and tin are the alloys of those two metals, and, in general, 20 or 25 grs. of the alloy previously reduced to a very fine state of division are sufficient to conduct successfully the separation. The alloy is dissolved as usual in a mixture of hydrochloric acid and chlorate of potash.

It is in this instance more especially that the use of

aqua regia should be forbidden; bichloride of tin, like perchloride of antimony, retains powerfully the fumes evolved by aqua regia, and it is not possible to drive off those fumes without volatilising a considerable quantity of tin and antimony.

The solution in hydrochloric acid and chlorate of potash, freed from chlorine as usual, is reduced by iodide of potassium until no more iodine is evolved. When this is done a quantity of iodide of potassium, equal to about half the quantity of iodide employed for the reduction of the liquor, is added in excess, and the mixture is heated for a short time. It is a judicious addition of a sufficient quantity of this salt in excess which decides a successful separation of antimony from tin by gallic acid. After the solution has been brought to the proper degree of concentration, gallic acid is added and afterwards water.

When the former series of operations has been properly conducted, bigallate of antimony settles very rapidly in the liquor. When, on the contrary, the operation has been badly performed, bigallate of antimony is mixed with peroxide of tin, and it remains in suspension in the liquor without settling. In this case the liquor should be rejected as unfit for a neat separation.

When, on the contrary, bigallate of antimony settles rapidly, the operation can be depended upon, and the filtering and washing of the precipitate are proceeded with. Antimony is estimated either as bigallate or as tersulphide, and tin is precipitated from the filtrate by sulphuretted hydrogen in the state of bisulphuret of tin, which, on calcination at a high temperature, gives pure peroxide of tin.

The separation of tin and antimony by gallic acid is not quite so simple as the separation of antimony from arsenic by the same process, for the reason that tin cannot be easily reduced from the state of perchloride to that of protochloride. But if it were possible to effect easily this transformation, the separation of antimony from tin would then be the easiest separation that can be effected by means of gallic acid. However, such as it is, the separation is very neat, and requires only a little attention and experience to be quite perfect.

Separation of Antimony from Arsenic and Tin.

Although gallic acid separates well antimony from arsenic, and antimony from tin, it does not follow that gallic acid should separate properly antimony from arsenic and tin. Still, it is a positive fact gallic acid separates, and separates well, antimony from arsenic and tin. The separation is conducted exactly as a separation of antimony from tin.

The three metals are dissolved by hydrochloric acid and chlorate of potash respectively in the state of perchloride of antimony, arsenic acid, and bichloride of tin. On addition of iodide of potassium until complete evolution of iodine, antimony is reduced to the state of terchloride, arsenic to that of arsenious acid, and, on addition of a proper quantity of iodide in excess, tin is transformed into biniodide of tin.

When the solution thus obtained has been brought to the proper degree of concentration, and properly freed from the excess of hydrochloric acid which it might still contain, it is precipitated by gallic acid, water is added, and the remaining part of the operation is conducted as usual.

The best indication that the separation is perfect is the fact that bigallate of antimony settles rapidly.

In this instance, as in the case of the separation of antimony from tin by gallic acid, if bigallate of antimony refuses to settle rapidly, it is an indication that it is mixed with peroxide of tin, and the liquor should be rejected at once as useless.

In the filtrate, tin and arsenic should be precipitated by sulphuretted hydrogen in the state of sulphides, and this mixture should be separated by one of the approved methods.

Remarks.—After the separation of antimony from arsenic, from tin, or from arsenic and tin, the bigallate of antimony obtained and used for the estimation of antimony should be dissolved in weak hydrochloric acid and precipitated by sulphuretted hydrogen, when antimony ought to be precipitated after each separation in the state of that fine orange-coloured sulphide so well known.

Final Considerations.—Although the separation of antimony from arsenic and tin is a very simple one, when the gallic acid process is applied to it, I cannot say that I have succeeded in solving that most difficult of problems, an easy separation of antimony, tin, and arsenic.

I have signally failed there, where so many have failed before me, for the reason that a mixture of antimony and arsenic does not behave with reagents as a mixture of antimony and arsenic, but, on the contrary, as a new metal, *stibarsenicum*, which possesses peculiar properties and requires special reagents.

A mixture of tin and arsenic also presents all the appearance of the new metal *stannarsenicum*; and a mixture of tin and antimony all those of the new metal *stannantimonium*.

But the properties and the reagents of those three new metals being well studied and well known, it might appear that those of a mixture of the three would soon be mastered.

It is not so, however, and their mixture possesses all the characters of a new metal, *stannarsenicantimonium*, differing in properties from stibarsenicum, from stannarsenicum, from stannantimonium, from arsenic, from antimony, and from tin.

It is not, therefore, surprising that the problem of the separation of antimony, arsenic, and tin should be so difficult to solve.

The solution of this problem, however, will be found in the use of powerful reagents, capable of destroying the strange affinities exhibited by the three metals, and I have every reason to believe that organic acids will be the means of accomplishing this object.

ON THE COLOURS OF METALS.*

By Professor C. A. SEELY.

Of all the metals, two only, gold and copper, are distinctly coloured. When nicely polished the surfaces of all metals become nearly perfect mirrors, reflecting almost all the light, whatever be its tint, which falls upon them, and the chemically clean matte surfaces of all metals except gold and copper appear white to the eye. Yet the white light from such surfaces is invariably contaminated with a small amount of coloured light, and this coloured light is without doubt the result of a normal and ordinary decomposition of the incident white light. If the greater part of the incident white light were in the same way decomposed, the metals, instead of appearing to us white, would shine with splendid colours. The colours of natural objects are always mixed with white light, that is, the white light falling on the surfaces of natural objects is never completely decomposed, and in this regard the case of the metal shows a difference in degree and not in kind. To the eye of the scientist, then, all the metals may be coloured; the colours are ordinarily invisible simply because they are diluted or overpowered by the white light with which they are mingled. With the explanation thus given I assume in this paper that all metals are coloured.

The most satisfactory method of rendering the colours of metals apparent heretofore proposed consists in repeatedly reflecting a beam of white light from the metallic surface under examination. A convenient arrangement is two parallel plates of the metal, between which the

* Read before the New York Lyceum of Natural History.

light is reflected from one to the other at a small angle of incidence.

At each incidence the white light is partially decomposed, and if the number of incidences be sufficiently multiplied, all the white light will have disappeared, and only the pure coloured rays be visible. In this way the colours of most of the metals have been exactly determined. The actual experiment, however, is not a very brilliant one, inasmuch as the larger part of the light with which it begins is lost by gradual diffusion; especially the coloured light is so lost, probably for the reason that the decomposition of the white light takes place within the reflecting surface.

Another method of developing the true colours of metals has recently occurred to me, and it is the main purpose of this paper to describe it. I present first a few theoretical considerations.

When white light is decomposed by a coloured body, the reflected coloured ray is complementary to that part of the white light which is transmitted or absorbed; if a coloured body be seen both by reflected and transmitted light, the colours so seen should be complementary, or an approach to being so.

These statements seem to have many exceptions, as, for example, the coloured transparent salts of metals show the same colour by reflected as by transmitted light. But I am persuaded that a careful discussion of the case would show that such exceptions are not well taken, and that this apparent discrepancy with the statements may be consistently explained away; thus it may be shown that the supposed reflected light of the exceptions is really a part of the transmitted light which has been returned by internal reflection; such mixture of the transmitted with a reflected light implies a considerable degree of transparency of the substance under test. The lustre and whiteness of metals have a close relation to their opacity and density; perhaps the relation is that of effect and cause. If the opacity and density of metals be progressively decreased, the optical metallic character will in the same ratio be diminished; the true colour by reflected light would become brighter and freer from white light till it come to be contaminated with more and more of the returned transmitted light. Such changes are beautifully exemplified by the gradual additions of a solvent to fuchsine or other aniline colours in crystals. Aniline colours, Prussian blue, indigo, carmine, and all other dye-stuffs which have very great tinctorial powers, have the metallic lustre, and their colour by transmitted light is nearly complementary to that by reflected light.

In their relation to light I suggest that metals are closely analogous to those dye-stuffs which show a bronzed surface by reflected light. Metals are more perfectly bronzed because their opacity and density are greater, or, in other words, their tinctorial powers are greater.

It will be seen that the above theory requires for its demonstration a transparent diluent or solvent of metals, which shall have no chemical action on them. Such a solvent, for a few of the metals, is anhydrous liquid ammonia. If this menstruum be gradually added to the silver-white alkali metals, the whiteness disappears, is replaced by copper-redness, which at last gives place to the blue of transmitted light. The changes of tint in this case from copper-redness to the transparent blue may be exactly repeated by treating pure aniline blue with alcohol. The alkali metals are then copper-red in reflected light, and by transmitted light blue. In this connection, the fact that the salts of copper are blue is, perhaps, of some significance.

The solution of metals without definite chemical action is almost a new idea in chemistry. Faraday made the first approach to it by showing that the colour of ruby glass is due to metallic gold; and it received a final and definite shape in a demonstration of the solvent properties of anhydrous liquid ammonia, which I made at the late Troy meeting of the American Association for the Advancement of Science.

The tinctorial power of metals appears to be vastly greater than that of any known dye-stuff, and the colours they should yield are very brilliant. There is reason, then, to hope that these facts about metals may some day receive some useful application.

ON THE OXYCHLORIDES OF ANTIMONY.*

By WILLIAM CARLETON WILLIAMS,
Student in the Laboratory of Owen's College.

Phosphorus oxychloride, $POCl_3$, having been prepared by heating together one molecule of phosphorus pentoxide with three of pentachloride, it appeared not unlikely that a similar reaction might occur with antimony giving rise to the missing oxychloride corresponding to the phosphorus compound above mentioned.

The following investigation was undertaken at Dr. Roscoe's request, with the view of elucidating the above reaction, as no oxychlorides derived from the pentachloride have as yet been described.

A mixture of one molecule of antimony pentoxide prepared by heating the pentachloride with water with three molecules of the pentachloride, was heated for some hours in sealed tubes to 140° C. On opening the tube after cooling, it was found to contain, besides unchanged pentachloride and pentoxide, two distinct solid crystalline compounds. When the pentoxide prepared by the action of nitric acid on the metal is heated with the pentachloride in a similar way no oxychloride is formed.

One of these fuses at 85° C. to a clear yellowish liquid, whilst the other, produced only in small quantities, is found adhering to the top of the tube in minute yellowish crystals, which fuse at a higher temperature. In order to obtain the first of these substances in a pure state it is sufficient to place the tube upright in a vessel of water at 90° with the empty end downwards; the fusible oxychloride then melts and collects as a perfectly clear yellowish liquid. After cooling, the tube is opened, and the small quantity of residual pentachloride having been poured off, the solid mass is dried on a porous plate over solid caustic potash *in vacuo*. The oxychloride thus obtained is a perfectly white crystalline substance, exceedingly hygroscopic, so that when exposed to the air for a few minutes it becomes a pasty mass, which rapidly changes to a liquid. It readily dissolves in an aqueous solution of tartaric acid, whilst it is decomposed by water and is perfectly insoluble in carbon disulphide. The melting-point of the substance is 85° C. as a mean of well agreeing determination made with four different preparations. When heated in a retort until it boils, chlorine gas is evolved, whilst pentachloride and trichloride of antimony distil over, a residue of antimony pentoxide remaining in the retort.

A modification of Rose's well-known method of precipitation, first as insoluble antimoniate of soda, and then as antimony sulphide, was employed for the determination of the antimony; the precipitated sulphide was (1) oxidised to Sb_2O_4 either by treatment with pure fuming nitric acid or by heating with from 10 to 20 times its weight of pure mercuric oxide, and (2) the sulphide was completely reduced to metallic antimony by heating gently in a current of hydrogen until sulphuretted hydrogen ceases to be evolved. In the estimation of chlorine it was found than when silver nitrate is added to a solution of an antimony oxychloride acidified by nitric acid, a small trace of antimony is invariably carried down with the silver chloride. In order to free the precipitate from antimony, the silver chloride is first heated gently in a current of hydrogen, when the silver is reduced, and on

* Read before the Manchester Literary and Philosophical Society, October 17th, 1871.

stronger ignition the whole of the antimony is volatilised as the hydrogen compound. Thus 1·277 grms. of an alloy, containing 2·5 parts of antimony to 97·5 parts of silver, was found to lose on heating in hydrogen 0·0321 grm., corresponding to 97·48 per cent of silver.

The accuracy of each of the above methods was tested by determining the percentage of antimony and chlorine in pure antimony trichloride, the results agreeing closely with each other and with the theoretical composition. The objection to Schaeffer's method of decomposing the oxychloride by boiling with a solution of sodium carbonate is, that the precipitated oxide of antimony being in a very finely divided state, a portion of it is very apt to pass through the filter on washing.

The simplest formula which agrees with the analytical results is $Sb_3Cl_{13}O$, or three molecules of pentachloride in which two of chlorine are replaced by one of oxygen.

	Calculated.	Found.
Sb_3	43·39	43·46
Cl_{13}	54·71	54·75
O	1·90	—
	100·00	

That this is a definite compound and not a mere mixture of pentoxide and pentachloride ($Sb_2O_5+14SbCl_5$) is evident from the fact that the latter substance is not dissolved out by washing with carbon disulphide. The calculated percentage of pentoxide contained in this compound is 7·68; on heating 2·517 grms. of the oxychloride in a tube retort a residue of 0·1799 grm. of pentoxide remained, corresponding to a percentage of 7·14.

The second oxychloride formed by heating the mixture of one molecule of pentoxide and three of pentachloride is produced only in small quantities as yellowish crystals. To obtain it in the pure state, that portion of the tube in which the substance is found is cut off, and after the tube has been re-sealed it is placed in a slanting direction in a vessel containing water heated from 85° to 90°. The $Sb_3Cl_{13}O$ melts and runs down, leaving the other less fusible oxychloride behind; this is then dried on a porous plate *in vacuo* over solid caustic potash. Two determinations showed that the melting-point of this substance is 97·5° C.

The simplest formula agreeing with the analytical numbers is $Sb_3O_4Cl_7$, or three molecules of antimony pentachloride in which 4 atoms of oxygen replace 8 of chlorine.

	Calculated.	Found.
Sb_3	53·93	53·89
Cl_7	36·62	36·58
O_4	9·44	—
	100·00	

From the above results it is clear that the simple phosphorus oxychloride is not reproduced under similar circumstances in the antimony series, but that this element in agreement with its general deportment gives rise to more complicated compounds.

The oxychlorides derived from antimony trioxide have been frequently examined; the results of the analyses of powder of algaroth made by different investigators varies considerably, and Sabanejeff has recently shown that these differences are probably due to the presence in the substance of antimony trichloride in varying quantities. This impurity he gets rid of by washing the oxychloride obtained by the action of a large excess of water on the trichloride with ether or carbon disulphide, in which the trichloride dissolves. In this way he obtains a compound having the constant composition $Sb_4Cl_2O_5$, or two molecules of trioxide in which one of oxygen is replaced by two of chlorine, whilst a simpler monoxychloride, SbOCl, is prepared by acting with only from 2 to 10 molecules of water on the trichloride. But this on treatment with ether or carbon disulphide loses trichloride and yields $Sb_4Cl_2O_5$; thus $5SbOCl=SbCl_3+Sb_4Cl_2O_5$.

The results of my experiments lead me to the conclusion that the body obtained by the action of boiling water on the trichloride does not possess the composition—

$$Sb_4Cl_2O_5,$$

but consists of 10 molecules of this substance and one of the trichloride, which latter, however, can be removed by washing with either carbon disulphide or ether. Antimony determinations in two different preparations gave—

(1) 75·45 per cent Sb. (2) 75·88 per cent Sb; corresponding chlorine determinations gave (1) 12·43 per cent Cl; (2) 12·49 per cent Cl.

Hence we have:—

	Calculated for $10Sb_4Cl_2O_5+SbCl_3$.	Calculated for $Sb_4Cl_2O_5$.	Found.
Antimony	75·57	76·37	75·66
Chlorine	12·34	11·11	12·46
Oxygen	12·09	12·52	—

By acting upon 15 parts by weight of antimony trichloride with 1 part of trioxide in a sealed tube, Schneider (*Pogg. Ann.*, vol. cviii., p. 407) obtains a crystalline oxychloride, to which he assigns the formula $7SbCl_3SbOCl$ Repeating Schneider's experiments I obtained a pearl-grey crystalline mass melting at 72° C., the melting-point of the trichloride. When acted upon by absolute alcohol it yields powder of algaroth, $Sb_4Cl_2O_5$, and its composition appears to be even more complicated than that assigned to it by Schneider.

Antimony determinations in two specimens gave (1) 54·24 per cent Sb; (2) 54·16 per cent Sb; whilst the corresponding chlorine estimations were (1) 45·69; (2) 45·87 instead of 55·08 per cent Sb and 44·02 per cent Cl required by Schneider's formula, but agreeing with the formula $Sb_{16}Cl_{46}O$, which requires 54·2 per cent of antimony and 45·357 of chlorine.

The differences here found between the substances as prepared by Schneider and myself may arise from the admixture of antimony trioxide with the oxychloride in the former preparation. When the tube in which the substance has been prepared is placed in an upright position and allowed to cool, the undissolved oxide sinks to the bottom of the tube, but on still further cooling when the contents of the tube are about to solidify, the oxide rises from the bottom and mixes with the oxychloride. To obtain the substance perfectly free from undissolved oxide, the contents of the tube are gently heated, and when the finely divided oxide is deposited, the clear liquid oxychloride is drawn off with a pipette.

TESTS FOR NITROUS ACID.

By THOMAS M. CHATARD.

During the course of some work on the nitrites of nickel and cobalt, it was necessary to have an easy and accurate test for nitrous acid. I therefore reviewed all the tests given for that acid, comparing their relative degrees of delicacy, with the following results:—For testing, a very dilute solution of Fischer's salt—

$$(Co_2 6NO_2+6(KNO_2)+2Aq),$$

which contained 1-200,000th part by weight of nitrous acid, was employed.

Schönbein's* test with a weak solution of indigo decolourised by potassic sulphide failed to give accurate results. Besides there are many substances which would have the same action upon the decolourised indigo as the nitrous acid.

C. D. Braun's† test with cobaltous chloride and potassic cyanide gave no reaction with so dilute a solution, even when several cubic centimetres were taken, the reaction only appearing when a comparatively strong solution of the nitrite was used.

Hadow's‡ reaction in which a nitrite when heated with

* *Jahresberichte*, 1864, 699.
† *Ibid.*, 1865, 702.
‡ *Journ. Chem. Soc.*, vol. iv., p. 341.

prussic acid, which is detected by an alkaline sulphide, gave good results only when the nitrous acid was present in larger quantities, not being delicate enough to give a reaction with the standard solution of nitrite which I employed.

A modification of this test suggested itself, in which the nitroprussic acid is thus produced. To the solution suspected of containing the acid, potassic ferrocyanide and acetic acid are added, and the whole boiled. The solution is allowed to cool, and ammonic sulphide added. If nitrous acid was originally present, the characteristic blue reaction will appear. 10 c.c. of the test solution gave the reaction, but it failed with a smaller quantity.

The problem was finally solved by another reaction, namely, the production of phenol from aniline by means of nitrous acid. Evaporate the test liquid nearly to dryness, then rub it with a few drops of a strong solution of sulphate of aniline. If nitrous acid is present, the odour of phenol will immediately result. This test is remarkably delicate, 1 c.c. of the test solution giving a perfectly distinct reaction. Nor can nitrous be confounded with nitric acid, as this last produces no phenol, but merely a yellow colour, which of itself, as is well known, is of value as a test for that acid.—*American Journal of Science.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 2, 1871.

Professor Frankland, F.R.S., President, in the Chair.

The minutes of the last meeting having been read and confirmed, the Secretary proceeded to read the list of donations, amongst which were two volumes of manuscript lectures of the celebrated Dr. Black's.

The names of the following gentlemen were read for the first time:— Charles Thomas, Benjamin Tanner, Hugh Paterson, Frederick Hicks, George Joseph Warner, Samuel William Moore, William John Wilson, William Gray, Robert Irvine, Reginald C. Woodcock, and Donald Munroe.

For the third time—R. Gerstl, Esq., who was balloted for and duly elected.

The Secretary then read a paper on "*A Process for the Estimation of Fluorine*," by Archibald Liversidge, A.R.S.M., Scholar of Christ's College, Cambridge. The method employed consists in decomposing the fluoride by concentrated sulphuric acid in the presence of silica, and passing the silicic fluoride formed into solution of ammonia, the amount of silica carried over being then estimated, and the fluorine calculated therefrom. The powdered mineral is introduced into a platinum retort, similar to that described by Professor Maskelyne for the estimation of silica, together with the requisite amount of sulphuric acid and finely divided silica. It is now heated first in a water-bath and afterwards at 160° C., the gaseous silica fluoride thus formed being decomposed by passing it through a solution of ammonia, the last traces of the gas being carried over by drawing a current of air through the apparatus. The ammonia solution is gently evaporated in a platinum dish until the gelatinous silica passes entirely into solution, and it can then be precipitated as silico-fluoride of potassium by the addition of potassium chloride and alcohol. The difference between two determinations of fluorine in the same specimen seldom exceeded 0·05 per cent.

The President said that the thanks of the Society were due to the author for his method, as there was considerable difficulty in accurately determining the fluorine in a mineral when it was present in small quantity; but he should like to have seen the results obtained by the analysis of a fluoride of known composition, in order to be certain that there was not some constant error introduced affecting the determinations.

Dr. Williamson observed that as the mineral was only reduced to an impalpable powder, and not fused with an alkaline carbonate previous to being submitted to the action of sulphuric acid and silica, it was likely, in minerals containing but a small percentage of fluorine, that the interior of the particles might escape decomposition and thus some of the fluoride remain undecomposed in the retort. In this case the results obtained would be too low.

The next paper was on "*Anthraflavic Acid*," by W. H. Perkin, F.R.S. He first mentioned that Dr. Schunck had succeeded in isolating anthraflavic acid, a yellow crystalline substance accompanying artificially prepared alizarine, and to which he had assigned the formula $C_{15}H_{10}O_4$, Liebermann, also, in a paper on a "*By-Product in the Manufacture of Alizarine*," had described a substance apparently identical with the above, the composition of which, however, he gave as $C_{14}H_8O_3$, and regarded as monoxyanthraquinone. The fact that this substance is found accompanying alizarine prepared from pure anthraquinone renders it far more probable that it contains fourteen than fifteen atoms of carbon; in order, therefore, to determine the nature of this body, the author prepared some anthraflavic acid by precipitating the pure baric salt by hydrochloric acid and crystallising the resulting acid from alcohol. It formed bright yellow silky needles, which were found to be anhydrous, and on analysis gave numbers corresponding to the formula $C_{14}H_8O_4$. Baric anthraflavate was prepared from the commercial alizarine by boiling it with baryta water, and precipitating the acid from the yellow solution by means of hydrochloric acid. The crude acid was then purified by washing it with alcohol and treating the product with dilute caustic soda, which leaves certain impurities undissolved. On adding baric chloride to the boiling solution and filtering, the baric anthraflavate is deposited in reddish-brown needles, which may be rendered pure by three or four re-crystallisations from water. The freshly crystallised salt was found to have the composition $2(C_{14}H_6BaO_4)3H_2O+10aq$; dried *in vacuo* it had the formula $2(C_{14}H_6BaO_4)3H_2O$, and at 150°, $2(C_{14}H_6BaO_4)H_2O$, the last H_2O not being driven off even at 180°. It appears, therefore, that anthraflavic acid is an isomer of alizarine, and the author finds that it accompanies the latter in variable proportion, according to the method of experimenting. Another secondary product also accompanies artificial alizarine, and like it has dyeing properties; this the author is at present investigating.

The President remarked that the isomerism of anthraflavic acid and alizarine was very interesting, indicating, as it did, the probability of there being other isomers, some of which might be found to have valuable dyeing properties like alizarine itself. As the author had not obtained any salt free from water, there was still some doubt as to whether it was a dibasic acid or not; but if it proved to be so, it would contain two atoms of oxatyl, COHO, leaving the residue $C_{12}H_6$, a constituent of alizarine, which undergoes the isomeric modifications. It would, therefore, be highly desirable to settle this point by preparing, if possible, some salt free from water.

Dr. Armstrong said that, as he understood that Dr. Schunck had obtained anthracene by distilling the anthraflavic acid with zinc powder, it would tend to show that the nucleus contained C_{14} and not C_{12}.

Dr. Muller suggested treating the anthraflavic acid with benzoyl chloride, as in the case of chrysophanic potassic ferrocyanide and mercuric chloride forms nitro-

acid he had obtained anhydrous substances which were well adapted for the determination of the atomic weight.

The Secretary then read a paper "*On the Distillation of Wood*," by Mr. Watson Smith. The wood preferred for distillation is oak; oak crop wood and old oak timber being the kinds generally employed. The operation lasts about eleven hours, and is known to be finished when the exit pipes from the retorts become cool. The author finds that the escaping gas burns with greater luminosity just before the completion of the distillation, and that the amount of acetic acid contained in the crude wood acid which comes over gradually increases. 1000 parts of old oak timber yielded 327 of charcoal, 509 of wood acid of sp. gr. 1·025 to 1·027, and 55 of tar. The amount of wood-spirit present in the crude wood acid varies considerably, as in one instance it was found to be in the proportion of 88 gallons of sp. gr. 862 to 1000 cwts. of wood, and in another instance only 56½ gallons of sp. gr. 883; some of the spirit is retained by the wood tar, which, on the average, contains about 3 per cent of it. The crude wood acid, after being neutralised with lime, and the wood-spirit separated by distillation, may be evaporated to dryness, when it constitutes "black acetate of lime." If instead of evaporating this liquor quickly to dryness, it be boiled down, taking care to remove the tarry matters, &c., as they form, a pellicle of calcium acetate begins to form on the surface after a time; this is skimmed off as fast as it forms, drained from the mother-liquor, and dried, when it is known as "grey acetate," a purer variety than the "black acetate."

The Society then adjourned until Thursday, the 16th of November.

CORRESPONDENCE.

ELEMENTS, COMPOUNDS, AND MIXTURES.

To the Editor of the Chemical News.

Sir,—In reference to Mr. W. H. Wood's letter (Chemical News, vol. xxiv., p. 204), I wish to point out how the "indefiniteness" he finds in chemical teaching arises from the circumstance of a word having more than one meaning. Concerning the facts themselves there is no doubt, and the elementary treatises all properly begin by stating the indisputable truth that everybody belongs to one of two classes. For either it is a body out of which it is impossible to get any other kind of matter than itself, or it is a body out of which two or more distinct kinds of matter may be obtained. Most writers use the term "compound" to designate the latter class, and when we keep in view the ground or basis of the division, we see that all mixtures must be comprehended in this class. The object of the division is to mark off from all other bodies such as are simple or elementary, and if the terms simple and not simple, or simple and complex, had been used to designate the classes there would have been no ambiguity. The word "compound," however, in its ordinary sense, expresses that which is opposed to simple and single, and is, therefore, quite appropriately employed to denote such bodies as are not elements. Thus, Dr. W. A. Miller instances earth, air, and water, as compound bodies, in a paragraph headed "Chemical Distinction of Bodies into Elements and Compounds" (Miller's "Elements of Chemistry," part 1, p. 1).

But there is another special technical sense in which the word "compound" is most used in chemistry, namely, to denote the result of that intimate union of elements which takes place according to the laws of chemical combination. In this sense the term may be opposed to "mixture." I will quote a sentence from the first page of Fownes's "Manual," where the word is obviously used first in one sense and then in the other.

"Nearly all the objects presented by the visible world are of a compound nature, being chemical compounds or variously disposed mixtures of chemical compounds."

Most teachers would shrink from formally dividing bodies into elements, compounds, and mixtures at the very outset of the subject, because while such a classification would be unnecessary for their immediate purpose, it would embarrass the student by making a distinction which, at the commencement, he would not be in a position to appreciate. Naquet, however, in his "Principes de Chemie," after ranking all bodies under two classes, simple and compound, subdivides the latter into combinations and mixtures, and then states the law of definite proportions and other characters which distinguish the sub-classes.

It occurs to me that this word "combination" is better fitted to express the result of chemical union than the word "compound." The relegation of this last to the ordinary sense, and the employment of the former in the place of the technical sense, would also prevent ambiguity.—I am, &c.,

R. Routledge, B.Sc.

Bowdon, Cheshire,
Oct. 28, 1871.

ELEMENTS, COMPOUNDS, AND MIXTURES.

To the Editor of the Chemical News.

Sir,—I would suggest that the difficulty of which Mr. W. H. Wood complains may be removed somewhat in this way.

Matter is divisible into two classes, *elements* and *composite bodies*.

An element is not resolvable into two or more different kinds of matter, a composite body is separable into two or more different substances.

Composite bodies may themselves be classified under two heads, *compounds* and *mixtures*.

A compound is a body composed of two or more elements, united in a constant proportion by weight, and its properties are not the sum or mean of those of its constituents. In a mixture, however, the constituents are not united in a constant proportion by weight, and the properties of a mixture are the sum or average of those of its components.

Mixtures may be subdivided into mixtures of the first, second, and third degrees; those of the first degree consisting of elements only, as purified air; those of the second of an element or elements, and a compound or compounds, as ordinary air; those of the third, of compounds only, as solution of nitre.

This classification may be thus summarised:—

- Matter.
  - Elements.
  - Composite bodies.
    - Compounds.
    - Mixtures.
      - 1st degree.
      - 2nd ,,
      - 3rd ,,

I am, &c.,

John E. Wright.

23, Regent Terrace, Penzance,
Oct. 28, 1871.

VAPOUR DENSITIES.

To the Editor of the Chemical News.

Sir,—I shall be glad if you can spare me space to call attention to an error in the teaching of nearly all our text-books on the subject of vapour-density determinations. If we take Roscoe's "Lessons on Chemistry," for

example, we are told that in using Dumas's method we must observe the temperature and pressure of the air in the balance-case when the glass globe is weighed full of air, but the necessity of observing these points when the globe is weighed full of vapour is not mentioned. Then, in the example given, in order to obtain the weight of the vacuous globe, the weight of air contained in the globe is deducted from the weight of the globe in air, and the weight so found is subtracted from the weight of the globe and vapour, in order to find the weight of the vapour which fills the globe.

Now, it is clear that unless we wish to go to an extreme degree of exactitude (Roscoe does not take account of the expansion of the glass) we need not observe the temperature and pressure at the *first* weighing, but must observe them at the *second*.

The observed weight of the globe full of air with the point unsealed is really the absolute weight *in vacuo* of the empty globe, minus the weight of air displaced by the glass of the globe, which is, of course, extremely small, so that this weight may be taken without sensible error as the true weight of the empty globe. Then to find the weight *in vacuo* of the globe and vapour, we must add to the observed weight the weight of air displaced at this second weighing, which may easily be considerably different from that displaced at the first weighing.

Professor Thorpe in his "Chemical Problems" follows precisely the same method as Professor Roscoe. The calculation is given correctly in the French edition of Ganot's "Physics" incorrectly in the English edition, and the error is repeated in Fownes's "Manual of Chemistry," in Pouillet-Müller's "Lehrbuch der Physik," in Kekulé's "Lehrbuch der Organischen Chemie," and (with the addition of a misprint) both in the French and English editions of Deschanel's "Traite de Physique." The same mistake appears even in Watts's "Dictionary of Chemistry," the formula in which seems to be taken from Regnault's "Cours de Chimie." Regnault also directs to observe the barometer and thermometer at the first weighing, but takes care to say that, in case the pressure and temperature alter before the second weighing, it will be necessary to introduce a correction. It is clearly better to observe the temperature and pressure at the second weighing, and if then there is any difference between these conditions at the two weighings the correction to be introduced will be much less.

The calculation is given correctly in Cooke's "Chemical Physics."

Of course no chemist in the habit of making vapour-density determinations is likely to fall into such an error, but it is extremely undesirable that in books designed for teaching a necessarily complicated subject should be rendered more difficult by the use of roundabout or erroneous methods.—I am, &c.,

W. Marshall Watts.

MISCELLANEOUS.

University of London.—The following are lists of the candidates who have passed the recent B.Sc. examinations:—*Pass Examination.*—First Division. Thomas Olver Harding, B.A., Trinity College, Cambridge; Robert Moses Lewis, B.A., Downing College, Cambridge; Thomas Hutchinson Waller, B.A., Private study. Second Division. George Thomas Betany, Caius College, Cambridge; John Cameron Graham, University College and private study; Marcus Manuel Hartog, University College, London, and Trinity, Cambridge; John Landor Lowe, King's College; William Thomas Rowden, Royal School of Mines; William Whitchurch Taunton, University College; William Thorp, private study; George Mathews Whipple, private study.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Annalen der Physik und Chemie, von Poggendorff, No. 7, 1871.

This number contains the following original papers and essays relating to chemistry and collateral sciences:—

Expansion of a Drop of Liquid on the Surface of another Liquid.—Dr. C. Marangoni.

Thermo-Chemical Researches.—J. Thomsen.—The continuation of a very lengthy essay on this subject. This portion contains the following sections:—On the quantity of heat evolved by the neutralisation of bases; lithia, soda, oxide of thallium, baryta, strontia, lime, and ammonia; magnesia, protoxides of iron, manganese, oxides of nickel, cadmium, zinc, and copper. To be continued.

Description of a Pressure Guage for Measuring High Pressure of Gases.—V. Regnault.—Illustrated with engravings.

Researches on the Electro-Motive Force Evolved by the Contact of Different Metals, and on the Effect which Heat has thereon.—E. Edlund.—This lengthy essay is illustrated by engravings.

Refraction and Dispersion of Selenium.—J. L. Sirks.—An algebraico-optical essay.

Colouration Exhibited by Turbid Substances, and on the So-Called Coloured Photography.—C. Schultz-Sellack.

The Crystalline Form of Scheelite.—Dr. M. Bauer.—A strictly crystallographical paper. Scheelite is tungstate of lime.

Isomorphism of the Triclinic System of Crystals.—G. Tschermak.

Preparation of Pure Chromic Acid.—E. Zettnow.—After referring at length to the experiments on this subject made by Kuhlmann, Fritsche, Warrington, and Traube, the author describes a series of experiments made with the view to ascertain the best method to prepare chromic acid in the pure state, of which the following is an outline:—For 300 parts of the commercial bichromate, 500 c.c. of water and 420 c.c. of strong sulphuric acid are taken; when, after about ten to twelve hours, the bisulphate of potassa has crystallised out, the liquor is decanted, and the crystalline mass washed with about 12 c.c. of water. The solution of chromic acid having been heated to 90°, there are added to it 150 c.c. of strong sulphuric acid, and next just as much water as is sufficient to dissolve the chromic acid which has been precipitated in the flocculent state. The solution is then evaporated until a crystalline film appears on the surface of the liquid, which is then set aside to cool until, after some 10 to 12 hours, a first crop of crystals has separated; by a further evaporation of the mother-liquor more crops (two to three) of crystals may be obtained. Since the crystals of the chromic acid are very small, it is best to decant the liquid by filtration through a cone of platinum foil perforated with many small holes, in order to free the chromic acid completely from adhering sulphuric acid. The author washes the crystals with nitric acid, sp. gr. = 1·46, which acid ought to be pure. It dissolves hardly any chromic acid, but eliminates the sulphuric acid completely.

Specific Gravity of Pure Chromic Acid and of some of its Solutions.—E. Zettnow.—The author employs benzine for the purpose of taking the sp. gr. of the acid here alluded to; the average sp. gr. of crystallised chromic acid is 2·78, while that of the fused acid is 2·802.

Preparation of Crystallised Chromium.—E. Zettnow.—To 100 parts of bichromate of potassa are added 300 c.c. of rough hydrochloric acid, 150 c.c. of water, and 80 c.c. of alcohol at 80 per cent. To this fluid mixture, which becomes spontaneously very hot, are added 180 parts of chloride of potassium, and the whole evaporated to dryness, next gently ignited in a crucible so as to drive off all water, and the dry mass after having been broken up into small lumps is divided into four equal parts, and to each of these is added 50 parts of small chips of zinc-foil. This mixture keeps perfectly well in dry and stoppered bottles, but deliquesces by exposure to air. Each portion of this mixture is gradually placed in a bright red-hot crucible, and after the reduction of the chromium has taken place and the mass is cooled, it is first boiled along with water, and then treated with very pure and very dilute nitric acid, which dissolves the zinc and leaves the chromium in crystalline form. The author intends to publish further details on this metal in a future paper.

Apparatus for Exhibiting Momentum (Vis Inertiæ).—A Kurz.—Accompanied by engravings.

Erythroscope and Melanoscope.—E. Lommel.—An optical treatise.

No. 8, 1871.

This number contains the following original papers and memoirs:—

Continuation and End of Essay on Thermo-Chemical Researches.—J. Thomsen.

Researches on the Electro-Motive Force Evolved by the Contact of Different Metals and on the Effect which Heat has thereon.—E. Edlund.—Continuation and end of this very exhaustive essay.

Behaviour of Chlorophyll towards Light.—Dr. E. Lommel.

Action of Light upon Chlorophyll.—Dr. E. Gerland.—The contents of these essays are not suited for useful abstraction.

Water and Common Salt Contained (Occluded) in Rocks and Minerals.—Dr. F. Pfaff.—This paper, illustrated by several engravings, treats on the method of determining the quantity of water mechanically occluded between the pores and particles of rocks and minerals, while it appears that in many instances this water contains common salt also. The main result of the author's researches are:—All granitic rocks contain water mechanically occluded between the component crystals; the quantity of this water varies considerably, viz., from 0·11 to 1·8 per cent; the rocks alluded to and also the sedimentary rocks contain, in addition to water, chloride of sodium occluded; no water was found in any kind of lava, obsidian, and basalt.

On Sulphur Crystallites.—H. Vogelsang.—This paper is a reply to some critical observations made by Dr. E. Weiss on an essay published by the author some time since on crystallites.

Limits of the Sensitiveness of the Eye for Spectrum Colours.—S. Lamansky.—An algebraico-optical essay; an observation also relating to the following essay:—

The Spherical Electro-Dynamometer.—O. Frölich.

Spectra Exhibited by Lightning.—Dr. H. Vogel.—The account of spectrum observations made on the lightning during a severe thunderstorm, which lasted for several hours, on September 2 last.

On Coloured Gelatine as Suitable Objects for the Spectroscope.—E. Lommel.

Bulletin de l'Academie Royale des Sciences, des Lettres et des Beaux Arts de Belgique, No. 8, 1871.

This number contains the following papers relating to chemistry:—

New Mode of Formation of Diethylic Sulphate.—E. Dubois.—After referring to researches made by Dr. Odling and M. Baumstark, the author describes some of his experiments on the action of chloride of sulphuryl upon alcohol. The reaction is very violent, and the result is the formation of a body, $(C_2H_5)_2SO_4$, according to the following formula:—

$$SO_2Cl_2+4C_2H_5.HO=(C_2H_5)_2SO_4+2C_2H_5Cl+2H_2O.$$

Conversion of Citric Acid into Tricarballylic Acid.—E. Dubois.—The author begins this essay by observing that on examination of the three following formulæ:—

$C_3H_5\left\{\begin{matrix}CO_2H\\CO_2H\\CO_2H\end{matrix}\right.$	$C_3H_5\left\{\begin{matrix}CO_2H\\CO_2H\\CO_2H\end{matrix}\right.$	$C_3H_4(HO)\left\{\begin{matrix}CO_2H\\CO_2H\\CO_2H\end{matrix}\right.$
Tricarballylic acid.	Aconitic acid.	Citric acid.

it will be observed that there exist between these acids the same relation as exists between the following acids:—

$C_2H_4\left\{\begin{matrix}CO_2H\\CO_2H\end{matrix}\right.$	$C_2H_2\left\{\begin{matrix}CO_2H\\CO_2H\end{matrix}\right.$	$C_2H_3(HO)\left\{\begin{matrix}CO_2H\\CO_2H\end{matrix}\right.$
Succinic acid.	Fumaric acid. Maleic acid.	Malic acid.

The author next states that, by the aid of the action of iodhydric acid (at 50° B.) upon citric acid, continued for thirty hours, he has succeeded in converting the citric acid into tricarballylic acid, fully identical in every respect with the properties of that body and its salts as described by Dr. Maxwell Simpson.

The American Journal of Science and Arts, October, 1871.

This number contains, in addition to the lengthy papers and essays on geology, palæontology, natural history, and astronomy, the following paper which, to some extent, bears on chemistry:—

The Paragenesis and Derivation of Copper and its Associates on Lake Superior.—R. Pumpelly.—The continuation of a lengthy essay on this subject, setting forth the mode of formation of the minerals met with along with the metallic copper deposit alluded to. This paper is to be continued.

Journal für Gasbeleuchtung und Wasserversorgung, No. 18, 1871.

The original matter contained in this number only refers to gas- and water-works' engineering and management.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, August, 1871.

The original papers relating to chemistry and published in this number are:—

Second Paper on the Native Compounds of Tantalum and Niobium.—Dr. Rammelsberg.—The continuation of an exhaustive mineralogical essay on this subject, to which are added a very large number of chemical analyses of the minerals yttrotantalite, Fergusonite, bragite, tyrite, euxenite, and others herein treated of.

Methylisation of the Phenyl Group in Aniline.—Dr. A. W. Hofmann.—This lengthy essay, elucidated by a series of complex formulæ, contains the following sections:—Introduction; dimethylaniline; dimethyl-toluidine; dimethyl-xylidine; dimethyl-cumidine; dimethyl-cymidine.

Journal für Praktische Chemie, Nos. 15 and 16 (double number), 1871.

Nos. 13 and 14 of this periodical will be abstracted as soon as we obtain them. This number contains the following original papers and memoirs:—

Contribution to our Knowledge of some of the Chromium Compounds.—L. J. Heintze.—This essay treats at great length on the author's results of experiments, made with the view of preparing amido-chromium compounds. We regret that the great length of this succinctly-written memoir does not admit of any further account than the quotation of the headings of the different sections:—Introduction; action of ammonia upon potassium chloro-chromate; action of ammonia upon chromic acid chloride.

Mineralogical Notice.—A. Frenzel.—This paper treats on Pucherite, a mineral named from the locality, Pucher-Richtschacht, Saxony, where it occurs. This substance has a sp. gr. = 5·91, and is a compound of oxide of bismuth and vanadic acid; formula, $Bi_2O_3.VO_3$. In 100 parts:—Oxide of bismuth, 71·49; vanadic acid, 28·51. The main portion of the contents of this paper are strictly mineralogical.

Action of Light upon Chlorine and Bromine.—E. Budde.—This paper contains a preliminary account of a series of experiments, made with the view of inquiring more accurately into the phenomena of combustion and catalysis. The following points deserve notice:—Light decomposes the molecules of chlorine; highly refrangible light has upon chlorine an effect not quite known by being converted into heat, giving rise to the expansion of this gas; the division of the spectrum, adopted by Seebeck and Melloni, into a heating and non-heating chemically active portion, is not correct, because there exist bodies which are far more heated by the violet- than by the red-coloured rays; in fact, the division alluded to only applies to surfaces covered with lamp-black; bromine behaves as chlorine does.

Table Exhibiting the Quantity of Neutral Molybdate of Soda in Aqueous Solution.—B. Franz.

The Methods (Moden) of Modern Chemistry.—Dr. H. Kolbe.—Notwithstanding the high scientific value of this lengthy and very carefully written essay, its contents are not suited for useful abstraction, an observation also applying to the following paper:—

On some Electro-Capillary (Chemosmotic, Chemosmotische) Phenomena.—O. Loew.

Theoretical Observations on the Colours Exhibited by Bodies.—W. Stein.—This essay contains some very important facts bearing upon a difficult subject, but does not admit of any further quotation.

Estimation of Sulphur in Ultramarine.—W. Stein.—The main gist of this paper is that, instead of arsenious acid, sulphate of copper, but not chloride of copper, may be advantageously used.

Essay on the Spectrum of Calcium.—R. Blochmann.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, October 26, 1871.

This number contains the following original papers:—

Continuation of the Memoir on the Dissociation of Bodies.—C. Mène.

New Method of Preparing Pulp for Paper-Making Purposes from Wood.—M. Cattell.—The detailed description of a series of mechanical and chemical operations by which paper-pulp may be obtained from wood.

Bleaching Cotton, Hemp, Flax, Jute, and other Vegetable Fibres, by the Aid of Permanganates.—Tessié du Motay.—The description of a certainly very effective, but also rather complicated, process of bleaching, requiring not only permanganates, but, after its application, sulphurous acid, and then again alkalies.

Bibliography.—Under this title we call attention to the following works:—"Exposé d'un Système à Vapeur Economique ou à Détente très Prolongée," par M. Autier; a volume containing engravings. The contents of this work are highly spoken of, and specially worth notice on account of the greatly lessened consumption of fuel by the adoption of the author's system now in practice in several parts of France. "De la Notation Atomique et de sa Comparaison avec la Notation en Equivalents," par le Dr. Micé, chez Baillière, Paris. The contents of this work are, according to the short review here given, well worthy the attention of all scientific chemists.

November 2, 1871.

This number contains the following original essays and papers:—

Continuation of the Studies on the Chemical Dissociation of Bodies.—C. Mène.

Chemical Researches on Food Substances.—C. Mène.—The first portion of an elaborate chemico-physiological memoir, treating on digestion as an introduction.

New Apparatus for Heating Wines.—C. Tellier.—This paper, illustrated by woodcuts, describes a contrivance for ameliorating and maturing wines by the aid of heat.

Varying Quantity of Alcohol met with in the Wines Produced in Different Countries.—Drs. Blaukenhorn and Roesler.—A tabulated form exhibiting the names of different wine-growing countries

their mean annual temperature, the sp. gr. of the wines, and quantity of alcohol by volume per cent contained therein.

Bibliography.—Under this heading are published short reviews of the two following recently published books:—"Traité Complet de la Tourbe," par M. E. Bosc. From what is here published on this work it appears to deserve the notice of all who are interested in the question of the best and most advantageous modes of utilising peat. "Essai sur les Gravures Chimiques en Relief," par M. Motteroz. This work contains all, and the best, information on the subject of substituting for xylography a more rapid and yet equally satisfactory method of producing engravings which can be printed along with ordinary type.

Gazzetta Chimica Italiana, No. 7, 1871.

This number contains the following original papers and memoirs:—

Action of Perchloride of Phosphorus upon Bichloride of Aldehyde.—E. Paterno and G. Pisati.—The main results of this excellent essay may be *resumed* as follows:—Pure bichloride of aldehyde behaves with perchloride of phosphorus in the same way as do all the aldehydes, giving rise to the formation of a compound of the formula $C_2H_2Cl_4$; while, by the reaction which takes place, there is always formed a small quantity of the compound $C_4H_4Cl_6O$, due to the impossibility of completely excluding hydrochloric acid.

Presence of Manganese in Blood as a Permanent Constituent of that Liquid.—G. Campani.—This subject has been taken up by the author in consequence of a paper published in another scientific Italian periodical, wherein Dr. Pollacci asserts that manganese is an integral constituent of blood. It appears from the author's experiments, made with blood of oxen, that the globules as well as the serum contain, along with iron, weighable quantities of manganese.

Spectroscopical Characters of an Ammoniacal Solution of Carmine, of Cochineal, and of other substances.—G. Campani.

Urea a Product of the Spontaneous Decomposition of an Aqueous Solution of Hydrocyanic Acid.—G. Campani.—By the slow decomposition of the acid alluded to, there is formed, in addition to a brownish coloured amorphous substance (paracyanogen), a crystalline compound, which, on being tested with nitrate of mercury and other reagents, was found to be urea.

Contribution to our Knowledge on Sulphide of Carbon.—F. Sestini.—This paper is as yet only an abstract of an essay on this subject, but from what is here published we learn that sulphide of carbon is not quite insoluble in water, for if the sulphide is agitated along with pure water for several hours a perfect aqueous solution of the sulphide of carbon is obtained, which contains by weight 1 part in 1000 of water. When a mixture of water, of hydrate of lime, and of sulphide of carbon, is exposed to the action of the sun's rays, there is formed sulphocarbonate of lime, a reddish coloured solid substance, $3(CaH_2O_2)+CaSC+7H_2O$. As a very delicate test for sulphide of carbon, the author makes use of the aqueous solution of the sulphide, to which is added some solution of caustic potassa, and this mixture heated for five minutes to 50°; when then acetate of lead is added an abundant precipitate of sulphuret of lead is formed. The author states that by this test 1-10,000th part of sulphide of carbon may be detected.

No. 8, 1871.

This number opens with a lengthy essay:—

On a Supposed New Volcano in Sicily.—O. Silvestri.—A geologico-chemical paper of importance, especially to elucidate volcanic action.

Action of Sunlight upon Olive Oil.—L. Moschini.—The main point of interest in this paper is that olive oil, in its natural state, contains in solution a yellowish coloured substance, which, when acted upon by sulphuric adid (sp. gr., 1·63) and by nitric acid (sp. gr., 1·33), gives rise to a greenish colouration, while, with caustic soda solution (sp. gr., 1·34), a bright yellowish colouration is produced. After exposure to sunlight this coloured substance is so modified that the reagents alluded to do not produce the same reactions; moreover, by the action of the sun, the oleine of the oil is entirely altered, imparting to it many of the properties of elaidine, while, if the action of the sun's rays is very prolonged, there are free acids formed, and the olive oil becomes rancid.

Pharmaceutische Zeitschrift für Russland, Nos. 12, 13, and 14, 1871.

These numbers do not contain any original papers relating to chemistry and allied sciences.

No. 15, 1871.

This number contains the following original paper:—

On Picrotoxin and some of its Derivatives.—Dr. J. Gaabe.—This exhaustive essay obtained the golden Suworow medal from the Medical Faculty of the University of Dorpat. The first part of this paper gives a detailed account of all that has been done as regards chemical research of the so-called *Cocculus indicus*, the berry of the *anamirta*, or *Menispermum cocculus*, from 1730 (C. Neumann) up to the present day. The second portion of this paper records the author's experiments, divided into the following sections:—Preparation of pure picrotoxin; action of caustic potassa solution upon picrotoxin; action of sulphuric acid upon picrotoxin. From the tabulated form printed at the end of this essay we learn that the following are the main results of this research:—Picrotoxin, $C_{12}H_{14}O_5$; hydropicrotoxin, $C_{12}H_{16}O_6$; oxypicrotoxin, $C_{12}H_{14}O_6$; oxyhydropicrotoxin, $C_{12}H_{16}O_7$; dioxypicrotoxin. $C_{12}H_{14}O_7$; dioxyhydropicrotoxin, $C_{12}H_{16}O_8$; trioxypicrotoxin, $C_{12}H_{14}O_8$; trioxyhydropicrotoxin, $C_{12}H_{16}O_9$.

No. 16, 1871.

This number contains no original papers relating to chemistry.

NOTES AND QUERIES.

Lute.—(Reply to W. S.)—Loam or pipe-clay will probably answer your purpose.

Paraffin and Naphthalin.—Could any of your readers inform me of a method of testing the difference between paraffin and naphthalin? I have a lot of solid matter that comes off at a temperature of 370° to 450° F., or before all the light oil is off in the distillation of tar.—Thomas Danks.

Elements, Compounds, and Mixtures.—With reference to the questioned raised by Mr. W. H. Wood in your last number, permit me to quote the following from page 3 of of Dr. Miller's useful little "Introduction to Inorganic Chemistry"—"Every material object with which we are acquainted is, in a chemical point of view, either an element or a compound, or else a mechanical mixture of two or more elements or compounds." This appears to meet the case of natural mixtures having, within certain limits, a definite composition.—George Chaloner, Birkbeck Institution.

Purifying Coal-Gas.—(Reply to M. H.)—The gas which is supplied from the gas-works is not, as a rule, too impure for heating purposes, but if you desire it purer, especially as you only appear to require it on the small scale, pass the gas, previous to burning it, through an alcoholic solution of caustic potassa or caustic soda, whereby you will eliminate from the gas any sulphide of carbon and sulphuretted hydrogen it might happen to contain. If, however, you make your own gas, try the processes described by the Rev. W. R. Bowditch, M.A., in his work "The Analysis and Purification of Coal-Gas," published by Messrs. Spon; London, 1867.

Gallic Acid.—Hugo Tamm writes in a dashing, confident style, but wherefore does he notate gallic acid as $C_7H_1O_3$? (C=6, O=8)? M. Schiff regards—

Gallic acid as	$C_{14}H_6O_{10}$
Tannic acid	$C_{28}H_{10}O_{18}$
Tannin	$C_{54}H_{22}O_{34}$

The formation of these bodies conform to a generic formula of production.

Gallic acid + gallic acid − 2HO = digallic (tannic acid).
3 Gallic acid + sugar − 6HO = tannin, or trigallic glucoside.

The relation of tannic acid to anthracen and many other items seem to justify the latest opinion of that distinguished chemist.—S. E. P.

MEETINGS FOR THE WEEK.

Monday, Nov. 13th.—London Institution, 4. Prof. Huxley, LL.D., F.R.S., on "Nervous Matter: its Structure and Properties."

Thursday, 16th.—London Institution, 7.30. Harry G. Seeley, F.G.S., on "The Influence of Geological Phenomena on the Social Life of the People."

— Chemical, 8.

TO CORRESPONDENTS.

*** Vol. XXIII. of The Chemical News, containing a copious index, is now ready, price 11s. 4d., by post, 12s., 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. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxiv. commenced on July 7th, and will be complete in twenty-six numbers. Reading Cases, price 1s. 6d. each, post free, may also be obtained at the Office.

Errata.—Vol. xxiv., p. 208, col. i., line 7 from bottom, *for* "$SbO_3(C_7HO_3)_23HO$" *read* "$SbO_3(C_7HO_3)_2+3HO$." Col. ii., line 6 from top, *for*—
(1.) "$SbO_3(C_7HO_3)_2+3HO$." (2.) "$SbO_3(C_7HO_3)_2+5HO$," *read* "$SbO_3(C_7HO_3)_2+5HO$."

C. S. E. Wood.—You will find the information you require in Crookes and Röhrig's "Metallurgy," vol. ii.

X. Y.—Hypochlorite of lime liquor is made by passing chlorine gas through a mixture of lime and water placed in cisterns; the solution possesses similar properties to dry bleaching-powder.

J. Leith.—A work treating on the subject is in the press.

THE CHEMICAL NEWS.

Vol. XXIV. No. 625.

GALVANIC BATTERY ELEMENTS.

By W. H. COFFIN.

Having made a series of tests with various galvanic elements, with a view of determining experimentally their respective adaptabilities for telegraphic, signal, clock, and other work, their relative cost, constancy, and strength; I send you a brief account of the results, thinking them to be of sufficient general interest.

The following cells were prepared:—

(*a*). Leclanché's. Zinc, ammonic chloride solution in water, and manganic oxide mixed in the state of coarse powder with fine crushed best gas carbon, and packed with larger pieces of carbon in porous cell around carbon block. Reduced probably to dimanganic trioxide.

(*b*). Similar to (*a*), with the substitution of plumbic peroxide for manganese, and sulphuric acid 1 to water 25 for ammonia solution.

(*c*). A modification of Marié-Davy's element, zinc, sulphuric acid 1 to water 25, and mercuric sulphate; securing equal electromotive force with much greater constancy.

(*d*). Zinc, water, and plate of carbon; the latter descending to the bottom of receptacle, and dipping into a layer of mercuric sulphate. Zinc and carbon closely approximated, no porous division.

(*e*). Highton's new element, zinc, ammonic sulphate solution in water, and carbon in porous cell, packed with crushed carbon, and surmounted by a tower of cinders. Was made as closely as possible according to the inventor's description, the porous cell being selected for porosity and size, being three inches in diameter, and extending to about six inches above the surface of the solution, the upper part pierced with numerous holes.

(*f*). Zinc, sulphuric acid 1 to water 25, and carbon packed exactly as in (*a*), minus the manganese.

(*g*). New cell.

(*h*). New cell.

(*i*). New cell.

The elements (*c*), (*g*), (*h*), (*i*), if still satisfactory after further research and modification, will be made public.

All zincs exposed equal surfaces to solution. Porous cells, with the exception of (*e*) being precisely similar, and saturated for an inch from the bottom with paraffin. Chemicals, with the exception of acids, being the ordinary ones of commerce; zinc well amalgamated, ordinary best Belgian rolled, and the weight of substances at the negative pole being in each case, except (*e*) and (*f*), sufficient to neutralise the hydrogen displaced by one ounce of zinc.

Current variations were determined by a very sensitive tangent galvanometer, having a diameter-needle ratio of 20, R=0·09 Ohms, and reading easily by estimation to 15′ or 20′.

A word of explanation will be necessary respecting the electromotive forces as entered in the table. These were measured after poles were connected for two seconds by a small resistance of 0·197 Ohms. By this method I think a more correct estimate can be made of the practical value of the element, for the potential, though constantly falling on short circuit, decreases to a very remarkable extent during the first two seconds only, the fall after that interval being inconsiderable in comparison; the ratio between the force tending to produce a current, and the current that can be maintained, even on long circuit, differs to a remarkable extent between the various descriptions of cells; for example—the element (*a*), by connecting with a condenser of not too extensive a surface, and discharging through galvanometer, indicates about 1·49 volts, whereas, if tried after two seconds current through 0·197 Ohms, indicates as in the table only about 1·137 volts., being then considerably less than some elements whose initial forces are much less than that of (*a*) at first.

It is quite evident that the force as estimated by first method is seldom, if ever, available in practical telegraphy, especially in charging cables of great electrostatic capacity, whereas, by the method pursued here, results are obtained that can be accepted with confidence. The electromotive force was in each case every time determined by three distinct methods, namely—that indicated above; the method of Fechner or Wiedemann of sum and difference in comparison, the galvanometer above alluded to being employed; and the other method due to Fechner, of direct comparison through high resistance, using a sine galvanometer of great delicacy, having 2000 turns of fine wire, and a resistance of about 4560 Ohms.

Zincs being weighed and poles insulated for 60 minutes, the potentials (*e*) were measured and inserted in col. 2 of table. After thirteen hours open they were coupled in series, each one working through resistance of $R=\Sigma r+0{\cdot}197$ Ohms. for 60 minutes, the variation in current strength during that interval being as in col. 3, the signs + (inferred) and − denoting in this and all other determinations of current variation an increase or decrease in the same, respectively, unity being taken as that current producing a deflection of 45° on a certain galvanometer. 36 hours from this, with poles insulated in the interval, E was again measured and inserted in col. 4. Working in the same conditions as in col. 3 for 6 hours, the variations were as in col. 5, after which the variations with open poles in 15 minutes were entered in col. 6. Col. 7 shows the potentials one hour after last experiment. In col. 8 is the variation in 12 hours through $R=\Sigma r+379$ Ohms. Cols. 9, 10, and 11 show the variation in three consecutive intervals of 5 minutes each, through R=0·197 only. Col. 12 contains the variation in the next 5 minutes through R=O. The potentials after 2 hours' open poles were then found to be as in col. 13. Poles were insulated for eighteen days, and loss of zinc since beginning of experiments was found to be as in col. 14, in grs. The absolute resistance of each cell was undetermined, but their relative resistances were measured both before and after tests, and in cols. 15 and 16 are indicated by numbers the inverse order of their resistances—that is to say, from the most to the least conductable, before and at the termination of the experiments respectively.

The zinc of (*a*) was in the best condition, smooth and clean, but with a few small crystals, and a fine black pulverent non-adhesive deposit; (*e*) was slightly more attached, but covered with a quantity of large crystals, forming a continuous coat; (*c*), (*g*), (*h*), (*i*), were quite clean, but slightly pitted and rough on surface; (*b*) was quite dirty, very rough, and showing traces of much local action; (*d*) was very much attacked, great local action. These results, I think, afford sufficient data for valuable inference. I should select (*g*) where great constancy was particularly essential and final cost a consideration; the negative pole of this element being absolutely perfectly insoluble in the solution, unaffected by it for any length of time, and the cost of replacing it very small indeed. When continuous action with high electro-motive force is required, element (*c*) is indicated. The same on short circuit, where conductivity is and expense is not a consideration, will indicate (*d*). When the battery is not to be called upon for an indefinite period of time, and then only occasionally on long circuit, element (*a*) should be selected, especially if it is to be placed in inaccessible positions, the cost of maintenance under such circumstances being remarkably small. When, however, great economy in working is essential, and constancy not particularly necessary, the element (*e*) is certainly the best if it is to be rather constantly used, and on long circuit.

Elements.	2. E initial.	3. Var. 60 mins. after 13 hours. R=Σr=0·19.	4. E, 36 hours after.	5. Var. 6 hours. R=Σr=0·19.	6. Var. 15 mins. R = 8.	7. E, 1 hour after.	8. Var. 12 hours. R=Σr+379.	9. Var. 5 mins. R=0·197.	10. Var. 5 mins. R=0·197.	11. Var. 5 mins. R=0·197.	12. Var. 5 mins. R=O.	13. E, 2 hours after.	14. Loss zinc. Grains.	15. Order of $\frac{1}{R}$ initial.	16. Order of $\frac{1}{R}$ final.
). $(MnO_2)(NH_4Cl)$ ..	1·115	−1·110	1·137	−0·653	0·326	0·773	−0·685	−0·566	−0·056	0·000	−0·168	1·046	72·0	5.	3.
(*b*). $(PbO_2)(SO_4H_4)$ ..	1·326	−0·790	1·340	−0·618	0·059	0·792	−0·059	−0·519	−0·180	−0·100	−0·090	1·090	533·5	7.	6.
(*c*). New cell	1·346	0·087	1·457	−0·594	0·594	1·237	−0·061	−0·550	0·000	0·000	−0·570	1·286	129·2	2.	2.
(*d*). $(SO_4Hg)(H_2O)$ ..	1·354	−0·408	1·352	0·000	0·000	1·230	0·172	−0·224	−0·304	−0·072	−0·111	1·314	800·0	1.	1.
(*e*). $[SO_4(NH_4)_2]$ ..	1·224	−0·205	1·181	−0·490	0·080	1·162	−0·393	−0·330	−0·105	−0·020	−0·203	1·080	96·0	3.	7.
(*f*). $(C)(SO_4H_2)$	1·245	−0·236	1·009	−0·055	0·040	0·699	−0·127	−0·148	−0·022	−0·022	−0·028	0·990	0·0	9.	9.
(*g*). New cell..	1·080	0·218	1·120	0·017	0·087	1·068	0·000	−0·096	0·000	0·000	0·018	1·050	139·0	4.	4.
(*h*). New cell	1·109	−0·018	1·146	0·000	0·070	1·036	0·114	−0·219	−0·079	−0·013	−0·028	1·050	157·0	8.	5.
(*i*). New cell..	1·325	−0·079	0·623	0·000	0·000	0·618	0·052	−0·024	0·000	0·000	−0·012	0·598	132·0	6.	8.

NOTES OF

DEMONSTRATIONS ON PHYSIOLOGICAL CHEMISTRY AT ST. GEORGE'S HOSPITAL.

By S. W. MOORE.

III.

Uric acid ($H_2C_5H_2N_4O_3$). White crystalline powder, 1 part soluble in 10,000 parts water. Crystallises in rhombic tables; these are modified in the presence of colloid matters, and form lozenges, as in morbid urine. It combines with bases to form salts, as urate of ammonium, which so frequently separates from the urine on cooling, and is again dissolved by heat.

Uric acid occurs most largely in the excrement of serpents, which consists almost wholly of urate of ammonium. It is contained also in healthy urine and in the blood, traces in the sweat (Stark), &c.; in some morbid states of the system uric acid is abundant, separating from the urine in red grains, and in gout is secreted by the synovial membranes as urate of lime.

Uric acid may be readily obtained from urine by evaporating to ⅛th part of its bulk and adding HCl, when the crystals separate. In abnomal urine the simple addition of HCl is sufficient if the acid be present; to demonstrate it in gouty blood, Garrod recommends that the blood be acidulated with acetic acid, a thread placed in it and left for twelve hours, crystals then form on thread; this is conveniently done in a watch-glass.

Calculi frequently occur composed of impure uric acid, though sometimes in combination with a base.

The best method of obtaining pure uric acid is to dissolve boa excrement in KHO and add HCl, collect the precipitate and repeat the operation, when, on drying, you will have the acid pure.

Decomposition Products.

Uric acid is readily acted on by oxidising agents, and a large number of products obtained; the most important are the following:—

Alloxan ($C_4H_4N_2O_5,3H_2O$). Obtained by adding dry uric acid to HNO_3, sp. gr. 1·42, keeping the vessel cool as violent effervescence ensues. When sufficient uric acid is added, alloxan separates in crystals.

It crystallises in octahedra, which become pink by exposure to light; a solution stains the skin pink, and communicates a sickly odour. Alloxan is not acid, but reddens litmus paper, and gives a purple reaction with a ferrous salt.

Alloxanic acid ($H_2C_4H_2N_2O_5$). Treat alloxan with BaH_2O_2 until precipitate does not dissolve, and gently heat; baric alloxanate produced. Add cautiously H_2SO_4, filter and evaporate; crystals of the acid form.

Mesoxalic acid ($H_2C_3O_5$). Boil baric alloxanate and baric mesoxalate precipitates; H_2SO_4 sets the acid free; it is very soluble.

Parabanic acid ($H_2C_3N_2O_3$). Obtained from the mother-liquor of alloxan by concentration and crystallisation.

Ammonium parabanate on evaporation breaks up into ammonium oxalurate; H_2SO_4 sets free the acid.

Alloxantin by reducing alloxan with H_2S, &c.

Boiling solutions of alloxantin and NH_4Cl mixed in a tube, corked, and cooled, form crystals of uranil.

Murexid or purpurate of ammonium may be obtained by adding alloxan to an ammoniacal solution of uranil; thus, step by step, we descend the ladder of the series, keeping the original uric acid still in sight.

The production of murexid is the most characteristic test for uric acid. A portion of the substance is dissolved in HNO_3, the solution evaporated to dryness and ammonia added, if uric acid be present, murexid is formed; this is changed to a violet colour by adding KHO.

From what we have now seen in the changes this body may undergo, it is not improbable that in the animal economy many phases of disease are dependent on the imperfect modifications of this acid, its oxidation being arrested at too early a period or advanced beyond its proper limit.

Allantoin occurs in the allantoic fluid of the fœtal calf, and is procured by oxidising uric acid.

There are many other derivatives, but most of them are comparatively unimportant.

Cystin occurs in a rare form of calculus, and is, perhaps, strictly a pathological product; its formula is $C_3H_6NO_2S$. It contains 25·5 per cent of sulphur, and crystallises in haxagonal plates from its solution in ammonia; when heated it gives off a fœtid odour.

Hippuric acid ($HC_9H_8NO_3$) is present in large quantities in the urine of herbivora; traces occur in healthy human urine. This acid is closely allied to benzoic. If a horse be kept at rest no change occurs in the hippuric acid, but when worked it changes to benzoic; when benzoic acid is taken by man it is converted to hippuric acid in the urine.

Its constitution seems to be that of glycocine with an atom of H displaced by benzoyl, $HC_2H_3(C_7H_5O)NO_2$. It crystallises in rhombic prisms, and may be obtained from cow's urine by acidulation with HCl, in long silky needles; it melts at 240° C., is converted into benzoic acid and benzonitrile, a red oil smelling of Tonka beans.

ON AURINE.*

By R. S. DALE, B.A., and C. SCHORLEMMER, F.R.S.

In the July number of the *Journal of the Chemical Society* we have published a short note on "Aurine," a colouring matter discovered by Kolbe and Schmitt, in 1861, and which is now found in commerce under the name of aurine, yellow coralline, or rosolic acid. The commercial product which is obtained by heating phenol with oxalic and sulphuric acids, is a mixture of different bodies, from which we have isolated the pure colouring matter by dissolving the crude aurine in alcohol, and treating this solution with ammonia. A crystalline precipitate, a compound of aurine with ammonia, separated out, whilst the other bodies present remained in solution. The ammonia compound was washed with alcohol by means of Bunsen's filter pump, and decomposed by dilute acetic acid. The

* Read before the Manchester Literary and Philosophical Society October 31, 1871.

aurine thus obtained was further purified by repeated crystallisation from strong acetic acid. It crystallised in rhombic needles or prisms, the colour of which varies according to the concentration of the acid, and as it appears also, according to the purity of the substance. We have obtained it in needles having the colour of chromic acid, and a brilliant diamond lustre, or in darker red crystals of varying shades, with a steel-blue, greenish-blue, or splendid beetle-green reflection. We have analysed these different specimens, partly dried at 100° and partly at higher temperatures, and although samples of the same preparation gave very agreeing results, those of different preparations varied very much in their composition. The reason of this is, that aurine retains most obstinately water and acetic acid, a fact which has also been observed by Fresenius,* who has lately published a note on the same subject.

From concentrated hydrochloric acid aurine crystallises in fine hair-like red needles, which, dried at 110°, contain a large quantity of hydrochloric acid. We tried to obtain the pure compound by precipitating a dilute alkaline with dilute hydrochloric acid, and washing the precipitate by Bunsen's filter pump, but also this product contains hydrochloric acid, which was only given off above 110°.

By spontaneous evaporation of an alcoholic solution, aurine is obtained in dull red crystals, with a green metallic lustre. Dried at 110° this body contains no alcohol, but still retains a large quantity of water, which only escapes between 140° to 180°, the crystals not changing their appearance at all, and they may be heated up to 200° without any further alteration, which fact does not agree with Fresenius's observation, that aurine crystallised from alcohol or acetic acid melts at 156°. The analysis of this body, dried at 200°, which we believe to be pure aurine, gave numbers closely agreeing with the formula $C_{20}H_{14}O_3$, and the mode of its formation may, if this formula is correct, be expressed by the equation

$$3C_6H_6O + C_2O_2 = C_{20}H_{14}O_3 + 2H_2O.$$

The substance dried at 110° lost at 180° 5·4 per cent of water corresponding to the formula $C_{20}H_{14}O_3 + H_2O$.† Caro and Wanklyn obtained by the action of nitrous acid on rosaniline a body, which they believe to be identical with aurine, and to which they assign, from the mode of formation, the composition $C_{20}H_{16}O_3$,‡ differing from our formula only by two atoms of hydrogen.

Nascent hydrogen converts aurine into colourless *leuco-aurine*, $C_{20}H_{18}O_3$. This reduction may be effected by heating it in an alkaline solution with zinc dust, but at the same time a dark resinous body is formed, from which the leuco-aurine cannot be easily freed. Better results are obtained by acting with zinc dust on a solution of aurine in strong acetic acid. Leuco-aurine crystallises from acetic acid or alcohol in compact colourless prisms.

A body resembling leuco-aurine is contained in crude aurine; we have not as yet obtained it in a pure state. It differs from leuco-aurine, however, by yielding a purple solution on adding potassium ferricyanide to its alkaline solution, whilst leuco-aurine under the same conditions is oxidised to aurine, which dissolves in alkalies with a magenta red colour.

By passing sulphur dioxide into a hot alcoholic solution of aurine, brick-red crystals separate, being a compound of aurine with sulphur dioxide. They do not smell of sulphur dioxide, undergo no change when exposed to the air, and are only decomposed at a temperature above 100°, when they split up into sulphur dioxide and aurine.

On mixing an alcoholic solution of aurine with a solution of a bisulphide of the alkaline metals, the liquid becomes colourless, a compound of aurine with the bisulphide being formed, which by spontaneous evaporation of the solution, is obtained in splendid colourless needles. These compounds are decomposed by acids as well as alkalies. We have not as yet analysed these different compounds, but intend to do so, hoping thus to find the correct formula for this remarkable compound.

By heating aurine with alcoholic ammonia in closed vessels to 110°, the so-called red coralline is obtained, a body which has great resemblance to the yellow aurine, but dyes a redder shade. This compound we have also obtained in fine crystals.

* *Journ. f. Prakt. Chem.*, No 10, 1871.

† Fresenius analysed aurine which was crystallised from alcohol and dried at 100°. His numbers agree exactly with the formula

$$C_{20}H_{14}O_3 + 2\tfrac{1}{2}H_2O.$$

‡ *Proc. Roy. Soc.*, xv., 210.

ON THE

SEPARATION OF THE OXIDE OF IRON FROM OXIDE OF URANIUM,

AND THE

ESTIMATION OF PHOSPHORIC ACID BY MEANS OF URANIUM.

By H. RHEINECK.

According to Arendt and Knop (see the fourth German edition of Fresenius's "Quantitative Analysis," p. 421), a precipitate of oxide of iron containing uranium is obtained when a mixed solution of the acetates of these two oxides is boiled. In order to separate, in this manner, the iron from the uranium, the nitric acid solution of the two oxides was first as nearly as possible neutralised with carbonate of soda, next converted into acetates by the addition of acetate of soda, and thereupon diluted with water to fifty times the weight of the oxides present. Since I observed that when a solution of acetate of uranium is boiled over an open fire there is a great chance that oxide of uranium is deposited on the sides of the vessel wherein the liquid is contained, I heat the vessel on a water-bath. A small quantity of the precipitate thus formed, having been tested directly after the precipitate was formed, was found to be free from uranium; but the bulk of the precipitate having been left standing for a length of time, without having been first thoroughly well washed, exhibited a crystalline admixture, which could only be removed by being heated with a large quantity of water, care being taken to heat on the water-bath, and the oxide of iron was then found to be quite free from uranium. The small crystals alluded to, having been separated from oxide of iron adhering thereto, were found to possess the peculiar colour of salts of oxide of uranium and a tetrahedrical shape. I considered it of some interest to make a further investigation of these crystals.

When to any salt of oxide of uranium in aqueous solution acetate of soda is added, the result is, that either at once, or in more dilute solutions after some time, a crystalline compound is precipitated. This precipitate exhibits the following properties:—Shining, hard, small crystals, chiefly octahedra. This body is not acted upon by either air or light, not even in aqueous solution under the direct action of sunlight. 1 part of this substance requires 25 parts of water at the ordinary temperature for solution, and the substance may be heated to 130° without undergoing any change. When heated in contact with air to moderate red heat the material burns off, the acetic acid being destroyed, and there is left yellow oxide, of which, by two different experiments, I obtained 68·68 and 67·21 per cent. By heating with sulphuric acid in excess, and continuing the heating to incipient red heat, so as to drive off all the excess of sulphuric, and also the acetic acid completely, it yielded a residue of 93·82 per cent. Phosphate of soda, having been first acidified with acetic acid, yielded a precipitate which, after ignition, amounted to 78·15 per cent. Since there is no water of crystallisation, this loss by ignition represents acetic acid ($C_4H_3O_3$),

and gives, when compared with the phosphoric acid precipitate, a clue to the composition of the crystalline substance. The quotients $\frac{100-68{\cdot}68}{C_4H_3O_3}$ and $\frac{100-67{\cdot}21}{C_4H_3O_3} = \frac{31{\cdot}32}{59}$, and $\frac{32{\cdot}79}{59} = 0\ 614$ and $0{\cdot}643$ stand to the quotients $\frac{78{\cdot}15}{(U_2O_2)PO_7} = \frac{78{\cdot}15}{359} = 0{\cdot}2176$, about in the relation as three to one; therefore there are upon 3 equivalents of acetic acid 2 equivalents of oxide of uranium, the rest being soda. The formula $(U_2O_2)_2Na,3C_4H_3O_3=472$, when is taken $U=60$, requires 67·59 per cent of residue after ignition, also 94·70 per cent of sulphate of uranium, $(U_2O_2)_2Na,3SO_4$, and lastly 76·05 per cent of pyrophosphate of oxide of uranium. Consequently the salt hereinbefore alluded to is the same as that which Wertheim* described as being obtained by mixing acetic acid combinations of uranium and soda in aqueous solution. In order to apply this salt to the volumetrical estimation of phosphoric acid, I proceed just in the same manner as has been described by Stohmann†; but the preparation of the uranium liquid can be more simply done, while, moreover, a previous test-titration by means of phosphate of soda can be dispensed with. The solution of the salt (to be weighed in the state either of very small crystals or ground up) may be made at the ordinary temperature. I prefer to take of the double salt $\frac{47{\cdot}2}{2}$ grm. to 1 litre of water, so that it is a normal solution at $\frac{1}{20}$th; that is to say, 1 c.c. indicates 0·00005 grm.-equivalent, or 0·00355 grm. of PO_5. Such a solution does not throw down crystals (viz., of the double salt), and the solution might be even more diluted. While experimenting, I purposely employed upon 10 c.c. $\frac{1}{10}$th of normal phosphate of soda solution, always 2 or $3\frac{1}{10}$ c.c. more than 20 c.c., in order to call forth faintly the reaction with ferrocyanide of potassium. In order to make this reaction appear, it is not necessary to add a certain excess of uranium, and therefore I finish off the experiment by the addition of the phosphoric acid-containing fluid until the reaction with ferrocyanide just ceases to be perceptible; and if, for that purpose, a normal solution of phosphate of soda at $\frac{1}{20}$th be taken instead of the phosphoric acid solution to be tested, it is only required to subtract the number of c.c. employed of that solution from the number of c.c. employed of the uranium solution. The result thus obtained will be undoubtedly nearer to the true relation existing between phosphoric acid and oxide of uranium than when the reaction with ferrocyanide is simply relied on.

In order, however, to determine more accurately the relation existing between the weight of the uranium double salt and phosphoric acid when the former substance is used for the volumetrical determination of the latter, I prepared solutions of the same strength—that is to say, such solutions which by equal bulk contain equal quantities by weight—the experiment being so conducted as to render me independent of balance, measuring vessels, and the influence of varying temperature. The solutions contained 2 grms. of substance for 100 c.c. Ten c.c. of phosphate of soda solution were acidulated with acetic acid and warmed. After the addition of 15 c.c. of the solution of the uranium double salt a very small drop of the fluid gave, on being tested with a very small drop of ferrocyanide solution, a deep brown colouration (the drops of ferrocyanide solution should be kept ready at hand on a small porcelain slab). No reaction was perceptible after the addition of 2 c.c. of the first-named solution; a rather strong reaction was observed after a further addition of 2 c.c. of the second solution; again, after addition of 0·5 c.c. of the first solution a weak reaction, and upon the addition of 0·2 c.c. more of the same solution a very weak reaction was observed; lastly, after the addition of 0·2 c.c. of the same solution all reaction with the ferrocyanide ceased, but 1 drop $=\frac{1}{20}$th c.c. more of the uranium solution brought about the reaction faintly again. Accordingly, upon 12·9 c.c. of the first solution 17 c.c. of the second have been applied—that is to say, upon 129 parts by weight of phosphate of soda 170 parts by weight of the double acetate of uranium and soda—taking the equivalent of phosphate of soda, Na_2H,PO_8+24HO, at 359, and the formula of reaction—

$$Na_2HPO_8+(U_2O_2)_2Na.3C_4H_3O_4= \\ =3C_4H_3NaO_4+(U_2O_2)_2HPO_8 \quad 129 : 170 : 473{\cdot}1.$$

The quantity of the double salt to be used for the volumetric estimation of phosphoric acid is the number 473; but when 472 ($U=60$) is the right number, there can only be a very small error, equal, in this instance, and under the premises just stated, to 0·233 per cent of the uranium taken in excess; and since the percentage of phosphoric acid obtained in excess is precisely the same, it is either in the calculation or in the quantity of the solution of the uranium that the required correction can be made.

* *Journ. für Prakt. Chem.*, vol. xxix., p. 216.
† Fresenius, *Zeitschr. für Anal. Chem.*, Jahrgang vii.

ON THE

ATOMIC WEIGHTS OF COBALT AND NICKEL.

By RICHARD H. LEA.

The atomic weights of cobalt and nickel have long been subjects of controversy, but though much time and labour have been spent upon them, the results arrived at are not as satisfactory as could be desired.

Under these circumstances Professor Gibbs suggested to me a new investigation of the subject. Before giving an account of my own methods and results, I will state briefly those of other chemists. Rothhoff,* in 1826, first endeavoured to ascertain the atomic weights of cobalt and nickel. He determined the amount of chlorine in the respective chlorides by means of silver, and, and from a single analysis of each chloride, obtained for cobalt the equivalent 29·55, and for nickel the equivalent 29·60. As the methods of separating the two metals were at that time imperfect, and as but a single analysis was made in each case, Rothhoff's results can hardly be considered as deserving of confidence.

Erdmann† and Marchand, in 1852, determined the atomic weight of nickel by reducing nickelous oxide in hydrogen. Their results varied between 29·1 and 29·3, and they regarded the lower number as more probably correct. It seems at least possible that the nickel they employed contained traces of cobalt. The subject was again taken up by Schneider‡ in 1857. Pure metallic cobalt was prepared by igniting chloride of purpureo-cobalt in hydrogen. The metal was then dissolved in chlorhydric acid and precipitated by sodic carbonate. The carbonate was washed, and then digested with oxalic acid, the resulting oxalate again washed, burnt in a current of oxygen and the oxide reduced by hydrogen. In other portions of the oxalate the carbon was determined by combustion with cupric oxide.

The following tables gives a summary of the results obtained:—

	Oxalate taken.	Cobalt found. Per cent.	Carbon found. Per cent.	Equivalent Co
1.	1·6355 2·3045	32·552	13·024	29·993
2.	1·1070 1·9010	32·619	13·041	30·015
3.	2·3090 4·0580	32·528	13·005	30·014
4.	3·0070 5·3500	52·523	13·014	29·989
			Mean,	30·003

* *Poggendorff's Annalen*, vol. viii., pp. 184-5.
† *Annalen der Pharmacie*, vol. lxxxii., p. 76.
‡ *Poggendorff's Annalen*, vol, ci., p. 387.

Determinations of the atomic weights of cobalt and nickel were also made in 1857 by Marignac.* Cobaltous sulphate was purified by repeated crystallisation and a weighed quantity of the salt heated so as to expel the acid. The resulting oxide was then heated with a known weight of silicate of lead so as to expel the excess of oxygen over and above that required to form cobaltous oxide, CoO. The results obtained varied between 29·32 and 29·38.

Crystallised cobaltous chloride dried at 100° was found to retain 1 atom of water. Three determinations of the chlorine in this salt by means of silver gave for the atomic weight of cobalt 29·42 to 29·51. Anhydrous cobaltous chloride was obtained by heating the crystallised salt with sal-ammoniac, in a current of dry chlorine or dry chlorhydric acid gas. The salt almost always, however, left a slight residue insoluble in water. Five analyses of the anhydrous salt gave results varying from 29·36 to 29·42.

In 1859 Dumas† turned his attention to the subject. Perfectly pure metallic cobalt was dissolved in nitro-muriatic acid, the solution evaporated to dryness with frequent additions of chlorhydric acid, and the cobaltous chloride submitted to a red heat. In a second preparation from a different sample of metal the chloride was dried *in vacuo*. In this manner the following results were obtained:—

	$CoCl_2$.	Silver.	Equivalent.
1.	2·3520	3·9035	29·57
2.	4·2100	6·9900	29·54
3.	3·5920	5·9600	29·59
4.	2·4920	4·1405	29·50
5.	4·2295	7·0255	29·51

The mean of these five determinations is 29·54. In all cases the chloride was dissolved in boiling water and the solution allowed to cool before precipitating with $AgNO_3$. The argentic chloride was reduced in hydrogen. The method employed for the preparation of pure cobalt is not stated.

Russell‡ determined the atomic weights of cobalt and nickel in 1863. Pure metallic cobalt was prepared by igniting chloride of purpureo-cobalt in hydrogen. The metal was dissolved in nitric acid and the solution evaporated and strongly heated. The black oxide obtained was ignited in a current of carbonic dioxide, by which it was converted into light brown cobaltous oxide, CoO, which was then reduced by pure hydrogen. Omitting two trial experiments, the results obtained were as follows:—

	CoO.	Cobalt.	Cobalt pr. ct.
First sample, 1.	2.1211	1·6670	78·591
2.	2·0241	1·5907	78·588
3.	2·1226	1·6673	78·550
4.	1·9947	1·5678	78·598
5.	3·0628	2·4078	78·614
		Mean,	78·588
First specimen twice purified—			
1.	2·1167	1·6638	78·603
2.	1·7717	1·3924	78·591
3.	1·7852	1·4030	78·591
		Mean,	78·595
First specimen three times purified—			
1.	1·6878	1·3264	78·588
2.	2·2076	1·7350	78·592
		Mean,	78·590
Second specimen—			
1.	2·6851	2·1104	78·597
2.	2·1461	1·6868	78·598
		Mean,	78·597
Third specimen—			
1.	3·4038	2·6752	78·595
2.	2·2778	1·7901	78·589
3.	2·1837	1·7163	78·596
		Mean,	78·593

* *Bibliothèque Universelle de Geneve*, Nouvelle Series, vol. i., p. 373.
† *Ann. de Chemie et de Physique*. 3rd series, vol. lv., p. 148.
‡ *Annalen der Pharmacie*, vol. cxxvi., pp. 322-336.

The mean of all the results is 78·5926, from which we find for the equivalent of cobalt on the old system 29·37.

In 1866 the subject was taken up by Sommaruga,* who determined the amount of metallic cobalt in chloride of purpureo-cobalt by reduction in a bulb tube with hydrogen. His results were as follows:—

	Salt taken.	Cobalt found.	Equivalent.
1.	0·6656	0·1588	30·002
2.	1·0918	0·2600	29·929
3.	0·9058	0·2160	29·982
4.	1·5895	0·3785	29·926
5.	2·9167	0·6957	29·992
6.	1·8390	0·4378	29·916
7.	2·5010	0·5968	30·009
		Mean,	29·965

Winkler†, in 1867, determined the atomic weight of cobalt by heating a known weight of the metal with a perfectly neutral solution of double chloride of gold and sodium. The cobalt was obtained by the reduction of chloride of purpureo-cobalt.

	Salt taken.	Gold found.	Equivalent of Co(Au=196).
1.	0·5890	1·3045	29·497
2.	0·3147	0·6981	29·451
3.	0·5829	1·2913	29·492
4.	0·5111	1·1312	29·518
5.	0·5821	1·2848	29·522
		Mean,	29·496

Finally, in 1869, Weselsky‡ made a new determination of the atomic weight of cobalt by finding the quantity of metallic cobalt in weighed quantities of cobalti-cyanide of aniline-ammonium and of ammonium. The results were as follows:—

	Cobalt salt.	Cobalt found.	Equivalent
1.	0·8529 gr.	0·1010	29·44
2.	0·6112 ,,	0·0723	29·38
3.	0·7140 ,,	0·0850	29·59
4.	0·9420 ,,	0·1120	29·54
1.	0·7575 ,,	0·1160	29·46
2.	0·5143 ,,	0·1130	29·55
		Mean,	29·48

The first four analyses were made with the aniline, the last two with the ammonium salt. These are the only determinations of the atomic weight of cobalt which I have been able to find, and I will therefore pass to my own analyses.

Commercial cobaltic oxide was treated in a large porcelain crucible with enough strong sulphuric acid to make it into a stiff paste. The crucible was then placed in a muffle furnace and heated for some time, at first gently and afterwards to low redness. The sulphate obtained was dissolved, filtered, and submitted for some time to a current of sulphydric acid gas, by which copper, arsenic, &c., were removed. The filtrate was treated with chlorine water to peroxidise the iron present and then allowed to stand for forty-eight hours in contact with baric carbonate, the whole being frequently and thoroughly stirred. In this manner iron and manganese were almost wholly removed. The filtrate was then treated with a large excess of baric carbonate, and cyanhydric acid gas passed into the liquid until the whole of the cobalt was converted into cobalti-cyanide of barium, $Co_2Cy_{12}Ba_3$. The solution of this salt was then boiled with mercuric oxide to separate the nickel present, as $NiCy_4Ba$, as well as traces of iron and manganese. The mercury was then removed from the filtrate by sulphydric acid gas, and the solution of cobalti-cyanide barium regarded as chemically pure. The methods which I adopted to determine the atomic weight of cobalt do not differ in principle from those of Weselsky and Sommaruga. I first formed cobalti-cyanides of

* *Sitzungsberichte der Wiener Akad.*, vol. liv, p. 50.
† *Zeitschrift für Annal. Chemie*, 1867, p. 18.
‡ *Berichte der Deutschen Chem. Gessellschaft*, 1870.

alkaloids having high atomic weights and forming highly crystalline and perfectly definite double cyanides. I then determined the water of crystallisation in these salts directly, and afterwards the percentage of cobalt in each. This last was effected by first carefully heating the salt in a platinum crucible by means of a ring-burner, and afterwards burning off the carbon first in air and then in oxygen. Finally the cobalt was reduced to metal by a current of pure hydrogen, and weighed. In this manner but two weighings were necessary. In another series of experiments I determined the amount of metallic cobalt in weighed quantities of chloride of purpureo-cobalt by igniting the salt in a current of pure hydrogen gas. To effect the reduction without loss, I employed an arrangement due to Dr. Gibbs, and consisting of a small thin disk of porous earthenware. The chloride of purpureo-cobalt was placed in a porcelain crucible and the disk of earthenware supported above it by the walls of the crucible. The hydrogen was introduced by a tube passing into the bored cover, and the crucible was then carefully heated from above. In this manner the gas diffused through the porous septum, which in turn served to prevent the escape of any particles of solid substance. The reduction was absolutely complete, and the metal did not oxidise after slowly cooling in an atmosphere of hydrogen. In the analyses made in this manner, also, but two weighings were necessary.

In my first series of experiments I employed only the cobalti-cyanides of brucine and strychnine, the corresponding salts of morphine, narcotine, chinine, and cinchonine having been found difficult to prepare in a state of purity by re-crystallisation. The brucine and strychnine salts were prepared by decomposing the sulphates of these bases with cobalti-cyanide of barium, and repeatedly re-crystallising the salts formed. The brucine salt crystallised in beautiful white, barb-shaped crystals with a high lustre. It was but slightly soluble in cold water, and crystallised with remarkable facility. The strychnine salt was in beautiful, nearly colourless needles, and like the brucine salt crystallised almost completely from its solution on cooling. Six analyses were made with each of these salts.

Of the strychnine salt—

0·7084 gr. dried at 115° C. lost 0·0392 gr. of water = = 5·53 per cent. The formula,

$$\mathrm{Co_2Cy_{12}(C_{21}H_{22}N_2O_2)_6H_6+8OH_2},$$

equires 5·57 per cent water of crystallisation.

The following are the results of my determinations of the amount of cobalt in this salt :—

No.	Salt taken. Gr.	Cobalt. Gr.	Cobalt. p. c.	At. weight.
1.	0·4255	0·0195	4·5830	59·22
2.	0·4025	0·0185	4·5960	59·36
3.	0·3733	0·0170	4·5540	58·83
4.	0·4535	0·0207	4·5640	58·96
5.	0·2753	0·0126	4·5770	59·14
6.	0·1429	0·0065	4·5490	58·76
		Mean,	4·5705	59·05

The probable error of the mean is ±0·012, and the atomic weight of cobalt 59·05, with a probable error of ±0·156. In the case of the brucine salt, three determinations of the water of crystallisation were made.

Gr.		Gr.			
0·4097	gave	0·0465	water at 117° C.	= 11·35	per cent.
0·3951	,,	0·0453	,, 119° ,,	= 11·46	,,
0·6653	,,	0·0752	,, 128° ,,	= 11·30	,,

The mean of these three determinations is 11·37 per cent.

The formula, $\mathrm{Co_2Cy_{12}(C_{23}H_{26}N_2O_4)_6H_6+20OH_2}$, requires 11·39 per cent water of crystallisation.

The results of my determinations of the amount of metal in this salt are as follows :—

	Salt taken. Gr.	Cobalt. Gr.	Cobalt, p. c.	At. weight.
1.	0·4097	0·0154	3·7590	59·41
2.	0·3951	0·0147	3·7200	58·76
3.	0·5456	0·0204	3·7390	59·08
4.	0·4402	0·0165	3·7480	59·22
5.	0·4644	0·0174	3·7470	59·21
6.	0·4027	0·0151	3·7470	59·24
		Mean,	3·7437	59·15

The probable error of the mean is here ±0·0088, and the atomic weight of cobalt 59·15, with a probable error of ±0·146.

The method of analysing the chloride of purpureo-cobalt has already been described. The results of my analyses are as follows : —

No.	Salt taken. Gr.	Cobalt. Gr.	Cobalt, p. c.	At. weight.
1.	0·9472	0·2233	23·5750	59·07
2.	0·8903	0·2100	23·5870	59·11
3.	0·6084	0·1435	23·5860	59·11
4.	0·6561	0·1547	23·5790	59·08
5.	0·6988	0·1647	23·5690	59·05
6.	0·7010	0·1653	23·5810	59·09
		Mean,	23·5795	59·09

The probable error of the mean is here ±0·004, and the calculated atomic weight 59·09 with a probable error of ±0·0146.

The mean of my eighteen determinations of the atomic weight of cobalt is 59·10. For the sake of comparison I give here the results obtained by other observers, in tabular form, reduced to the modern scale of atomic weights :—

Rothhoff,	59·10	Russell,	58·74
Schneider,	60·00	Sommaruga,	59·93
Marignac,	58·84 to 59·02	Winkler,	58·99
	58·72 to 28·84	Weselsky,	58·96
Dumas,	59·08	Lee,	59·10

Nickel.—The atomic weight of nickel was also first determined by Rothhoff* in 1826, by determining the amount of chlorine in a weighed quantity of nickelous chloride. A single experiment gave for the equivalent 29·60, a number which is probably too high, in consequence of the imperfection of the processes known at that time for the separation of nickel from cobalt. Erdmann and Marchand took up the subject in 1852†. Nickelous oxide prepared by various processes was reduced in a current of hydrogen and the metal weighed. No data are given, but the authors state that their results varied between 29·1 and 29·3, and that they consider the lower number more probably correct.

Schneider‡, in 1857, also determined the atomic weight of nickel. Pure nickelous oxalate was burnt with cupric oxide to determine the oxalic acid, while the amount of metallic nickel was obtained by reducing the oxide with pure hydrogen. In this manner Schneider obtained as the mean of four analyses the number 29·02.

Marignac,‖ in 1857, determined the atomic weight of nickel by methods precisely similar to those employed by him in the case of cobalt already cited. His analyses of the sulphate of nickel gave results varying from 29·2 to 29·5, while those of the chloride gave results varying between 29·4 and 29·64. Marignac does not give his method of obtaining pure salts of nickel.

The subject was next investigated by Dumas,§ who determined the quantity of chlorine in nickelous chloride, and obtained for the equivalent of nickel as a mean of five analyses the number 29·514. The author does not give the process by which the nickel was obtained free from cobalt.

Russell,¶ took up the subject of the atomic weight of

* *Pogg. Ann.* vol. viii., p. 184.
† *Ann. der Pharmacie*, lxxxii., p. 76.
‡ *Pogg. Ann.*, ci., p. 387.
‖ *Bibliothêque Universelle de Geneve*, Nouvelle Series, vol. i., p. 373.
§ *Ann. de Chemie et de Physique*, 3rd series, vol. lv., p. 148.
¶ *Ann. der Pharmacie*, vol. cxxvi., pp. 322—336.

nickel, together with that of cobalt, in 1863. Pure nickelous oxide was first ignited in a current of carbonic dioxide, and afterward in pure hydrogen. His results were as follows:—

1st specimen, mean of 3 determinations, 100 parts of oxide gave 78·596 Ni.
2nd specimen, mean of 3 determinations, 100 parts of oxide, gave 78·584 Ni.
3rd specimen, mean of 3 determinations, 100 parts of oxide, gave 78·598 Ni.
4th* specimen, mean of 3 determinations, 100 parts of oxide, gave 78·592 Ni.

The mean of all the determinations gave for the quantity of nickel in 100 parts of the oxide 78·5925, and for the atomic weight of nickel 58·74.

In 1866, Sommaruga† determined the atomic weight of nickel by ascertaining the quantity of sulphuric acid in pure crystallised double sulphate of nickel and potassium. The mean of six analyses gave for the equivalent of nickel the number 29·013, with a probable error of ±3·079.

Winkler‡, in 1867, employed the method of reduction already described. The mean of four analyses gave for the equivalent 29·527, with a probable error of ±0·056.

With these preliminary statements I pass to an account of my own methods and results. Metallic nickel of commerce was dissolved in nitro-sulphuric acid, and the nitric acid expelled by heat. The sulphate was then dissolved in water and the traces of copper and arsenic removed by a long-continued current of sulphydric acid gas. The iron in the filtrate was then oxidised by means of bromine, and precipitated by agitation with $BaCo_3$. The cobalt was removed by potassic nitrite and the nickelous sulphate then converted into nickel-cyanide of potassium, which was re-crystallised. This salt contained only a trace of cobalt after four crystallisations. To determine the atomic weight of nickel I adopted the method already employed to determine that of cobalt. I first formed the double cyanides of nickel with brucine and strychnine, and then determined, first the quantity of water in each of these salts, and afterward the percentage of metallic nickel. This last determination was effected by first carefully heating the salt in a platinum crucible, employing the ring-burner of Dr. Gibbs so as to apply the heat at the rim of the crucible first, and afterward in successive zones until the bottom of the crucible was reached. The remaining carbon was then burned off in a current of pure oxygen, and the oxide of nickel finally reduced by igniting it in carefully purified hydrogen.

The double cyanides of nickel, brucine, and strychnine were prepared by double decomposition, the salts being but slightly soluble in cold water. They were then repeatedly re-crystallised, and when tested by the spectroscope were found to be absolutely free from potassium. All of these salts crystallised in very pale yellow needles.

My analyses of the brucine salt led to the following results:—

0·4496 gr. dried at 120° C. lost 0·0258 gr. ΘH_2 = 5.738 per cent water.

The formula $Ni_3Cy_{12}(C_{23}H_{26}N_2O_4)_6H_6+10\Theta H_2$, requires 5·929 per cent.

No.	Salt taken.	Nickel.	Nickel, p. c.	At. weight.
1.	0·3966	0·02270	5·7240	57·92
2.	0·5638	0·03230	5·7290	57·98
3.	0·4000	0·02300	5·7500	58·20
4.	0·3131	0·01795	5·7330	58·02
5.	0·4412	0·02520	5·7120	57·79
6.	0·4346	0·02490	5·7290	57·98
		Mean,	5·7295	57·98

The probable error of the mean percentage of nickel is ±0·008 and the atomic weight of nickel 57·98, with a probable error of ±0·089.

Six analyses of the strychnine salt were then made.

0·3399 gr. dried at 112° C. lost 0·0178 gr. water = 5·24 per cent.

The formula $Ni_3Cy_{12}(C_{21}H_{22}N_2O_2)_6H_6+8\Theta H_2$, requires 5·45 per cent.

No.	Salt taken.	Nickel.	Nickel, p. c.	At. weight.
1.	0·5358	0·0354	6·607	58·15
2.	0·5489	0·0363	6·613	58·21
3.	0·3551	0·0234	6·589	57·98
4.	0·4495	0·0297	6·607	58·15
5.	0·2530	0·0166	6·561	57·72
6.	0·1956	0·0129	6·595	58·04
		Mean,	6·595	58·04

The probable error of the mean percentage of nickel is ±0·013, and the atomic weight 58·038, with a probable error of ±0·119.

The mean of all my determinations of the atomic weight of nickel is 58·01. The following table gives all the determinations made:—

Rothhoff,	59·20	Dumas,	59·028
Erdmann and Marchand,	58·20 to 58·60	Russell,	58·740
		Sommaruga,	58·026
Schneider,	58·04	Winkler,	59·054
Marignac,	58·40 to 95	Lee,	58·010

In conclusion, my thanks are due to Dr. Gibbs for the selection of the subject of my work, and for his advice during the course of my investigation.—*American Journal of Science.*

* Second purification.
† *Sitzungsberichte der Weinen Akad.*, vol. liv., p. 50.
‡ *Zeitschrift für Analyt. Chemie*, 1867, p. 18.

ON THE

DETERMINATION OF NITROUS ACID, WITH SPECIAL REFERENCE TO THE MANUFACTURE OF OIL OF VITRIOL.*

By W. CROWDER.

In the course of my daily occupation I have had occasion to make some observations at the chambers on the absorption of nitrous acid, and being in want of some rapid but accurate method for determining the quantity in the vitriol from the columns and denitrators, I have endeavoured to devise a good process for accomplishing this object.

I cannot find that there are more than one or two persons on the Tyne who use any quantitative process at all, most managers depending upon the rule-of-thumb method of adding water and judging the amount of absorption by the quantity of gas evolved on admixture.

The only methods with which I am acquainted are the "chloride of lime" and the "urea" processes. The chloride of lime process is in use occasionally, but I cannot find that any attempt has been made to express in terms of nitrous acid or nitrate of soda the percentage of nitrous acid present.

The directions for performing this analysis in Richardson and Ronalds are as follows:—

"A small tube, measuring 20 cubic centimetres, is filled with chloride of soda of 100 Gay-Lussac; its contents are poured into a phial which contains about two-thirds of a pint of distilled water.

"Another glass instrument, measuring 20 cubic centimetres, divided into 200 parts, is filled with nitrous sulphuric acid to be tested, and the acid is gradually poured from it into the phial which contains the solution of chloride of soda until, on adding a few drops of a solution of indigo in sulphuric acid, the blue colour is no longer destroyed. If 17 or 20 parts only have been used, 10 pints of the acid tested will cause a saving of 1 lb. of nitre. The more acid required to destroy the colour of the indigo the less nitrous acid it contains."

I have not used this method, but I hear the results are pretty constant.

* Read before the Newcastle-upon-Tyne Chemical Society.

"Hart's process," by nitrate of urea, is founded upon the fact that urea, when brought in contact with nitrous acid, is instantly decomposed into carbonic acid and nitrogen, thus:—

$$\text{Urea } C_2N_2H_4O_2+2NO_3=2CO_2+4N+4HO,$$

and upon the fact that nitrous acid decomposes iodide of potassium with liberation of free iodine.

If, therefore, a solution of a known quantity of urea be taken and nitrous vitriol dropped into it, so long as any urea remains undecomposed no reaction of nitrous acid is manifested, but so soon as all the urea is decomposed the nitrous acid produces the well-known reaction upon iodide of potassium, liberates iodine, and in the presence of a solution of starch gives at once the characteristic blue colour of iodide of starch.

The practical part of the process is as follows:—

Twenty grains of nitrate of urea are dissolved in a few ounces of water and the fluid raised to the boil. The nitrous vitriol to be examined is filled into a burette. The solution of urea is removed from the lamp and the nitrous vitriol dropped into it. Brisk effervescence takes place from the evolution of carbonic acid and nitrogen gases; a drop of the fluid is from time to time taken out and added to some drops of solution of iodide of potassium and starch spotted on a white plate. At first the iodine and starch fluid manifest no reaction, but as fresh additions of nitrous vitriol are made to the solution of urea a point is arrived at when the nitrous acid has decomposed all the urea, any further quantity of nitrous acid now remains in the fluid, and a drop of the fluid now added to the spots of iodide and starch developes the colour and indicates the conclusion of the reaction.

The number of graduations of nitrous sulphuric acid used in decomposing the 20 grains of nitrate of urea, indicates at once, by a simple calculation, the quantity of nitrous acid present.

The calculation is based on the fact, that for every 20 grs. of nitrate of urea there would be required 12·35 grs. of nitrous acid, which is equivalent to 27·64 grs. of nitrate of soda.

I have made some enquiries among chemists here, but I cannot find anyone who has succeeded in making it a practical process.

I have tried it myself on the same sample of nitrous vitriol, four times over, but I cannot say that I have been successful, as will be seen by the following results:—

Grs. of nitrate of urea required.	Grs. of nitrous sulphuric acid.
20	334·90
20	190·30
20	187·80
20	327·20

It is possible that I may not have complied with some necessary condition, but I think I have followed the process exactly as laid down in Muspratt's "Chemistry," vol. ii., p. 1040.

There appears to me to be a defect in the process, inasmuch as the reaction is ordered to be effected at a boiling-heat.

Now, on adding nitrous vitriol to a boiling solution of nitrate of urea, a very tumultuous effervescence takes place, and, I think, an error of loss of nitrous acid occurs, and from some cause, which I confess I cannot clearly understand, the reaction of iodine does not manifest itself so soon in some cases as in others, the result being that you cannot hit the mark on two occasions successively. There is a further objection, that the heating of the fluid requires time, and where many samples are to be tested, this becomes an object of some importance.

To obviate these difficulties, I have contrived a plan founded upon this reaction of nitrous acid on urea, which is exceedingly simple and gives very constant results.

I have already shown that in the decomposition of urea by nitrous acid there are formed 2 eqs. of carbonic acid, 4 eqs. of nitrogen, and 14 eqs. of water. The carbonic acid and nitrogen escape with effervescence, and by suitable appliances may be weighed; the loss of weight will express, by a simple calculation, the quantity of nitrous acid present.

The apparatus required is an ordinary carbonic acid apparatus, in which the moisture is arrested by sulphuric acid, and by which the acid to be tested can be run into the solution of nitrate of urea in a very gentle stream. Such an instrument is described in Fresenius as a Geissler's carbonic acid apparatus. The one I have been using is on the same principle, but slightly modified in details.

The operations are as follows:—

The bottle of the instrument is half filled with water, containing about 20 grs. of urea or 30 grs. nitrate of urea in solution. The instrument is now weighed; the acid tube is filled with the nitrous vitriol, to be tested and weighed again; the difference is the quantity of substance taken.

The tap containing the nitrous vitriol is turned on, and a slow stream of acid falls down through the solution of nitrate of urea to the bottom of the vessel. In the course of a few minutes the acid tube has become empty, the apparatus is shaken to cause complete admixture, and after the violent effervescence which at first takes place is over, the instrument is heated to about 200° to separate all the dissolved gas.

When cold, it is sucked through to remove the gas remaining in the apparatus and weighed.

The difference of weight before and after the operation indicates the quantity of carbonic acid and nitrogen liberated.

The quantity of nitrous vitriol taken is about 300 grs.

The calculation is as follows:—

$$C_2N_2H_4O_2+2NO_3=2CO_2+4N+4HO;$$

Therefore, $2CO_2+4N : 2NO_3$ quantity of CO_2+N found,

Equiv. = 100 : 76 : X : : nitrous acid found.

The results are very constant, as will be seen by the following analysis of samples of nitrous vitriol:—

	Expt. 1.	Expt. 2.
1st trial, by Dr. Hess ..	3·02	2·62
2nd ,, ,, ..	3·08	2·60
3rd ,, W. Crowder ..	3·16	2·63
4th ,, ,, ..	2·35	—

This process seems to me much preferable to the mode of operating with iodide of potassium and starch, and since it is dependent upon a decomposition which is perfectly definite and constant, and the results of which can be most accurately weighed, I am inclined to believe that it is much more to be depended upon than any process in use at present.

I was anxious to institute a comparison between this method and some process dependent upon the oxidation of nitrous acid into hyponitric or nitric acid. Margueritte's process for oxidising proto- into peroxide of iron, suggested itself as one of the best, from the remarkable distinctness with which the point of complete oxidation is indicated; and the rapidity with which it can be performed was a further recommendation.

With this view, I prepared a solution of permanganate of potash in water, of such strength that a burette divided into 1000 grs. measure of water, oxidised a solution containing about 5 grains of iron to peroxide, as in Margueritte's method. Now, to peroxidise protoxide of iron requires the addition of 1 eq. of oxygen to every 2 eqs. of iron.

Therefore, if 2 eqs. Fe : 1 eq. O : : Fe : O.
56 : 8 : : 5 : 0·714.

In the reaction which takes place when permanganate of potash is added to nitrous vitriol, I assume that the whole of the nitro-compounds are there in the form of NO_3. This is in accordance with the experience of those who have paid any attention to the subject, and I

further assume that this NO_3 in the addition of permanganate of potash is converted into nitric and not hyponitric acid.

The above 0·714 gr. of oxygen would, therefore, represent the following quantity of NO_3:—

$$2 \text{ eqs. } O : NO_3 :: O : NO_3$$
$$16 : 38 :: 0{\cdot}714 : 1{\cdot}70$$

The practical process is conducted as follows:—

About 100 to 150 grs. of the nitrous sulphuric acid to be tested is weighed out in a beaker of some 6 oz. capacity. The standard solution of permanganate is poured from the burette, and the number of graduations noted at the point at which the vitriol ceases to decolourise the permanganate.

Care must be taken at the commencement of the operation not to shake the acid and solution, and to keep a little permanganate floating on top of the vitriol, until the vitriol is somewhat diluted, otherwise there is fear of losing a small quantity of nitrous acid by effervescence before it becomes oxidised; this can, however, be very easily managed with ordinary care. The results are perfectly constant, as may be seen by inspection of the tables.

The operation may be varied with advantage for manufacturing purposes by taking a measured quantity of standard solution of permanganate, and dropping into it from a graduated tube, with a pinch-cock, the vitriol to be tested; and it has this great advantage, that it shortens the time, and being done by measure, it involves no trouble or time in weighing.

At the time when I first made these experiments I was not aware that such a plan (although obvious enough) was in use in any laboratory; but on communicating with Mr. Clapham, of the Walker Alkali Works, I found that he had been using this method very successfully for a long time.

From some cause, which I am as yet quite unable to account for, I find that the results obtained by this process are about one-third less than those obtained by the urea method. Whether there is any inaccuracy in the way of calculating and comparing the results I cannot yet discover; but by taking a vitriol containing a known quantity of nitrous acid, as determined by the "urea" process, and standardising the permanganate by that quantity, results are obtained which agree perfectly well with the quantity of NO_3 in other samples as determined by the urea process. It is my intention, as time and opportunity presents itself, to continue the investigation of this very interesting subject of enquiry.

Although a subject of great theoretical interest, it is one which is of considerable practical importance, inasmuch as an accurate method of determining nitrous acid cannot fail to assist a manager in settling many questions of practice about which there is at present great difference of opinion.

Need I further point out the great advantage that the man who works by "rule-of-three" has over the man who works by "rule-of-thumb?"

(To be continued.)

NOTE ON A CUPRIC PHOSPHATE FROM CORNWALL.

By Professor A. H. CHURCH, M.A.

Mr. Talling, of Lostwithiel, forwarded to me some weeks ago specimens of a beautiful mineral, emerald-green to verdigris-green in colour. It occurs on quartz in minute botryoidal forms, and gave on analysis the following percentages:—

Cupric oxide	66·61
Phosphorus pentoxide ..	24·51
Water	8·88
	100·00

From these results and others which I shall take occasion to publish before long, this mineral appears to correspond among the phosphates to Cornwallite among the arseniates. It is a rare mineral, so far as Cornish localities are concerned, though I possess a few specimens obtained from old collections.

It is pseudomalachite, var. A. of Dana, and ehlite of Breithaupt. It formula is evidently $5CuO,P_2O_5,2H_2O$, which may be written $Cu_3P_2O_8+2CuH_2O_2+aq$, thus corresponding to that of Cornwallite as revised by me,* namely—$Cu_3As_2O_8+2CuH_2O_2+aq$. The theoretical percentages demanded by the formula proposed for the Cornish copper phosphate (which is now again being raised, I am told) are these:—

CuO	66·98
P_2O_5	23·92
H_2O	9·10
	100·00

MISCELLANEOUS.

Lectures at the Franklin Institute, 1871-72.—The course of Lectures to be delivered at the Hall of the Franklin Institute, Philadelphia, comprises a series of forty lectures, divided as follows:—"On Physics and Mechanics," by John G. Moore, M.S.; "On General Physics and Acoustics," by Prof. Edwin J. Houston; "On Guns, Gunpowder, and Projectiles," by Lieut. C. E. Dutton; "On the Chemistry of the Earth and of the Vital Process in Animals and Plants," by Prof. Samuel B. Howell, M.D.; "On the History of Alchemy," by William H. Wahl, Ph.D.; "On the Metallurgy of Iron and Steel," by Thomas M. Drown, Ph.D. Besides the lectures enumerated, the Institute has arranged with a number of eminent lecturers for the delivery of a popular course of scientific subjects, for which purpose the Academy of Music has been engaged.

Masses of Meteoric Iron.—At the meeting of the Geological Society held on the 8th inst., there was read a letter from the Embassy at Copenhagen, transmitted by Earl Granville, mentioning that a Swedish scientific expedition, just returned from the coast of Greenland, had brought home a number of masses of meteoric iron found there upon the surface of the ground. These masses varied greatly in size; the largest was said to weigh 25 tons. Mr. David Forbes having recently returned from Stockholm, where he had the opportunity of examining these remarkable masses of native iron, took the opportunity of stating that they had been first discovered last year by the Swedish arctic expedition, which brought back several blocks of considerable size which had been found on the coast of Greenland. The expedition of this year however, has just succeeded in bringing back more than twenty additional specimens, amongst which two were of enormous size. The largest, weighing more than 49,000 Swedish pounds, or about 21 tons English, with a maximum sectional area of about 42 square feet, is now placed in the hall of the Royal Academy of Stockholm; whilst, as a compliment to Denmark, on whose territory they were found, the second largest, weighing 20,000 lbs., or about 9 tons, has been presented to the Museum of Copenhagen. Several of these specimens have been submitted to chemical analysis, which proved them to contain nearly 5 per cent of nickel, with from 1 to 2 per cent of carbon, and to be quite identical in chemical composition with many aërolites of known meteoric origin. When polished and etched by acids, the surface of these masses of metallic iron shows the peculiar figures or markings usually considered characteristic of native iron of meteoric origin. The masses themselves were discovered lying loose on the shore, but immediately resting upon basaltic rocks

* *Journ. Chem. Soc.*, July, 1868.

(probably of Miocene age), in which they appear to have originally been imbedded; and not only have fragments of similar iron been met with in the basalt, but the basalt itself, upon being examined, is found to contain minute particles of metallic iron, identical in chemical composition with that of the large masses themselves, whilst some of the masses of native iron are observed to enclose fragments of the basalt. As the chemical composition and mineralogical character of these masses of native iron are quite different from those of any iron of terrestrial origin, and altogether identical with those of undoubted meteoric iron, Prof. Nordensckjold regards them as aërolites, and accounts for their occurrence in the basalt by supposing that they proceeded from a shower of meteorites which had fallen down and buried themselves in the molten basalt during an eruption in the Miocene period. Notwithstanding that these masses of metallic iron were found lying on the shore between the ebb and flow of tide, it has been found, upon their removal to Stockholm, that they perish with extraordinary rapidity, breaking up rapidly and falling to a fine powder. Attempts to preserve them by covering them with a coating of varnish have as yet proved unsuccessful; and it is actually proposed to preserve them from destruction by keeping them in a tank of alcohol. Mr. Maskelyne then stated that the British Museum already possessed a specimen of this native iron, and accounted for its rapid destruction on exposure by the absorption of chlorine from terrestrial sources, which brought about the formation of ferrous chloride. This was particularly marked in the case of the great Melbourne meteorite in the British Museum; he had succeeded in protecting this, as well as the Greenland specimen, by coating them externally, after previously heating them gently, with a varnish made of shellac dissolved in nearly absolute alcohol. He considered it probable that a meteoric mass falling with immense velocity might so shatter itself as to cause some of its fragments to enclose fragments of basalt, and even to impregnate the neighbouring mass of basalt with minute particles of the metallic iron: but he considered the question of meteoric origin could only be decided by examining the same mass of basalt at some greater distance from the stones themselves, so as to prove whether the presence of such metallic iron was actually characteristic of the entire mass of the rock.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, October 16, 1871.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Thermical Researches on the Energy of the Galvanic Current.—A. Favre.—An instalment of a very excellent and exhaustive essay on this subject, but not suited for useful abstraction; an observation also applying to the following paper:—

Observations on some Points of Spectrum Analysis, and on the Constitution of the Induction Spark.—Lecoq de Boisbaudran.

Researches on the Caloric Coefficients of the Hydro-Electric and Thermo-Electric Currents.—F. M. Raoult.—The main result of the author's researches may be summarised as follows:—The heat evolved by an electric current is independent of the nature of the galvanic element; the caloric coefficient, K*e*, is the same for all sources of galvanic electricity.

Thermo-Chemical Researches on Ammoniacal Salts.—Dr. Berthelot.—The continuation of this very exhaustive memoir (see Chemical News, vol. xxiv., p. 181).

Action of Chlorine upon Various Bodies Belonging to the C_3 Series, and on Substances Isomeric with Trichlorhydrine.—C. Friedel and R. D. Silva.—The authors describe at length a series of experiments, made with the view to prove the isomerism of the compound, $C_3H_5Cl_3$, and next the identity of the two compounds, C_3H_5Cl, derived from aceton and propylen.

Hot Springs and Scalding Sands of the Maronti District of the Island of Ischia.—A. Ranieri.—The author has written a work on this subject, and proposes to utilise the natural (volcanic) heat for the purpose of evaporating sea-water. The Ancients, from a very remote antiquity, were acquainted with the phenomena here alluded to (the island is situated off Naples), and fable attributed the heat to the convulsions of the giant Typhée, killed by lightning by Jupiter, and buried under the rocks of Ischia.

October 23, 1871.

The original papers and memoirs relating to chemistry and collateral sciences published in this number are:—

Thermical Researches on the Electrolysis of the Hydracids.—P. A. Favre.—The second portion of a very lengthy and exhaustive memoir on this subject.

Variable Aspect of the Protuberances and other Remarkable Portions of the Sun's Surface.—Rev. A. Secchi, S.J.—The fifth communication on this subject, this paper being elucidated with woodcuts.

Theory of the Simple Limited Reactions by Inverse Action as Applied to the Metamorphosis of Phosphorus.—G. Lemoine.—A very lengthy algebraico-chemical paper, illustrated with woodcuts.

Industrial Working of a Deposit of Chloride of Potassium near Kalutz (Galicia).—A. Jacot.—It appears that at the locality alluded to there was discovered two years ago a saline deposit, very similar to that of Strassfurth. The kainite of the deposit alluded to consists of:—Sulphate of magnesia, 30·04; chloride of potassium, 29·46; chloride of sodium, 20·67; chloride of calcium, 1·27; total, 81·44 (the remainder upon 100 appears to be impurities, among which is clay). The mass, as brought up from the mine, is broken up, and next ground to a fine powder, then treated with warm water, and the chloride of potassium separated, and, having been dried, is chiefly used to be converted into nitrate of potassa (by means of nitrate of soda) for gunpowder manufacture. Common salt has been obtained at Kalutz for a series of years in quantities of nearly 100 tons daily.

Phosphatic Mineral Deposits in France.—M. J. Dumas.—The author exhibits specimens of a native phosphatic mineral, found near Caylux and Cajarc (Lot) some years ago; similar deposits have been found in the Département of Tarn and Garonne, samples of which gave, on analysis, 32·62 per cent of phosphoric acid, equal to 70·64 per cent of tribasic phosphate of lime. It appears that these deposits are sufficiently extensive to be quarried.

Statico-Chemical Researches on the Phenomena Observed by the Mutual Precipitation of Dilute Solutions of Salts of Silver by Hydrochloric, Hydrobromic, and Hydriodic Acids, and by Chlorides, Bromides, and Iodides.—M. Stas.—This excellent and very exhaustive essay bears especially on Gay-Lussac's process for the assay of silver by the moist way.

Thermo-Chemical Researches on Ammoniacal Salts.—Dr. Berthelot.—Continuation of this essay.

Conversion of the Glucoses into Monatomic and Hexatomic Alcohols.—G. Bouchardat.—The author describes at length how, by the application of sodium amalgam (3 per cent sodium), a solution of glucose yields a mixture of ordinary alcohol and of isopropylic alcohol. Sugar of milk, in concentrated solution, yields by the same process similar products. As regards lactine, the author states that it may be made to yield two different glucoses, one of which forms, by hydrogenation, dulcite, and, by oxidation, mucic acid; while the second yields, by hydrogenation, mannite—

$$C_{24}H_{22}O_{22}H_2O_2 = \underbrace{C_{12}H_{11}O_{11}}_{\text{Galactose.}} + C_{12}H_{11}O_{11}.$$

On Hexabromide and Hexachloride of Silicium.—C. Friedel.—Notwithstanding the high scientific merits of this essay, its contents are not suited for useful abstraction.

Method of Determining the Gases which are Formed by the Explosion of Nitro-Glycerine.—L. L'Hote.—The author introduces nitro-glycerine into an eudiometer-tube, wherein a mixture of oxygen and hydrogen is contained. When only a small quantity (6 centigrms.) of nitro-glycerine is operated upon, the tube resists the force of the explosion. 1 grm. of perfectly pure nitro-glycerine yields 284 c.c. of gas, composed, in 100 parts, of:—Carbonic acid, 45·72 deutoxide of nitrogen, 20 36; nitrogen, 33·92.

Bulletin de l'Académie Impériale des Sciences de St. Petersbourg, Vol. xvi., No. 5, 1871.

This number contains the following paper relating to crystallography:—

Crystals of Cerusite (White-Lead Ore) more Especially as Found in Russia.—N. v. Kokscharow.—Illustrated by magnificently executed engravings. The contents strictly belong to crystallography.

Journal für Gasbeleuchtung und Wasserversorgung, No. 19, 1871.

The contents of this number relate strictly to matters concerning gas- and water-works' engineering and management, but, in speaking of a severe fire at the Darmstadt gas-works in August last, the editor (Dr. Schilling) observes that this fire, originating by lightning falling upon the chimney of the aforesaid gas-works, has proved the inefficiency of lightning conductors, even when, as was the case in this instance, well made and in good working order, in the event of very severe thunder-storms taking place.

Polytechnisches Journal von Dingler, first number for October, 1871.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Observations on the Preparation of Malleable Cast-Iron.—Dr. E. F. Dürre.—This paper contains a detailed historico-practical account of a branch of industry which was originally a French invention (Réaumur), but the pig-iron preferably used for making the material is that obtained from the Ulverstone district.

Studies on Blast-Furnaces for the Smelting of Iron Ores.—C. Schinz.—The continuation of this exhaustive memoir, there being added to this portion several tabulated forms exhibiting the average specific heat of fuel.

So-Called Scott's Cement.—F. Schott.—By Scott's cement is understood a peculiar preparation of lime and sulphur, obtained either by exposing lime ignited to redness to the vapours of sulphur, or by passing sulphurous acid over lime at the ordinary temperature. The contents of this very lengthy essay are detailed under the following headings:—Preparation and nature of this cement, which varies in composition (but this may be elucidated by the following percentage figures:—Sulphuric acid, 30·65; lime, 53·70; sulphuret of calcium, 13·56; sulphite of lime, 2·09); preparation of the cement from gypsum and lime; the hardening of this cement, and the conditions under which it takes place; practical observations.

Testing of Potatoes by means of a Solution of Common Salt. Dr. W. Schultze.—This paper, elucidated by a series of tabulated forms exhibiting results of experiments, treats on the estimation of the quantity of starch contained in potatoes, by means of the specific gravity of the tubers, as determined by the aid of strong brine.

Les Mondes, October 26, 1871.

This number opens with an exhaustive description of an important work, the first part of which has been just published, viz.—

Physical Atlas of France, Edited by the Observatory of Paris, under the Direction of MM. Delaunay and Marié-Davy.—Without entering into the minute details here described, we quote the main headings of the several divisions of this work (published by MM. Hachette):—Political and administrative divisions of France; the soil and waters of France; climatology, agronomy; industry, commerce, navigation; population.

Most Advantageous Arrangement of Galvanic Batteries.—Count du Moncel.—An algebraico-physical essay.

November 2, 1871.

Production of Hydrogen on the Large Scale.—H. Giffard.—The author's apparatus (not further specified) for the production of hydrogen, by passing steam over red-hot iron has been constructed and tested at M. Flaud's works at Paris. It appears that 2 cubic metres (rather more than 70 cubic English feet) of the gas are generated per minute of time; after awhile, the oxide of iron (the current of steam having been previously shut off) is reduced again to the metallic state, by a current of dry oxide of carbon gas.

Estimation of the Value of Beet-Roots for Sugar Manufacture by Chemical Analysis.—M. Felz.—This essay treats on a method, invented by M. Tolopihine, of determining the value of the beet-root juice by a very sensitive and, for this purpose, expressly constructed areometer.

New Method of Applying Bone-Black in Sugar Refining.—E. Rousseau.—The chief point of interest in this paper is that, instead of granulated black, the author proposes to use the material in the state of powder.

Steam-Boiler Incrustation.—Rev. F. Moigno.—The substance alluded to was found to consist, in 100 parts, of:—Water, 3·0; silica, 6·05; magnesia, 3·67; oxide of copper, 11·90; oxide of iron, 7·50; lime, 20·25; alumina, 2·25; carbonic acid, 14·10; traces of sulphuric acid and chlorine; organic matter, 27·68. The water used to feed the boiler was the condensed steam from boiling beet-root juice.

New Kind of Furnace for Reviving Bone-Black.—M. Derrien.—According to the detailed financial account here given, the furnace alluded to is very economical in use.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 223, July, 1871.

This number contains the following original memoir relating to chemistry and collateral sciences:—

Report on the Bichromate of Potassa Battery in general, and particularly on the Arrangement of MM. Chutaux, Delaurier, and Barker.—Th. Count du Moncel.—This interesting paper, illustrated by a series of woodcuts, leads to the following conclusions:—Of all the galvanic elements used in industry and arts, those with bichromate of potassa yield the greatest electro-motive force, are the most economical, give off no irritating vapours, but are, on the other hand, not very constant, and become strongly polarised. These defects are less marked in the Delaurier element with two liquids, and are also greatly obviated in the Chutaux elements with constant discharge *(écoulement continu)*; the use of the Chutaux element with sand and constant discharge offers peculiar advantages in every respect for electric telegraphy and all similar applications, because this element is for equal force more economical than the Daniell element. The Delaurier element with two liquids may be advantageously used instead of the Bunsen element when strong electric currents are required; in order to obtain a continuous and energetic action with the bichromate of potassa battery, this can only be effected by the use of the air current, as invented and applied by M. Grenet; by the addition of bisulphate of mercury to the bichromate solution in the Chutaux element, a very continuous and energetic electric current may be obtained.

Le Moniteur Scientifique Quesneville, No. 355 and 356 (double number), October 1 and 15, 1871.

The original papers and memoirs relating to chemistry and allied sciences in this number are:—

On Anthracen and its Derivatives.—E. Kopp.—The continuation (see CHEMICAL NEWS, vol. xxiv., p. 120) of the very elaborate and exhaustive essay on this subject, divided into the following sections:—Action of bromine upon anthracen; action of oxidising substances on anthracen; action of chromic acid on anthracen. This essay is to be continued.

Diffusion of Albuminous Liquids when placed in Contact with Distilled Water.—A. Commaille.—The contents of this paper bear strictly upon physiology rather than chemistry, but we call attention to its contents on account of the light it throws upon the active principles in vaccine lymph and other animal fluids.

Second Memoir on the Action of Ammonia upon Phosphorus.—A. Commaille.—This essay describes a series of experiments, under the following headings:—Action of ammonia upon the phosphuret, P_3H; action of supersaturated solution of liquid ammonia upon phosphorus; action of liquid ammonia upon phosphorus assisted by heat; action of dry ammonia gas upon phosphorus (contrary to what is stated in the "Dictionnaire de Chimie," vol. i., p. 216, *dry* ammoniacal gas does not exert any other action upon phosphorus than the change that element undergoes by exposure to light); action of carbonate of ammonia upon phosphorus; action of an alcoholic solution of ammonia; action of the last-named assisted by heat; action of water upon the deep green coloured phosphorus, and search for ammonia in that phosphuret of hydrogen.

Researches on the Influence of Temperature upon the Optical Rotatory Power of Ordinary Sugar and Inverted Sugar.—C. Tuchschmid.—We regret that the contents of this excellent and practical essay are not suited for abstraction, on account of the necessity of reproducing, for the proper understanding of the subject, a series of tabulated formulæ.

Destruction of Torpedoes when placed under Water.—A. Guiot.—This interesting paper embodies the author's ideas on this subject, as communicated to M. le Ministre de la Marine.

NOTES AND QUERIES

Gallic Acid.—(Reply to S. E. P.)—Be kind enough to notice Errata inserted in the same column below your query; then substitute HO to SbO_3 in the correct formulæ. They then become—

(1). $HO(C_7HO_3)_2+3HO=C_{14}H_6O_{10}$.
(2). $HO(C_7HO_3)_2+5HO=C_{14}H_8O_{12}$.

Formula (1) is that of gallic acid dried at 100°; (2), that of crystallised gallic acid. Then follows this little calculation:—

Hugo Tamm's formula $=C_{14}H_6O_{10}$.
Hugo Schiff's formula $=C_{14}H_6O_{10}$.

Consequently—

Hugo Tamm's formula = Hugo Schiff's formula.

Divide both members of equation by "Hugo's formula," and you will find that—

Tamm = Schiff.

In other words, the two Hugo's agree splendidly together.—HUGO TAMM.

MEETINGS FOR THE WEEK.

MONDAY, Nov. 20th.—London Institution, 4. Prof. Huxley, LL.D., F.R.S., on "Consciousness" (Course of Elementary Physiology).
—— Medical, 8.
TUESDAY, 21st.—Civil Engineers, 8.
—— Zoological, 9.
WEDNESDAY, 22nd.—Society of Arts, 8.
—— Geological, 8.
THURSDAY, 23rd.—London Institution, 7.30. Mr. P. L. Simmonds, F.R.C.I., F.S.S., on "Science and Commerce; Illustrated by the Raw Materials of our Manufactures."
—— Royal, 8.30.
—— Philosophical Club, 6.
FRIDAY, 24th.—Quekett Microscopical Club, 8.

TO CORRESPONDENTS.

E. K.—"Elements de Chimie," par M. Victor Regnault (Paris: Victor Masson et Fils), is one of the best for your purpose; as there are several editions be careful to order the last.

C. Claus.—We cannot insert your reply to our querist, "W. S."; it is better adapted for our advertisement columns than for "Notes and Queries."

NOTICE TO AMERICAN SUBSCRIBERS.

In answer to numerous inquiries, the Publisher begs to state that Subscribers in the United States can be supplied with the CHEMICAL NEWS from this Office, post free, for the sum of £1 2s. 4d. per annum payable in advance.

Now ready, Second Edition, much Enlarged, with numerous Engravings, 8vo., 12s.,

A Systematic Handbook of Volumetric Analysis; or the Quantitative Estimation of Chemical Substances by Measure, applied to Liquids, Solids, and Gases. By Francis Sutton, F.C.S., Norwich.

J. and A. Churchill, New Burlington Street.

Now ready, Sixth Edition, with 98 Engravings, fcap. 8vo., 6s. 6d.,

Bowman's Practical Chemistry, including Analysis. Edited by C. L. Bloxam, Professor of Chemistry in King's College, London.

J. and A. Churchill, New Burlington Street.

Now ready, price 4s., with coloured frontispiece of the more important of the Spectra.

Inorganic Chemistry, by the late Professor George Wilson, of Edinburgh University; thoroughly revised and brought up to the latest state of the Science by H. G. Madan, M.A., Fellow of Queen's College, Oxford, and Natural Science Master in Eton College.

W. and R. Chambers, London and Edinburgh.

Chemical Technology, or Chemistry in its Applications to the Arts and Manufactures. By Thomas Richardson and Henry Watts. Second Edition, illustrated with numerous Wood Engravings.

Vol. I., Parts 1 and 2, price 36s., with more than 400 Illustrations.

Nature and Properties of Fuel: Secondary Products obtained from Fuel: Production of Light: Secondary Products of the Gas Manufacture.

Vol. I., Part 3, price 33s., with more than 300 Illustrations.

Sulphur and its Compounds: Acidimetry: Chlorine and its Bleaching Compounds: Soda, Potash: Alkalimetry: Grease.

Vol. I., Part 4, price 21s., 300 Illustrations.

Aluminium and Sodium: Stannates, Tungstates, Chromates, and Silicates of Potash and Soda: Phosphorus, Borax: Nitre: Gun-Powder: Gun Cotton.

Vol. I., Part 5, price 36s.

Prussiate of Potash: Oxalic, Tartaric, and Citric Acids, and Appendices containing the latest information and specifications relating to the materials described in Parts 3 and 4.

Bailliere and Co., 20, King William Street, Strand.

AMSTERDAM EXHIBITION, 1869.

The GRAND DIPLOMA of HONOUR, being the First Prize, and superior to the Gold Medal.

Liebig Company's Extract of Meat.—Paris EXHIBITION, 1867, TWO GOLD MEDALS; HAVRE EXHIBITION, 1868, THE GOLD MEDAL.—Only sort warranted perfect and genuine by Baron Liebig, the Inventor. "A success and a boon."—Medical Press and Circular. One pint of delicious beef-tea for 2½d., which costs 1s. if made fresh from meat. Cheapest and finest-flavoured "stock" for soups, &c.

CAUTION.—Require Baron Liebig's signature upon every jar. Sold by all Italian Warehousemen, Grocers, Chemists, and Ships. Store Dealers; all Wholesale Houses; and of LIEBIG'S EXTRACT of MEAT COMPANY (LIMITED), 43, Mark Lane, E.C.

NOTICE.—Various chemical analyses have been published purporting to show a fraction more of moisture to exist in the Company's Extract than in some imitation sorts. It is extremely easy to evaporate the water almost to any extent, but it is quite as certain that the fine meaty flavour which distinguishes the Company's Extract from all others would be destroyed if the concentration of the Extract were carried beyond a certain degree. Beef-tea made from Liebig Company's Extract with *boiling-hot water* will be found to be greatly superior in flavour, strength, and clearness, to any other sort. This explains the universal preference it obtains in the market.

This Extract is supplied to the British, French, Prussian, Russian, and other Governments.

PRACTICAL CHEMISTRY.

Laboratory, 60, Gower Street, Bedford Square, W.C.

Mr. Henry Matthews, F.C.S., is prepared to give Instruction in all branches of PRACTICAL CHEMISTRY, particularly in its application to MEDICINE, AGRICULTURE, and COMMERCE.

The Laboratory is open daily, except Saturday, from ten to five o'clock; on Saturday, from ten till one o'clock.

Mr. Matthews is also prepared to undertake ANALYSES of every description.

For Particulars and Prospectuses, apply to Mr. Henry Matthews, the Laboratory, 60, Gower Street, Bedford Square, W.C.

BERNERS COLLEGE of CHEMISTRY.—EXPERIMENTAL MILITARY and NAVAL SCIENCES, under the direction of Professor E. V. GARDNER, F.E.S., &c.: of the late Royal Polytechnic Institution and the Royal Naval College.

The Laboratory and Class Rooms are open daily.

Especial facilities for persons preparing for Government and other examinations.

Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

For particulars, &c., apply to Prof. E. V. G., 44, Berners-street, W

North London School of Chemistry, Pharmacy, &c.—For Instruction in Practical Chemistry and Evening Classes for the Study of Chemistry, Botany, Materia Medica, &c. Conducted by Mr. J. C. BRAITHWAITE, *for thirteen years Principal Instructor* in the Laboratories of the Pharmaceutical Society of Great Britain, and Demonstrator of Practical Pharmacy, Pharmaceutical Latin, &c.

Mr. Braithwaite, having taken the premises adjoining his house, has been enabled *nearly to double the size of his Laboratories*, and, at the same time, procure a large piece of ground which *he has had laid out as a Botanic garden*. Every facility is, therefore, offered to Students desirous of acquiring a practical knowledge of this branch of their education.

The Session 1871—1872 will commence on the 2nd of October, when the Laboratories will re-open at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

THE CHEMICAL and TOXICOLOGICAL CLASS will meet as usual every Monday and Thursday evening, commencing October 2nd, at 8 p.m.

The LATIN CLASS for the reading of Physicians' Prescriptions, Cæsar's Commentaries, &c., every Tuesday and Friday evening, commencing October 3rd, at 8 p.m.

The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday evening, commencing October 4th, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will be continued every Saturday, until further notice, at 10 a.m.

Fee to either of the above Classes Half-a-Guinea per Month. Pupils can enter at any period.

Gentlemen Privately Prepared for the Examinations of the Pharmaceutical Society, and the "Modified Examination for Assistants," &c

All Fees must be paid in advance.

Letters of inquiry should be accompanied with a stamped envelope.

Mr. Braithwaite receives a few Pupils to Board in his house.

Address—54, Kentish Town Road, N.W.

ANALYTICAL LABORATORY AND SCHOOL OF TECHNICAL CHEMISTRY.

7 and 9, HACKIN'S HEY, LIVERPOOL.

Conducted by A. NORMAN TATE, Analytical and Consulting Chemist, and Chemical Engineer.

Established for Educational Purposes connected with Chemistry in its practical Applications to Manufactures, Commerce, &c.; for the performance of Analyses, Assays, and Chemical Investigations; and for affording information respecting the construction, &c., of Chemical Manufactories, and the conduct of Chemical Manufacturing Processes.

The Course of Instruction, in addition to the ordinary Chemical studies, comprises, as far as possible, all such other subjects as are necessary to give the scientific and practical information required in the Arrangement, Construction, and Management of Chemical Manufactories, and in the Application of Chemistry to Industrial Pursuits.

Students' Fees may be known on Application.

Plans, &c., for Chemical Apparatus and Manufactories are supplied, and the Erection of Plant and Buildings is superintended when required.

Water-glass, or Soluble Silicates of Soda and Potash, in large or small quantities, and either solid or in solution, at ROBERT RUMNEY'S, Ardwick Chemical Works, Manchester.

THE CHEMICAL NEWS.

Vol. XXIV. No. 626.

ON THE METHOD OF ASSAYING SILVER ADOPTED IN THE ASSAY OFFICES OF H.M. INDIAN MINTS.*

By H. E. BUSTEED, M.D.,
H.M. Madras Army, Officiating Assay Master, Calcutta Mint.

The process of assaying silver about to be considered is one which (on a large scale, at least) is peculiar to the Indian Mints: it has been in practice in the Calcutta Mint since 1850; it extended thence in course of time to the Bombay Mint, and more recently to the Madras one.

Though it has been favourably reported on, and described more or less fully as an official duty by various assay officers to local Mint Committees, &c., &c., no steps, that I am aware of, have yet been taken towards making more public the manipulatory details of the process.

It has been suggested to me that it might prove not only interesting, but useful to have described the practical working of a system of the utility of which great experience has been afforded in the Indian Mints, as, on assays made by it, an amount of silver bullion reaching on an average the value of over seven† millions sterling is annually purchased by these mints, and by it a silver coinage to about the same value annually, is watched over as regards its purity and maintained up to the legal standard of fineness.

I propose, therefore, to give a somewhat detailed account of the process, omitting only the minor steps in the manipulations, which it would be unprofitably tedious to attempt to bring within the compass of a description; practice alone can lead to an acquaintance or can familiarise with these.

To render more intelligible to the general reader the nature and object of this process of assay, and wherein it contrasts with the other methods in more general use, it may be desirable in the first place to allude briefly to the principles on which those other systems depend for their results, avoiding technicalities and details, as a full description of those processes may be found in any work on assaying, and in most works of chemistry and metallurgy.

In general terms, then, it may be said, that the particular duty of an assayer is to ascertain the proportion of pure gold or silver present in any specimen of mixed metal submitted to him for examination, so that from this report the value may be assigned by calculation to the mass which the sample is supposed to fairly represent.

This is done by the separation of the precious metals from the coarser ones with which they may happen to be alloyed.

The most ancient plan for thus separating silver is that by "cupellation" which attains the end in view, owing to the fact that silver resists the action of air, at a high temperature, while the baser metals under identical circumstances become oxidised, and if a certain proportion of lead be present, its very fusible oxide unites with the other oxides produced during the operation and renders them capable of soaking with it into a porous little vessel (made of bone-ash), called a cupel, leaving behind on the surface of each cupel a glistening button of pure metallic* silver, whose weight can be accurately ascertained.

A certain weight of the specimen of the metal to be assayed is folded up in a certain proportion of thin lead and placed on a cupel. The operation is conducted in a suitable oven (called a "muffle") and furnace. When the remaining little button of silver has cooled, it is weighed and the loss of weight of the specimen operated on represents the baser metals that have been removed; thus, if the specimen weighed 20 grs. and the resulting bead of pure metal weighs 15 grs., the mass would be reported to contain 75 per cent of pure silver.

Several contingencies, however, and collateral circumstances (known to assayers) tend to modify the result of an assay by cupellation, and the assayer has to consider them all in arranging his compensation; failing this the report would be most erroneous; everything, therefore, depends on his skill and experience; but even in the hands of the most experienced and the most skilful the result will fall short of accuracy, and a margin for error must be left, owing to unavoidable imperfection in the assay: the average range of this error ought not, however, to exceed ½ dwt. (12 grs.) in the lb. troy, or say 2 parts in 1000; so that this method is sufficiently accurate for keeping a coinage tolerably close to "standard" and even well within† the legal limits on either side of it.

The assay report furnished by it, however, is too remote from accuracy, *i. e.*, is not within sufficiently narrow limits to fairly regulate the valuation of merchants' bullion with satisfaction to seller or buyer, the latter being, in this country, almost invariably the mint.‡

The above was the method of assay prevailing in this mint up to 1850. Though it is still practised by many English assayers of great skill, it has been almost entirely superseded on the Continent in consequence of its shortcoming by one contrived by Gay-Lussac, which is less dependent on the individual operator.

This, known as *La voie humide*, or the volumetric process for ascertaining the fineness of silver bullion, consists in precipitating the silver as an insoluble chloride from the solution in nitric acid of a certain weight of the metal to be examined, and in effecting this by the use of a solution of common salt (chloride of sodium), containing a known proportion of salt; this is added gradually till just sufficient has been used to throw down the whole of the silver present as chloride; as chlorine unites with silver in definite chemical proportion, the amount of silver present can be easily and accurately estimated by merely ascertaining the amount of salt which has been exactly necessary to convert the whole of it into chloride of silver.

This is the method practised at the Paris Mint, and by the eminent outside assayers to the Royal Mint of Great Britain, and I believe at most of the European and American Mints.

Assays can be confidently made by it to ¼ dwt. or about 6 grains in the pound troy, or even indeed to half this, say to ½ part (0·5) in 1000.

The volumetric system is especially applicable where the silver to be assayed by it is alloyed with copper only, and where the fineness is approximately known beforehand; both these conditions to its successful usage exist

* From the *Journal of the Asiatic Society of Bengal.*

† Average for last 20 years.

* Should gold or platinum happen to be present in the specimen assayed, as they also resist oxidation, they remain behind, included in the "button," and are, under ordinary circumstances, estimated as silver.

† It being impossible in the operations of a mint to produce a certain mixture of metals (such as silver and copper) with mathematical accuracy, a certain deviation is allowed above or below the legal standard. In India this deviation or "remedy" in fineness is 1 dwt. in the pound troy, *i. e.* 1-220th part, equal to about 4½ parts in 1000.

PS. Since this paper was read, a Legislative Act of the Government of India has been promulgated which declares that the remedy in fineness is not to exceed 2 thousandths for the rupee and half rupee, and 3 thousandths in the case of the smaller silver coins.

‡ That is, the mint receives the bullion in bulk and returns it in coin, a certain seignorage to cover expenses being deducted.

in such mints, where the only silver assays made are those of metal already alligated for coinage to the legal standard.

It is acknowledged by its advocates that the presence of mercury in the alloy would materially interfere with the accuracy of the assay, and a certain (rather tedious) modification of the process is essential to avoid error under such a contingency.

Its adoption in the Indian Mints was not considered desirable by their assay officers for reasons of which the following are a few :—

1. A vast amount of the silver which comes to the Indian mints, (viz:, China and Rangoon Sycee, bazaar cake silver, Japanese coins, &c.,) contains not only mercury, but lead and other coarse metals.

2. No sufficiently approximate idea of the fineness of such silver can be formed beforehand, thus necessitating a preliminary assay by cupellation.

3. The high temperature of an Indian climate renders it impossible to retain the solution of salt at an uniform strength for any length of time; the evaporation and concentration derange the equivalence which it is essential to maintain between it and the proportion of silver meant to be precipitated by it; thus involving very frequent tedious testing to ascertain daily the actual strength of the standard solution.

4. The whole of the important manipulations should be gone through by the assay master himself or his deputy, a labour beyond their strength in this climate with a very large daily number of assays of various finenesses; and one which would preclude the possibility of his attending to the many other important duties which devolve on the head of an assay office to a mint in India.

The method of assay by cupellation, then, not being accurate enough for the requirements of trade, and that by the French process being considered unsuited to the peculiar work devolving on the assay officers of the mints in India (where there are no bullion refineries), it became necessary here to adapt and introduce a system more likely to fulfil all the objects required of it.

In the volumetric system it has been seen that the proportion of silver present in a mixed metal is estimated by ascertaining the exact amount of salt which it took to precipitate it in the form of chloride of silver; the same end can be attained by collecting, drying, and weighing the chloride itself. One hundred parts of it represent 75·3 of pure (metallic) silver.

Hitherto this process when resorted to at all seems to have been restricted to a very limited application, such as a solitary analysis for some special purpose, possibly the examination of a standard "trial-plate" where the greatest accuracy was required, or perhaps an assayer would resort to it as a delicate confirmatory test of one or two of his assays by the volumetric method.

Some books which go into the principles and details of the assaying of silver, make no mention of it whatever; others allude to it merely to dismiss it as "tedious and less exact" (than the French process). In theory, the process is allowed by all to have the merits of accuracy and simplicity, but it is implied that the tediousness and difficulties of the manipulations (supposed to be) necessary to the carrying out of the theory, detract materially from its practical value; certainly the few details of the manipulations occasionally given, such as the weighing the chloride of each assay (after collecting on a filter and fusion)* in a porcelain capsule, previously counterpoised, were calculated to deter from the idea of this process being ever made available for the assay of silver on a large scale.

The credit is due to Mr. J. Dodd, a former assay master of the Calcutta Mint (and a surgeon in the Madras army), of having encountered those difficulties of manipulation, and of having overcome them, inasmuch as he modified and simplified them, and in short so systematised the whole practical working of the process as to render its application to the assaying of silver, to any amount, easy, accurate and economical.

That this result was not attained without much labour and much patient investigation, and that his successors in office acknowledge their deep obligation to Mr. Dodd's intelligent industry, will be apparent from the officially recorded testimony of two of them, which I think it due to him and to them not to withhold, when making mention of the practical carrying out of this method of assay. Viz., Sir Wm. O'Shaughnessy, who was deputy assay master of the Calcutta Mint in Mr. Dodd's time, and himself a practical chemist of high reputation, writes in April, 1852 :—

"Previous to making overcharge of the assay office to Dr. Shaw on the occasion of my proceeding to England on duty, I deem it an act of justice towards the assay master, Mr. James Dodd to place upon record an acknowledgment of the eminent service Dr. Dodd has rendered to the assay department and to the art of assaying generally by his investigation of the analytical process for assaying silver, his improvements in the manipulation of the process, and his admirable system of arrangement which renders it capable of effecting in 24 hours more assays of silver than the mint can ever require in that time."

Dr. Shekleton, the present assay master (now on leave), an assayer of long experience, when giving officially to the Mint Committee at their request a detailed statement of the process says (April, 1855) :—

"It would be quite impossible, however, by any mere description to form an adequate idea of the eloquence of the process, or the perfection to which it has been brought by the skill and unwearying industry of Mr. Dodd, late assay master. To him is due, not only the merit of its introduction, but the removal of every practical difficulty in its working; the confidence with which his system has been adopted by all his successors is the highest tribute to its completeness and efficiency."*

Method of Assaying Silver by the "Chloride process" (as conducted in the Calcutta Mint) given somewhat in detail.

The samples (or "musters") for assay are, to save time, first approximately weighed by an assistant; they are then placed (each sample in duplicate) in small shallow saucers of polished copper, and so brought in batches of 40 on a board, containing in numerical order receptacles for the little saucer, to the assay master who, in the delicate assay balance, exactly brings each sample to the one required weight.†

As each sample is weighed, it is transferred from the platinum skiff of the balance to a bottle on the left hand of the assayer, by means of a small copper funnel. The bottles‡ for this purpose are held in readiness for the musters by an assistant, and, on receiving them, are removed into the laboratory in batches of six.

On being taken to the laboratory, they are ranged on a circular platform or turn-table, and there one of the (European) assistants adds by means of a pipette 1½ drms. of nitric acid to each bottle, which are then (without their stoppers) transferred to a sand-bath and exposed to a considerable degree of heat, till solution of the contents is effected.

The specific gravity of the nitric acid used is generally 1200, *i. e.*, in the case of known alloys of only copper and silver, such as the standard meltings, coins, &c., but when

* Of course in practice it would be necessary periodically to recover the silver (by reducing it to the metallic state) from the closely attached fused chloride in each capsule,—a very tedious measure.

* When in the Madras Mint, I remember seeing recorded similar testimony from Dr. Shaw, the assay master, when describing the process on recommending to the Madras Government its adoption in his office.

† The amount of this weight will be more particularly referred to further on.

‡ The chief appliances will be described more fully in an appendix.

the nature of the alloy is uncertain, such as bazaar silver, or some sycee (where the presence of mercury may be suspected), a stronger acid of sp. gr. 1320 is used. It has been found, too, by experience that the chlorides from fine bar silver eventuate better when the solution has been effected in the stronger acid.

When the samples have been completely dissolved,* the bottles are brought back to the platform and there each receives through a glass funnel† about six ounces of cold distilled water.

There is then added to each bottle through a glass pipette as before 1½ drms. of hydrochloric acid, sp. gr. 1060, which immediately converts the silver present into the characteristic white precipitate of chloride of silver, which forms in slow-falling curdy volumes.

The stoppers (previously dipped in distilled water) are then carefully replaced, and the bottles are allowed to stand for five minutes.

The bottles are next well shaken two and two by the laboratory workmen for three or four minutes till the chloride aggregates and rapidly falls down; any particles which may retain attached to the neck or upper part of the bottles are washed down by a quick circular motion, and more distilled water being added to within about two inches of the neck (great caution being observed in removing and returning the stoppers), the bottles are then allowed to rest each in its assigned place on the platform for four hours.

At the expiration of that period, the clear supernatant liquid (blue-coloured when copper is present) is removed by a glass syphon, which is lowered to within an inch of the deposited chloride, the greatest care being taken that none of it is drawn up into the syphon. As each platform is made to revolve on its centre, according as each bottle is syphoned, the operator sitting in one place brings the platform round till the next bottle in order gets under the syphon, which is thus in rotation lowered into each. The fluid escapes from the long leg of the syphon through a funnel fitted in the table to a jar placed underneath.

After the first syphoning, the bottles are immediately filled again with distilled water, and each gets a quiet circular motion for a few moments, and the precipitate is again allowed to settle as evenly as possible; this time it will be sufficient to allow them to rest for two hours, when they are again syphoned as before and the stoppers returned.

Under ordinary circumstances these two washings are sufficient, but if the silver is evidently "coarse," a third or fourth washing is similarly given.

When it is considered that the chlorides have been sufficiently washed, the bottles are placed for half an hour in a reclining position on their platforms; this causes the chloride to fall and settle to one spot and renders its removal from the bottles more easy.

Meantime a pneumatic trough has been got ready, capable of containing a batch of twenty inverted bottles; the trough is filled with distilled water; for each bottle there is placed on the floor of the trough a small porcelain saucer holding a little Wedgwood crucible or cup, each numbered to correspond to the bottles. A laboratory workman then removes the stoppers from the bottles and hands them one by one to an assistant at the trough, who, placing his forefinger over the mouth of each bottle inverts it over its corresponding cup, and does not remove his finger till the neck of the bottle has passed down through the water and well into the cup; then the finger being taken away the bulk of the chloride falls by its own weight to the bottom of the cup.

The bottle is held in the position by two rings, one (the larger) above the other, which are fixed to the sides of the trough; this arrangement retains each bottle *in situ*, at the proper slant, and admits of the operator gently revolving or slightly raising the bottle with his left hand, while with the right he patiently taps the bottom and sides till the whole of the chloride has been dexterously got out; the finger is then again placed over the mouth and the bottle raised up through the rings and handed (mouth upwards) to the assayer, or to the supervising assistant standing by, who carefully examines it to see that every particle of chloride has been dropped into the cup. When this part of the manipulation has been neatly done, none of the chloride falls over into the saucer which is placed as a precautionary measure under each cup.

When the chloride falls into the cup, it is in an uneven lumpy state and not in a favourable condition for being uniformly dried; it has, therefore, next to be broken up. For this purpose the cups (containing the chlorides, and water to the brim) on removal from the trough are taken in batches on a tray to an assistant seated at a steady table, who first carefully decants off about half the water, and then with a finely polished glass rod (four inches long and one-third of an inch thick) gently stirs and beats the lumpy precipitate, while revolving the cup on the table; this causes it to lie evenly and loosely at the bottom of the cup as a purplish grey powder, not too fine.

He next washes the rod over the cup with distilled water from a drop bottle, lest any of the chloride may be adhering to it, and sprinkles a drop or two from it on to the surface of the water in each cup, so as to cause to sink any minute particles that may happen to remain floating. He then, after an interval of ten minutes, drains off about three-fourths of the supernatant water, which he lets run down the rod into a vessel near him, and with a tap or two with the rod to the outside of the cup to still further loosen the deposit, this part of the manipulation is concluded.

The crucibles are next taken to the drying furnace, where a steam bath is ready to receive them; on the perforated upper plate of this they are ranged, and allowed to remain for about an hour. This gradually, and without spurting, frees the chlorides from moisture, which may be known by their caking, *i. e.*, leaving the sides of the cups round the edges and forming at the bottom of each a loose cake, resembling somewhat a gun-wad. The crucibles are then arranged on a hot air plate and there exposed to a temperature of between 300° and 350° (F.) for about two hours, till thoroughly dried, when they are ready for weighing.* When the above manipulations have been carefully and satisfactorily gone through, each little cup contains an unbroken, tolerably firm, cake of chloride of silver, lying unattached, which admits of being easily grasped with a pair of forceps, and cleanly lifted out of the cup and conveyed to the skiff of the assay balance in which it is weighed. The cups are generally brought from the laboratory to the assayer at the balance in batches of eight or ten. A "standard," synthetically prepared of pure silver and copper, and an assay pound of pure silver are introduced with each day's set of assays, and their chlorides dried with the others, and the analysis of them verified before weighing the rest. Occasionally these "checks" are also fused and weighed in a porcelain capsule, but the weight found never differs from that of the chloride merely dried as above.

Once or twice a month, the silver is recovered from the accumulated chlorides, which are well pounded in a mortar and brought to a powder and then mixed with a proper proportion of chalk and charcoal, and put into a wrought-iron crucible and reduced with heat. The metallic silver so recovered is transferred to the mint.

Under the circumstances of the solution and of the precipitation as detailed above, should any gold happen to be present in the sample operated on, it is not dissolved, and, therefore, becomes entangled with the precipitated

* A slight residuum of gold as a black powder is very generally seen.

† The portion of this which enters the neck of the bottle is protected, or sheathed, with an inch of India-rubber tubing to prevent chipping, if struck against the neck of the bottle.

* The chlorides are weighed warm, to obviate the risk of their absorbing moisture; a precaution especially necessary in the heavy monsoon weather in this country.

chloride of silver and dried and weighed with it, and accordingly comes to be regarded and valued as silver. In this the chloride process resembles that by cupellation, which likewise takes no distinguishing cognisance of gold, and both these processes contrast in this respect with the volumetric one, which is a rigid analysis for silver alone; so that, strictly speaking, an assay conducted by either of the first named methods ascertains the proportion present of "the precious metals," *i. e.*, silver and gold.*

Should mercury be present it does not interfere with the result, when the solution has been effected in excess of nitric acid with strong heat. Thus the mercury becomes peroxidised, and hydrochloric acid forms no precipitate in solutions of mercuric salts; any mercuric chloride resulting from the combination would remain in solution and be washed away in the course of the process.

Should lead happen to be present, hydrochloric acid gives no precipitate in a dilute solution, the chloride of lead being soluble in a certain proportion of distilled water; but even were the proportion of lead to silver tolerably large, and the chloride of lead happened to be thrown down, the repeated washings would dissolve and get rid of it.

(To be continued.)

EXPERIMENTS ON THE PREVENTION OF THE DEVELOPMENT OF FUNGI IN AQUEOUS SOLUTIONS OF TARTARIC ACID,

AND THEIR BEARINGS ON THE THEORIES OF THE ORIGIN OF, AND CONDITIONS ESSENTIAL TO, LIFE.†

By W. H. WOOD.

1. In all cases of original scientific research, the investigator sets before his mind's eye the attainment of one or more of several results. He either wishes by his experiments to train his mind to the observance of phenomena and to the deduction and induction of results therefrom, the truths arrived at being, in this case, only of secondary importance; or he wishes, by such research, to augment the amount of truth and knowledge of the particular branch of science with which his research stands connected. Added to these may be the desire to apply the results so obtained in the arts and manufactures either for general or personal benefit, The love of scientific research for its own sake, without the wish to apply it at all to ulterior purposes, must for ever stand pre-eminent over researches made for any other end, for we consider the discovery of the truth, both scientific and otherwise, to be the duty as well as the highest aim and the noblest occupation in which man can engage.

2. The experiments about to be detailed were made with the intention of giving the experimenter a training, to some extent, such as has just been indicated, but at the same time the importance of the truths to be discovered was not considered as standing in the second place, but as being of equal, if not of greater moment.

3. It has long been known to chemists that aqueous solutions of tartaric acid exhibit—at a shorter or longer time after their preparation—signs of decomposition, as indicated by the growth of fungi, and the production of a small quantity of acetic acid in them. That this fact is generally known, will, I think, be evident from the following quotations:—

(*a*). The late Professor Miller, in his "Chemistry," vol. iii., p. 438, 3rd edition, says: "Its aqueous solution becomes mouldy when long kept, and is slowly converted into acetic acid."

(*b*). Richardson and Watts's "Chemical Technology," vol. i., part v., p. 163, says: "The solution becomes mouldy by keeping, producing a small quantity of acetic acid."

(*c*). Watts's "Dictionary of Chemistry," vol. v., p. 677, says: "The aqueous solution becomes covered, after a while, with a fungous growth."

These quotations might be greatly multiplied, but we think sufficient have been given to show that the fact above stated is generally known. Anyone, moreover, who has had a moderate amount of practice in chemical analysis must have proved the truth of this statement many times; and it was from coming in contact again and again with such solutions, that I was led three-and-a half years ago—simply from a desire to extend the domain of truth, and to train my faculties of observation and reasoning—to commence the course of experiments, some of which, with their results and deductions drawn from them, I intend to describe to you this evening.

4. My first experiments were made on July 18th, 1867. About two ounces of solution of tartaric acid was made by boiling 1 ounce of crystals of the acid in Halifax town's water as drawn from the tap. The solution was filtered, and divided into two portions of about an ounce each, and these placed in 2-oz. stoppered bottles, marked A. and B. To A. two drops of creosote were added, while B. was not subjected to any further treatment. These solutions are before you (part of B. has been used for another experiment), and you will see that up to the present, no formation of fungi or mould has occurred in either. The conclusion therefore seems warrantable from these experiments, that boiling the solution prevents the development of fungi.

5. This conclusion was—ten months after preparing the solutions just described, viz., on May 22nd, 1868—put to the test of experiment, in order to prove its truth or falsity. For this purpose three solutions of the acid were made with the same kind of water as before: No. 1 solution, by dissolving 40 grs. of acid in 1 oz. of the water, and filtering the solution without even warming; No. 2 solution, by dissolving the same amount of acid (40 grs.) in the same quantity of water (1 oz.), which had just been boiled, and was still hot, filtering as before; No. 3 solution was of the same strength as Nos. 1 and 2, but the solution was boiled for a few minutes, and then filtered. These solutions are also before you, and you will observe that while No. 1 solution contains—what was some time ago white mould with brownish nuclei—but which has now become almost entirely brownish, Nos. 2 and 3 solutions contain only a slight amount of sediment, without the least appearance of fungi. From this it is evident that boiling the solutions does prevent the development or formation of the fungi or mould. This treatment of the solutions (viz., the boiling), has, in every case but one in which it has been tried, been found to be efficacious; the case in which fungi have developed, even after boiling, is possibly explainable on certain grounds, as I shall endeavour to show, as also, maybe, a case in which an unboiled solution has not developed fungi.

6. The next solution before you (to take them in the order of their preparation)—and I should state that I shall only describe these, though they are not more than one-half of the solutions I have prepared,—is marked B, and is one of three experimented with on August 12th, 1868. A mouldy solution of the acid was filtered, and divided into two portions marked B. and C. B. was not heated, and has, as you see, again developed fungi, while C. (see Appendix), which is at Halifax, had not, the last time I saw it, developed any.

7. The question suggested itself to my mind, as to whether exposure to light had any influence upon the development of the fungi. To determine this point, I made

* Much of the silver which finds its way to the Indian mints is rich in gold; for instance, sycee contains on an average somewhat about 12 grs. in the troy pound. This in minting operations is considered as silver, and as such it enters into the coinage. There being as yet no refineries established here, through which such silver could pass to the mechanical departments of the mints the silver coins made during a period when a heavy importation of sycee had been worked up. contain as much as 4 or 6 grs. of gold in every 32 tolas or 1 pound troy.

† From the *Transactions of the Cleveland Litarary and Philosophical Society.*

on the 21st of September, 1868, two solutions (Nos. 1 and 2) of which No. 1 is before you, by dissolving 20 grs. of the acid in 240 grs. of Halifax water in the cold. The solutions were filtered, and No. 1 was exposed to light, while No. 2 was shut up in a dark cupboard. When examined on the 11th of January, 1869, No. 1 had developed fungi, while No. 2 had not. No. 2 being at Halifax, I cannot state positively whether fungi have developed yet or not (see Appendix). Anyhow, it is evident from these experiments that exposure to light does cause the fungi to develop more rapidly if it is not essential to their development.

8. The character of the water employed next suggested itself as possibly influencing the development of the fungi. To ascertain to what extent this possible cause operated, I made three solutions with Manchester water in the laboratory of Owen's College, in December, 1868, and January 1869, as follows:—Two solutions were made (the proportion of acid to water not being noted) with distilled Manchester water. No 1 was filtered but not heated; No. 2 was filtered and boiled (time of boiling not noted), and a third solution (No. 3) was made in undistilled and unboiled water, the solution being filtered. No. 1 solution has, as you see, undergone the usual change; No. 2, which was (as I have just stated) boiled, has, notwithstanding this, developed fungi, though in much smaller quantity than No. 1 solution, while No. 3 solution, which should, according to previous trials, develop them most readily, has not done so at all even yet, and, therefore, I shall have to remark on the two latter solutions specially.

9. A further series of experiments on this point (*i.e.*, to determine the influence exerted by the kind or quality of water used), I have made since coming to Middlesbrough. This last series of experiments has been conducted by the light of the experiments already described (as well as others), and modifications have been made in the mode of experiment which are not altogether unimportant.

Instead of the solutions being stoppered or corked up in bottles—so that contact with the outer air is only possible when the stoppers or corks are removed—these solutions have, as you see, been filtered into flasks, over the mouths of which (with two exceptions purposely left exposed), loosely-fitting watch-glasses have been placed. By this contrivance the introduction of dust into the solutions is prevented, while the air has (when alterations of temperature and pressure occur), comparatively free ingress and egress. The flasks were cleaned before use, by shaking some sulphuric acid in them, to destroy organic matters, &c., and were then washed out six times with filtered steam water. The solutions are all of the same strength, viz:—10 grms. of the acid to 50 grms. (or c.c.) of either Middlesbrough water or filtered steam water. They were prepared on the 9th of January, 1871, and numbered 1 to 6. They were then subjected to the following treatment:—

Middlesbrough Water.	No. 1, left exposed to the air and dust after being filtered and then boiled for five minutes.
	,, 2, covered after filtration.
	,, 3, covered after filtration, and boiled for five minutes.
Steam Water, filtered.	,, 4, left exposed to air and dust, after being filtered and then boiled for five minutes.
	,, 5, covered after filtration.
	,, 6, covered after filtration and then boiled for five minutes.

No growth or formation of fungi has yet occurred; the strength of the solutions appears to exercise some influence on the length of time required before the fungi make their appearance, but its exact bearing on the point has yet to be decided by further experiments.

10. *Citric Acid.*—An acid contained in the juices of the citron, lemon, orange, &c., and which is closely allied to tartaric acid, exhibits like it, similar phenomena in aqueous solution. The application of the knowledge gained as to tartaric acid solutions, to solutions of citric acid follows, therefore, in natural sequence. I have, accordingly, prepared two solutions of citric acid, and find so far, that the law (if we may dignify it by the name) applicable to tartaric acid solutions, viz., that boiling the solutions prevent subsequent decomposition, holds good for citric acid solutions. For, of the two solutions before you (prepared January 10th, 1871, and numbered 1 and 2), by dissolving 10 grms. of the acid in 100 grms. (c.c.) of Middlesbrough water, filtering, &c., and placing them in flasks (uncleansed by sulphuric acid, simply washed with water of kind to be used). No. 1 was filtered and left unheated, while No. 2 was filtered and then boiled for ten minutes. No. 1 has begun to develop fungi, No. 2 has not. The fungi in No. 1 solution may be well seen—as to their structure—by holding the flask between the eye and the light; they then appear as white semi-transparent globular bodies, fibrous, as if radiated from a central nucleus.

11. It was suggested to my mind that it might be possible to prevent the growth of these low forms of life in tartaric acid solutions, by re-crystallising the acid from a hot solution. Accordingly, I dissolved some crystals of the acid in hot steam water, and evaporated the solution on a sand-bath. It is somewhat difficult without constant watching to get crystals of the acid by this plan, as since the acid itself melts, it is not easy to say when the liquid has been sufficiently evaporated; the evaporation may, consequently, be continued after all the water has evaporated, the result being that the acid is, to a greater or less extent decomposed, as evidenced by the odour of burnt sugar evolved. The acid used in preparing the solution for this experiment was accidentally allowed to evaporate to this extent, and, therefore, I do not lay much stress or put much value on the result which it shows. The re-crystallised acid was dissolved in cold steam water without any filtering or heating. None of the usual appearances have yet presented themselves; but this cannot, as already stated, be considered quite a fair trial; consequently, I intend to make further experiments to elucidate this point.

12. The formation or growth of fungi in the boiled solution already spoken of may, I think, be accounted for on the ground of insufficient boiling—the time was not noted, but was not continued (so far as my memory serves me), for any great length of time. This explanation is borne out by the fact that a less considerable quantity of fungi are found in it than in the solution made at the same time which was unboiled, and this we should naturally expect to be the case. The other real or apparent exception to the general principle which I have endeavoured to establish is the third solution prepared at the same time as the one just mentioned. It was made, as already stated, with Manchester water, undistilled, and the solution was not heated, but simply filtered and corked up in the bottle. The explanation in this case I cannot as yet arrive at, I therefore leave it for further experiments to throw light upon.

13. Having now described the whole of the tartaric and citric acid solutions before you, I must attempt to trace out, as far as possible, the bearing of the results obtained on the questions of the origin of, and the conditions essential to, life. You are doubtless aware that at the present day there are two theories of the origin of life before the world, viz.: Biogenesis, or, to quote Professor Huxley's words, the theory "that living matter always arises by the agency of pre-existing living matter;" and Abiogenesis, the theory "that living matter may be produced by not living matter." Professor Huxley in his address to the British Association at Liverpool last year, showed that the evidence, both direct and indirect, in favour of Biogenesis is of great weight, though he carefully guards himself against supposing that "no such thing as Abiogenesis ever has taken place in the past, or

ever will take place in the future." Indeed, he says, "if it were given me to look beyond the abyss of geologically-recorded time to the still more remote period when the earth was passing through physical and chemical conditions, which it can no more see again than a man can recall his infancy, I should expect to be a witness of the evolution of living protoplasm from not-living matter. I should expect to see it appear under forms of great simplicity, endowed, like existing fungi, with the power of determining the formation of new protoplasm from such matters as ammonium carbonates, oxalates and tartrates, alkaline and earthy phosphates, and water, without the aid of light. That is the expectation to which analogical reasoning leads me (Professor Huxley); but I beg you once more to recollect that I have no right to call my opinion anything but an act of philosophical faith."

14. To which, then, of the two the theories do the results arrived at lend support? To Biogenesis or Abiogenesis? Most decidedly they support the Biogenesis theory. Let us suppose for a moment that this theory is true, what should we expect beforehand would be the result of boiling the tartaric acid solutions? We should expect—since it is known that living matter generally is killed by being raised to a high temperature—that any living matter which the solutions before described contained would be killed, and, therefore, that no forms of life would make their appearance in such solutions afterwards—an expectation which is confirmed by actual experiment. On the other hand, let us suppose that Abiogenesis is true: how can it be explained that the simple ebullition of our solutions prevents the development of living matter? No change has occurred in the solutions which can be shown to prevent matter developing into living forms, and that being so, we are led to decide that Abiogenesis does not occur at the present day. Nor do we see reason for Professor Huxley's expectation already quoted; seeing, that, unless the existence of a lawgiver be granted, on which Professor Huxley is silent,—we must conclude that the laws governing matter were the same at the period referred to as at the present day; and this being so, if it were possible to transport our boiled solutions to such a distant period, we should find that they would remain the same as at present, no forms of life appearing in them. The same lime of argument holds good against the expectation that living matter may be produced from brute matter at any time in the future. Pressing our argument still further we are led to the conclusion that, since dead matter cannot of itself develop living matter, and since life was and is developed, there was, and is, a lawgiver and a lifegiver.

15. Leaving this point of the origin, and passing to our other point—the conditions essential to life—we are led to notice a remarkable conclusion recently arrived at by Professor Frankland. This eminent chemist comes to the conclusion, from a series of experiments on effluent sewage-water, and on water for domestic purposes (see Chemical News, vol. xxiii., pp. 67 and 78, January, 1871, for the paper on "The Development of Fungi in Potable Waters"), that the statement of the German philosopher who said "Ohne Phosphor kein Gedanke"—(There is no thought without phosphorus), may warrantably be altered to "Ohne phosphor gar kein Leben"—(There is no life without phosphorus). If this conclusion can be correct, it follows that the solutions before you which have developed fungi contained phosphorus in some form or other, which has admitted of the growth of the fungi, and since boiling was the only difference (in nearly all cases) in the treatment of the solutions, the boiled solutions must contain it as well. If this be so, we arrive at a conclusion which is again in favour of the Biogenesis theory; this is, that since the conditions essential to life are complied with by the solutions, and yet no life is developed, the living matter present in the solutions before being boiled has its life destroyed by the ebullition.

16. Moreover, these solutions become the means whereby to test the truth or falsity of Professor Frankland's conclusion, and I intend, in a few days, to put it to the test of experiment (see Appendix). In order that you may understand the plan on which I intend to proceed, it will be necessary for me first to lay before you, as briefly as possible, the mode of experiment followed by Professor Frankland. He took a quantity of water as supplied to the metropolis for domestic purposes, and added to it a quantity of sugar; the water was then allowed to stand for a week or ten days to see if fungi developed, if not the absence of phosphorus was shown, and, consequently, it was necessary to add it to the water in some form or other, in order that these low forms of life might grow in the weak sugar solutions. He thus found that phosphorus in some form was essential to the development of these fungi, and from this he concludes that it is essential to life. You will now be prepared for the plan which I have devised as the *experimentum crucis* on this point. I have here two pint stoppered bottles filled with Middlesbrough water; to the water in the one marked A, 5 grammes of pounded loaf-sugar were added, when drawn, on the 18th of February; to the one marked B, the same quantity of sugar was added, and 5 grms. of tartaric acid in addition —both solutions were then allowed to stand. If neither of them developes fungi, the conclusion must follow that neither of them contains phosphorus: if only B does, it will show that the tartaric acid added contains it, while, if both do, it will show that both contain it (though the quantity of fungi developed will probably show which contains most phosphorus), and will not necessarily indicate (unless, as has just been said, the quantity is greater), that the tartaric acid added does. If the last result is obtained, the experiment will have to be repeated with water free from phosphorus in order to obtain reliable results. As yet, as you see, no fungi have made their appearance. When the experiment is successful I shall have pleasure in laying the result before you (see Appendix).

17. I cannot sit down with remarking on the benefit I have derived from this course of experiments. I commenced them little thinking of the extent of bearing they would have on such important questions as those of the origin of, and conditions essential to, life; and, to my mind, it is only one more in the host of researches which, commenced in obscurity, and also having bearings apparently obscure, have eventually thrown light upon questions of the greatest moment. This of itself is a sufficient reward for the labour these experiments have entailed, and will stimulate me to further research on this and other kindred subjects (as well as others), to the end that truth may be increased; and in this search for scientific truth, I trust I shall not be alone in the host of members of the Cleveland Literary and Philosophical Society who are interested in science.

Appendix.

I.—Solutions referred to.—Particulars received from Halifax, March 20th, 1871.

Solution C. of August 12th, 1868.—Not mouldy. Liquid quite clear.

Solution No. 2, of September 21st, 1868.—Not mouldy. Solution clear and sparkling; bright particles float about when shaken.

II.—Results of experiments made February 18th, 1871, to determine whether tartaric acid contains phosphorus or not.

A. has developed a quantity of filmy brownish-white fungi. The solution is clear.

B. has developed a larger quantity of fungi, of a similar colour, but the form is somewhat globular. The solution is turbid.

From these results I conclude that the tartaric acid added either contained phosphorus or more living matter, which developed in a weak sugar solution. A further experiment with boiled solution of the acid will be necessary, in order to show which of the two conclusions is the correct one.

ON THE

DETERMINATION OF NITROUS ACID, WITH SPECIAL REFERENCE TO THE MANUFACTURE OF OIL OF VITRIOL.*

(Concluded from p. 239).

By W. CROWDER.

The annexed tables are the result of a series of experiments in illustration:—

1st. Of the constancy of results obtained by the processes adopted.

2nd. A series of analyses of samples of nitrous and denitrated vitriol from four different works, illustrating the three different methods of denitrating, viz.:—

1st. By steam alone.

2nd. By a mixture of steam and sulphurous acid.

3rd. By passing nitrous vitriol down a column, and denitrating it by the hot sulphurous acid as it comes from the burners, which also concentrates the acid at the same time.

Analysis of Various Samples of Nitrous Vitriol by the Urea and Permanganate Processes, obtained from four Acid Works on the Tyne.

First Works—Acid Denitrated by Steam alone.

	Sp. gr. °Tw.	By the urea process.	By the permanganate process.
Acid condensed in burner pipes before entering the chambers	150	2·03	—
Nitrous acid from the cisterns	148	—	1·04
Ditto	,,	—	1·62
Ditto	,,	—	1·05
Ditto	,,	—	0·83
Ditto	,,	—	0·82
Ditto as it ran into denitrators (No. 1 set)	150	—	0·98
Ditto as it ran out after denitration by steam	132	—	0·16
Ditto as it ran into denitrators (No. 2 set)	150	—	1·12
Ditto as it ran out after denitration by steam	126	—	0·33
Ditto collected as it flows from absorbing columns (No. 1)..	148	—	1·16
Ditto collected as it flows from absorbing columns (No. 2)..	148	—	1·03
Ditto from the concentrating pans	150	—	0·14

Experiments Showing the Absorption which takes place in Passing through Columns.

Total height of absorbing columns 22 feet.

			Sp. gr. °Tw.	By urea process.	Absorption.
1st Expt.	1.	Nitrous strength of acid poured into column..	150	0·212	1·733
		Ditto as it ran out ..	,,	1·945	
	2.	Nitrous strength of acid poured into column..	,,	1·170	0·593
		Ditto as it ran out ..	,,	1·763	
	3.	Nitrous strength of acid poured into column..	,,	1·124	1·011
		Ditto as it ran out ..	,,	2·135	
2nd Expt.	1.	Nitrous strength of acid poured into column..	,,	1·033	0·730
		Ditto as it ran out ..	,,	1·763	
	2.	Nitrous strength of acid poured into column..	,,	1·778	1·312
		Ditto as it ran out ..	,,	2·090	
	3.	Nitrous strength of acid poured into column..	,,	2·254	0·248
		Ditto as it ran out ..	,,	2·492	

* Read before the Newcastle-upon-Tyne Chemical Society.

Second Works—Acid Denitrated by Steam alone.

Nitrate and denitrated acid.

Total height of absorbing columns, 45 feet.

	Sp. gr. °Tw.	By the urea process.	Repeated.	Repeated.	Repeated.
No. 1. From the concentrating pans	151	0·18	—	—	—
No. 2. Ditto after passing through the columns; analysis performed by Dr. Hess	148	3·02	3·08	—	—
The same sample, analysis performed by W. Crowder	—	3·16	—	—	—
No. 3. Another sample, by urea process, after passing through the column ..	149	2·62	2·60	2·63	2·35
The same, by permanganate standardised by a sample of nitrous vitriol, tested by urea process	—	2·73	2·73	—	—
Result in NO_3 calculated by amount of oxidation ..	—	—	1·66	—	—
No. 4. Another sample, tested permanganate as before..	149	2·81	2·84	—	—
Result in NO_3 by oxidation	—	—	1·77	—	—

Third Works—Acid Denitrated by a Mixture of Steam and Sulphurous Acid.

Nitrated and denitrated acid.

Height of absorbing column, 35 feet.

	Tested with permanganate
No. 1. Acid from absorbing columns— Sp. gr. 143° Tw., by oxidation process ..	0·444
No. 2. Denitrated acid (by steam and SO_2) Sp. gr. 123° Tw.	0·044
No. 3. Acid from absorbing columns Sp. gr. 142° Tw. ..	0·429
No. 4. Denitrated acid (by steam and SO_2) Sp. gr. 121° Tw.	0·026

Fourth Works—Acid Denitrated by Sulphurous Acid.

Nitrated and denitrated acid.

			Sp. gr. °Tw.	By permanganate. Per cent.	Result in NO_3 calculated by amount of oxidation. Repeated.
1st Expt.	No. 1.	Denitrated acid	153	0·15	0·17
	No. 2.	Acid from absorbing columns	151	0·96	0·92
	No. 3.	,, ,, ,,	152	0·58	0·63

		Sp. gr.	By urea Calculation.	Calculated by Oxidation.
No. 1.	Denitrated acid	153	0·27	0·164
No. 2.	Acid from absorbing columns	150	1·37	0·836
No. 3.	,, ,, ,,	151	0·76	0·461
No. 1 (*a*).	Denitrated acid	153	—	0·170
No. 2 (*a*).	Acid from absorbing columns	151	—	0·825
No. 3 (*a*).	,, ,, ,,	152	—	0·452

NOTES OF

DEMONSTRATIONS ON PHYSIOLOGICAL CHEMISTRY AT ST. GEORGE'S HOSPITAL.

By S. W. MOORE.

IV.

It will be convenient to pass over active principles and colouring matters, &c., considering them as they occur in their respective tissues and fluids. Non-nitrogenous matters will occupy our attention, as sugars, fats, &c.

Sugars Occurring in Animal Tissues.—Lactose in milk, glucose in urine, inosin in muscles, and glycocine, not as such, but as hippuric acid, which, as mentioned previously, is glycocine with an atom of H displaced by the radical benzoyl.

Lactose, or sugar of milk ($C_{12}H_{24}O_{12}$), is found exclusively in milk; it is secreted in the largest quantities by Herbivora, but also by animals fed exclusively on meat; it is a hard gritty body, crystallising in four-sided prisms, terminating in four-sided pyramids; sparingly soluble in cold water (5 parts), thus accounting for its inferior sweetening property; it turns a ray of polarised light to the right, is not fermentable, may be converted to galactose by boiling with acids; this is a fermentable variety, reduces copper salts in an alkaline solution, and combines with bases to form definite compounds. Lactose may be prepared by removing the casein from milk and evaporating the whey until crystals form.

Cow's milk contains 4 per cent, human milk 7 per cent of lactose; thus a few grains of lactose added to cow's milk approximates its composition to that of human milk.

Glu cose, or grape sugar ($C_6H_{12}O_6,H_2O$), occurs in the urine of diabetic patients as dextrose; its sweetening power is not so great as that of cane sugar; the variety from urine does not crystallise; it is dissolved but sparingly by alcohol; H_2SO_4 converts it to sulphosaccharic acid; KHO converts it to melassic acid; copper salts in alkaline solutions when boiled are reduced by glucose; it is also readily fermentable. A saturated solution of NaCl mixed with a solution of glucose crystallises in cubes ($NaCl,H_2O,2C_6H_{12}O_6$).

The frequent occurrence of sugar in the urine has led to the use of various tests, some of which are anything but reliable.

Runge's Test.—A film of the suspected fluid is evaporated to dryness on a porcelain dish and H_2SO_4 added; if sugar be present it is charred by the acid. It is asserted that albumen gives the same result; this is true to a certain extent, the charring is not so definite.

Trommer's Test.—This consists in adding to a portion of suspected fluid an equal bulk of *liq. potassæ*, and a few drops of solution of $CuSO_4$; the hydrated oxide of copper is thrown down; this is reduced to the suboxide, Cu_2O, on boiling if sugar be present.

Fehling's or Barreswil's Test.—This is a modification of the above, the potassic-cupric-tartrate being used instead of the $KHO+CuSO_4$.

The Copper Test serves not only as a qualitative but as a quantitative test for sugar; thus, if you have a volumetric solution of copper salt, made as directed in Mr. Sutton's "Volumetric Analysis," the estimation of the amount of sugar is readily made. A measured quantity of urine known to contain sugar is taken and heated in a porcelain dish; into this while boiling the copper solution is slowly discharged from a burette properly graduated; as soon as the urine becomes blue, the whole of the sugar has been expended in reducing the copper salt. The number of divisions of the volumetric solution used represents the amount of sugar in the known quantity of urine; this multiplied by the total quantity excreted in twenty-four hours gives the amount of sugar passed in that time.

Fermentation Test.—This perhaps is the best test of quantity, as it is most readily performed. Into a tube filled with mercury and inverted in a vessel full of the same metal is passed a measured quantity of saccharine urine, and with it a small piece of yeast; the whole thing is then left for twelve hours; at the end of that time the sugar will have been converted into CO_2 and H_2O; the first being a gas ascends and displaces the mercury. Every cubic inch of CO_2 thus formed represents about 1 grain of sugar, or more exactly 100 cubic inches represent 106·6 grains of sugar; the same rule as before gives the quantity passed in twenty-four hours.

The growth of *Torula*, a species of confervoid vegetation, is said to be characteristic of the presence of sugar. The presence of sugar in the blood has not been satisfactorily accounted for.

Inosin, or muscle sugar, is not of sufficient import to demand attention; of glycocine we have already spoken.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 16th, 1871.

Professor Odling, F.R.S., Vice-President, in the Chair.

After the minutes of the previous meeting had been read and confirmed, and the donations to the Society announced, the names of the following gentlemen were read for the first time:—Christopher Childs, William W. Abney, Jonathan Ingle Calvert, and Frederick J. Montague Page.

For the second time—William Gray, Frederick Hicks, Robert Irvine, Samuel William Moore, Donald Munroe, Hugh Paterson, Benjamin Tanner, Charles Thomas, William John Wilson, George Joseph Warner, and Reginald C. Woodcock.

The Secretary then read a paper "*On Burnt Iron and Steel*," by W. H. Johnson, B.Sc. In it the author expresses his opinion that the burning of iron and steel is not due to the action of uncombined oxygen. It would appear Mr. Williams thinks this to be the case from his paper, an abstract of which appeared in the *Journal of the Chemical Society*, but the oxygen does not exist in a free state in the hottest part of the furnace, as it is there united with carbon, forming carbonic acid and carbonic oxide. After referring to Mr. Lowthian Bell's experiments on the oxidising effect of carbonic acid, and the reducing action of carbonic oxide on iron at different temperatures, the author draws attention to the fact, that immediately the oxidising effect of the carbonic acid present becomes greater than the opposite action of the carbonic oxide, the iron begins to burn. The relative proportion of the two gases at which the point of equilibrium occurs varies greatly with the temperature; the higher this is, the smaller is the proportion of carbonic acid in the mixed gases necessary to produce the injurious effect; it takes place, moreover, with greater readiness when a comparatively pure iron is employed than with one containing sulphur or silicon. As red-hot iron is permeable to carbonic acid and carbonic oxide, their action is not confined merely to the surface, but penetrates into its substance. This induces the author to believe that the well-known increase of bulk which takes place when iron is repeatedly heated, is due to the formation of an oxide in the body of the metal, thereby increasing both its volume and its weight.

Dr. Odling said that, although the Society but seldom received papers of an argumentative character, the thanks of the members were due to the author for his observations on this important subject. The relation between the burning of iron and steel, and the experiments of Mr. Lowthian Bell on the varying oxidising power of carbonic acid at different temperatures and the corresponding reducing action of carbonic oxide, was of great interest, showing that there was a point at which these actions going on at the same time, so to speak, neutralised one another.

Mr. E. Riley said that it was quite as important to consider the mechanical treatment to which iron was subjected as the chemical reactions which took place; for instance, when iron which is so brittle as to be quite useless is piled two or three times it acquires, to a greater or less degree, a fibrous texture, whilst the very best iron, when melted in a crucible, yields a button which works very well under the hammer, but is otherwise quite changed, having become red-short. Great misconception

also existed as to the injurious action of many substances usually supposed to be prejudicial to the good quality of iron and steel. Iron containing silicon, for example, was difficult to puddle, but in steel its presence in small quantity was decidedly advantageous.

Dr. Odling asked whether he included phosphorus and sulphur amongst these substances.

Mr. Riley replied that the presence of phosphorus was certainly beneficial in some cases; Swedish iron puddled, is red-short, but when mixed with the proper proportion of Cleveland iron containing phosphorus, it yields an excellent iron. Lowmoor iron and the Yorkshire pig made from clay ironstone usually contain about 0·64 per cent of phosphorus, and the amount seemed to be the same whether the hot or cold blast were employed. Steel containing 0·1 per cent of phosphorus was bad, but he did not agree with those who say that the presence of silicon in steel is injurious. Silicon is necessary in the Bessemer process, and the best pig-iron sometimes contains a considerable quantity of it, the speaker having in his possession a piece of very superior quality which has as much as 2 per cent. Tungsten also may exist in very large proportion in steel; he had a specimen of very hard and most excellent steel which contained more than 10 per cent of it.

Dr. Muller asked whether the so-called Mushet's "titanium steel" contained titanium, as he had been unable to detect any in a sample he had examined.

Mr. Riley said that he had never found titanium in any white iron, and believed that it occurred only in grey iron.

Mr. F. W. Hart then described an improved syphon, consisting of an ordinary syphon having a globe at the bend furnished with a short vertical tube. The latter serves the purpose of starting the syphon, whilst the globe retains any gas that might be given off from the liquid, and which in an ordinary syphon would fill the bend and stop its action. A filter, consisting of an inverted funnel furnished with a perforated disk and covered with a layer of cotton wool or other suitable material can be attached to the shorter leg of the syphon.

Professor McLeod observed that the instrument was not new to him, as he had seen one of very similar construction in use some five or six years ago in the laboratory of the Royal Institution.

Mr. Hart stated that it was now about five years since he had first made one of these syphons, and, as far as he had been able to ascertain, no account of it had yet been published.

Dr. Vernon Harcourt said that he had had a syphon in use for a considerable time precisely similar to the one described. It is employed to maintain a constant level in the still of a distilled water apparatus, by supplying it with warm water from the worm tub of the condenser.

The Chairman then announced the adjournment of the meeting until Thursday, December 7, when a paper would be read by Dr. Gladstone "*On Essential Oils.*"

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section).

The business of the Section was resumed on the evening of Monday, the 6th inst., when Dr. W. Wallace, F.R.S.E., F.C.S., the President, delivered the opening address, which was occupied with a brief notice of certain topics of local interest, including the arrangements in the chemical department of the new buildings of the University of Glasgow, the appointment of Prof. Gustav Bischof to the Young Chair of Technical Chemistry in Anderson's University, the statue of the late Master of the Mint to be erected in Glasgow at the expense of Mr. James Young, and the disposal of the sewage, especially referring to Mr. Stanford's system of using seaweed charcoal as a deodorant of human excreta, and Mr. Gavin Chapman's method of utilising the urine from the public urinals of Glasgow.

Dr. Wallace also referred to the raid which parochial Boards in Scotland are making at the instigation of the Board of supervision in Edinburgh against the well-waters that are found to contain sewage contaminations. His large experience in analysing the waters of towns and villages justified him in saying that at least two-thirds of such waters are unfit for domestic use. In connection with this subject, he took notice of the evidence given by Dr. Letheby on the Edinburgh Water Bill last session, particularly in respect of the unhealthy character of soft waters, such as those supplied to Glasgow, Manchester, and other large towns where the mortality rates are high, and quoted from Mr. Bateman some remarks as a sort of reply to Dr. Letheby. Dr. Wallace considered that the more scientific physicians were the only persons who were competent to express opinions upon the subject, and he hoped they would inquire into it. Of the recent improvements in the alkali trade, Dr. Wallace spoke of and enlarged upon Weldon's process for regenerating manganese, Deacon's chlorine process, and Hargreaves's process for decomposing common salt by sulphurous acid. In metallurgical chemistry he referred to the difficulty and expense of making spiegeleisen for the Bessemer steel process, expressing his belief that ere long a suitable iron ore for this alloy would be got in Ireland in large quantity; to the splendid manganese colours obtained by Mr. Rowan, a member of the section; to Mr. Ferrie's self-coking blast-furnace; and to the introduction of the manufacture of zinc into Scotland. Mr. Spence's process of treating mineral phosphates in the manufacture of artificial manures was noticed, and so likewise were various topics connected with the subject of artificial lighting, and one or two others. The address was in every sense a most comprehensive and interesting one.

November 20th, 1871.

The annual meeting of the same section was held this evening, Dr. Wallace, the President, in the chair. After the transactions of some formal business, the election of the office-bearers of the section was proceeded with. As re-constituted the council consists of:—

President—Dr. William Wallace, F.R.S.E., F.C.S.

Vice-Presidents—Messrs. John Ferguson, M.A.; John Jex Long; W. R. Hutton.

Treasurer—Mr. P. M. Moir.

Secretary—Mr. R. R. Tatlock, F.R.S.E., F.C.S.

Other Members of Council—Dr. John Clark; Messrs. James Anderson; J. Couper; John Sutherland; James Mactear, F.C.S.; T. L. Paterson, F.C.S.; Alexander Whitelaw.

Before the meeting separated the President announced that a number of important papers had been promised for the ensuing session from Dr. Clark, Dr. T. E. Thorpe, Professor Bischof, and other members and associates of the section.

CORRESPONDENCE.

RELATION OF HEAT TO ELECTRICITY.

To the Editor of the Chemical News.

Sir,—It is generally said that the heat produced by a current of electricity varies as the square of the current (with the same resistance). I have no doubt that this is true in the cases from which the rule has been deduced, namely, where the sources of the electricity have been the same.

The following experiment would tend to throw a doubt on the general truth of the rule where the electricity is derived from different sources:—

I took two elements, one of zinc-platinum, and the other of iron-carbon, with the same electrolyte. The current from the former was 87° on a tangent galvanometer, of the latter 85°; consequently, the heating effects of the two currents ought to have been as the squares of the tangents of those angles, or about as 36 to 13; yet, on trial, I found the former would keep only about 1¾ inches of a platinum wire red-hot, whilst the latter would keep 2¼ inches of the same wire red; also in deflagrating different gauges of iron wire, I found that the latter would deflagrate like tow wire, which the former would keep scarcely red-hot. The sparks from the latter were also mu h more brilliant than from the former, emitting bright flashes and scintillations when a copper wire was rubbed along the rough edge of a rusty piece of iron.

The subject is worth investigation, and I venture, through your columns, to call the attention of scientific men to the point.—I am, &c.,

H. Highton.

2, The Cedars, Putney,
Nov. 18, 1871.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, October 30, 1871.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Thermical Researches on the Electrolysis of the Alkaline Bases and Alkaline Sulphates.—P. A. Favre.—The continuation of a very lengthy and exhaustive memoir on this subject.

Idocrase from Arendal in Norway.—A. Damour.—The sp. gr. of this mineral = 3·44; it is harder than felspar, fuses by the action of the blowpipe flame, is readily acted upon by acids, and consists, in 100 parts, of:—Silica, 36·32; alumina, 16·70; lime, 34·86; protoxide of iron, 0·6; protoxide of manganese, 0·14; magnesia, 0·07; water, 0·25. Formula, $18(CaO,FeO,MnO,MgO)+4Al_2O_3+15SiO_2$.

Analysis of a Mexican Grenate.—A. Damour.—The specimen alluded to was obtained from a locality, Rancho de San-Juan, where a crystalline limestone is the prevailing rock. The sample was crystalline; colour, pale rose-red; hardness, greater than quartz; sp. gr. = 3·57; readily fusible before the blowpipe flame, forming a semi-transparent yellow-brownish glass. When fused in the reduction-flame along with borax, the mineral yields a colourless glass. The grenate is slowly acted upon by acids, but readily dissolved by these, after having been first ignited to redness in a platinum crucible. Composition, in 100 parts:—Silica, 39·46; alumina, 21·69; peroxide of iron, 1·36; lime, 35·75; magnesia, 0·67; protoxide of manganese, 0·96; volatile matter, 0·4.

Note on the Use of Dynamite.—M. Barbe.—The contents of this paper may be summarised by stating that the author has given a very complete review of the various uses to which dynamite may be applied, while setting forth the great superiority of this explosive material over gunpowder, also as regards greater safety against accident. It appears that dynamite is manufactured in France in very large quantities, and is also rendered applicable for military artillery purposes.

Conversion of Cane Sugar in the State of Solution into Glucose under the Influence of Light.—E. M. Raoult.—The author placed, on May 10 last, a concentrated solution of sugar in water in glass tubes, and, while boiling the same, sealed the tubes; these were placed close to each other in the same locality and under identically the same conditions, with the exception that one of the tubes was kept completely in the dark, the other tube being exposed to bright daylight. On October 20 last the tubes were opened, and the contents examined. The solutions were perfectly clear, and did not, on being microscopically examined, exhibit the least trace of vegetable matter. The fluid in the tube exposed to light yielded an abundant red-coloured precipitate with the cupro-potassic reagent, thereby indicating the presence of glucose, while the contents of the tube kept in complete darkness did not manifest that reaction at all.

Continuation of the Thermo-Chemical Researches on Ammoniacal Salts.—Dr. Berthelot.

Spectra of Phosphorus and of Silicium Compounds.—G. Salet.

November 6, 1871.

This number contains the following original memoirs and papers relating to chemistry and collateral sciences:—

Mode of the Repartition of Potassa and Soda in Plants.—E. Peligot.—The fourth portion of a very lengthy and exhaustive chemico-agricultural essay; this part treats on the influence of common salt as occurring more particularly in soils of drained fen-lands and land recovered from the sea.

Thermical Researches on Electrolysis.—P. A. Favre.—The continuation and end of the very exhaustive memoir on this subject.

Observations on the Solubility of Chloride of Silver in Reference to the Recent Communication of M. Stas.—I. Pierre.—The author quotes some observations made by him, as far back as the year 1844, on the solubility of chloride of silver in strong hydrochloric acid, and the precipitation of the chloride by the subsequent addition of water, and also calls attention to the fact that boiling nitric acid may dissolve, and convert into nitrate of silver, the chloride alluded to.

Formation of Precipitates.—Dr. Berthelot.—A thermo-chemical essay divided into the following sections:—Formation of a solid compound; dehydration of precipitated compounds, lime, carbonate of lime, carbonate of magnesia, carbonates of iron and manganese, sulphates of lime, baryta, and strontia.

Detection of Hydrochloric Acid in Cases of Poisoning with that Acid.—J. Bouis.—After referring to the difficulty of detecting whether small quantities of the acid alluded to—always present, though in very minute quantity only, in the natural and healthy stomachic juices—are due to a poisonous dose, the author advises that the contents of the stomach to be tested should be first filtered through paper or fine muslin previously moistened with acetic acid, and that to the filtered liquid gold-leaf be added, and a few grains of chlorate of potassa. The mixture is then heated on a water-bath, and tested afterwards with protochloride of tin, to see whether any gold is dissolved; the substances to be tested should, however, first be tried for the presence of free nitric and sulphuric acids.

Journal de Pharmacie et de Chimie, September, 1871.

This number contains the following original papers and memoirs:—

Researches on the Action of the Substances which Aid the Decomposition of Chlorate of Potassa while Employed for the Preparation of Oxygen.—Dr. E. Baudrimont.—The continuation and end of this lengthy memoir. This portion contains the following sections:—Influence of the nature of the bodies present with the chlorate of potassa—the bodies experimented with are:—Spongy platinum, red oxide of mercury, oxide of silver, permanganate of potassa, black oxide of copper prepared by the moist way, native peroxide of manganese, peroxide of iron, protosesquioxide of manganese, black oxide of cobalt, peroxide of lead, oxide of aluminium; influence of the state of division of these substances; influence of the temperature; study on the chemical action which certain substances exert upon chlorate of potassa; on the action of contact; on the origin of the chlorine with which the oxygen is contaminated; is the oxygen evolved from chlorate of potassa in the state of ozone? observations on the fusion of chlorate of potassa when an active substance has been added thereto.

Differences which the Divers Processes for the Estimation of Cream of Tartar Exhibit.—P. Carles.—The contents of this paper record a few experiments made by the author with the view to prove that the estimation of cream of tartar (bitartrate of potassa) in wines, when the salt alluded to is precipitated from that liquid by the aid of a mixture of alcohol and ether, may, as compared with the method of calcination (after evaporating the wine to dryness, and calculating the weight of the carbonate of potassa obtained as representing bitartrate of that base), lead to great differences of result, due to the presence in some kinds of wine of other organic potassa salts which are not precipitated by a mixture of alcohol and ether. The contents of this paper are of particular value to wine-growers; that the difference alluded to is not small may be inferred, for instance, from the fact, that in a sample of Malaga wine, the precipitation process only yielded 0·95 and the calcination process 3·40 parts per litre of bitartrate of potassa, a quantity too large to be held in solution in the wine as an alcohol-containing liquid.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, September, 1871

The following original papers are contained in this number:—

Antidotes to Poisoning with Carbolic Acid.—Dr. T. Husemann.—An interesting chemico-therapeutical essay, in which the author recommends, upon sound practical and experimentally-proved grounds, the use of a strong solution of saccharate of lime as an antidote against poisoning with carbolic acid, when by accident taken internally.

Practical Observations on Essential Oil of Mustard Seed.—Dr. F. A. Flückiger.—The contents of this essay may be *resumed* as follows:—When to the essential oil of mustard seed 3 parts of concentrated sulphuric acid are slowly and gradually added, care being taken to cool the mixture, sulphurous acid and sulphocarbonic oxide are evolved after twelve hours' standing. The mixture should either be clear yet very thick, or entirely converted into a crystalline mass; the mixture should then exhibit no longer the peculiar odour of oil of mustard seed, but, in addition to a slight smell of sulphurous acid, that of leek. The colour of the mixture should not be turned dark; when 2 parts of the essential oil

are mixed with 1 of absolute alcohol and from 6 to 8 of strong liquid ammonia, and heated to 50° for some time, the result should be that, on cooling in open shallow vessels, the mass becomes crystalline (formation of thiosinammin); the mother-liquor from these crystals should leave, by spontaneous evaporation, crystals, but hardly any fluid, which should scarcely, moreover, exhibit the smell of leek. These reactions, along with the specific gravity, characterise mustard seed oil very distinctly.

Les Mondes, November 9, 1871.

Telegraphic Rockets.—M. Papafy.—The author has devised a series of sky-rockets (fireworks) adapted for telegraphic service at night for armies when in the field, so arranged that each rocket is, by a variation of coloured light, capable of transmitting six words, visible at a distance of 32 kilometers = 19·872 English miles. These signals can be readily kept unintelligible to the enemy, while everything relating to military and strategical matters can be easily expressed. The Prussian War-Department has bought the secret of this invention from the author, a Hungarian in service as captain in the United States Army.

New Method of Stopping in a Very Short Space of Time an Express Railway Train.—Rev. Thirion.—Illustrated by woodcuts. The contents of this paper decidedly deserve the serious attention of railway-engineers and locomotive-engine builders.

November 16, 1871.

New Hydraulic Invention.—A. Joly.—The author has invented a simple mechanism (not further specified) by the aid of which the concussion (*coup de bélier*) caused in water-conducting pipes by the sudden opening and closing of taps fitted to them, as well as the freezing of that liquid in the pipes, may be prevented.

Anhydrous and Hydrated Salts.—M. Favre.—All the crystallised anhydrous salts generate on being dissolved in water, cold, while the crystallised hydrated salts cause the evolution of heat, when becoming dissolved in water.

Chemical Laboratory at Neufchâtel (Switzerland).—Dr. Sacc.—From a short abstract, taken from the Report of the Cantonal Inspector of Public Instruction, here published, we learn that this laboratory, the property of the canton which bears the name of its chief town (above quoted), is every year becoming of greater importance. The collections of samples and specimens, minerals, ores, organic and inorganic compounds, instruments, and library, are almost daily added to either by the kind attention of donors interested in science, arts, and industry, or by purchase, and last, but not least, by the preparations made by the students who work there, their number being at present about ninety; most of these are foreigners to the Republic, the Government of which may be highly congratulated on the very favourable results its care has produced, as regards providing sound, effective, and cheap public instruction not only in respect of the high intellectual development of the inhabitants, but also of a very large number of foreigners. The regulations at Neufchâtel as regards those who desire to learn chemistry, both practical and theoretical, are such that the instruction may be said to be almost gratuitous.

Sitzungsberichte der Mathematisch-Physikalischen Classe der Königlich Bayerischen Akademie der Wissenschaften zu München, vol. i., 1871.

The original papers and memoirs relating to chemistry published in this volume are the following:—

Metamorphosis of Matter Observed in Cases of Poisoning with Phosphorus.—Dr. J. Bauer.—The contents of this lengthy memoir dwell on the peculiar effect of phosphorus, which results in an elimination of nitrogenous matters from the bodies of men and animals to whom large doses of this element are given, and the production of an excess of fat, due to an imperfect process of oxidation.

Geognostic Relation of the Ulm Cement Marl and its Affinity to Lithographic Stone, and the Foraminiferæ-Fauna which Accompany the Latter.—Dr. Gümbel.—This essay, accompanied by several engravings, treats on a peculiar kind of mineral met with near Ulm (Würtemberg), and used for the purpose of preparing hydraulic cement. The contents of this paper are strictly geognostical and palæontological.

Realisation of Certain Kinds of Ash-Constituents of the Animal Body.—Dr. Voit.—A physiologico-chemical essay on nutrition and on the action of certain inorganic constituents of the animal body in its embryo state.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, November 9, 1871.

Newly-Invented Ozone-Generating Apparatus.—M. Ruhmkorff.—The detailed description, elucidated by a woodcut, of a contrivance by the aid of which, under the influence of a very large number of electric sparks, air may be ozonised in a closed space, and the ozone so formed applied for use in chemical operations.

Apparatus for Measuring the Intensity of the Sun's Radiation.—Rev. Father Secchi, S.J.—This description is also illustrated by a woodcut.

Composition of Calorific Value of Two Samples of Welsh Coal.—M. Scheurer-Kestner and C. Meunier.—The coals alluded to are Bwlf and Powell.—The former consists, in 100 parts, of:—Water, 0·63; carbon, 87·48; hydrogen, 3·68; ash, 3·32; oxygen, 4·89; yields 82·08 per cent of a slightly caked coke; 1 kilo. of this coal evaporates 8·826 litres of water; calorific value = 8·780. The latter-named coal consists, in 100 parts, of:—Water, 0·75; carbon, 88·36; hydrogen, 3·80; ash, 3·72; oxygen, 3·31; yields 81·16 per cent of coke; 1 kilo. evaporates 9·076 litres of water; calorific value = 8·949. The authors, having been engaged for a considerable length of time in making researches on mineral fuel, have found that, as regards coal, the heat it yields by combustion exceeds that of the heat of all its constituent elements (when completely burnt) added together, while, as far as lignite is concerned, it appears that just the reverse obtains.

Continuation of the Tabulated Review of the Composition of Fertilising Substances which may be Added to Manures or are fit for Use as such by themselves.—C. Mène.—(See Chemical News, vol. xxiv., p. 182).

Bibliography.—Under this heading we find here short reviews of the two following books, lately published by MM. Hachette, viz.:—"Nôtre Planète," par M. J. Duval. This work treats more particularly on the relation existing between political economy and geography, and dwells at some length on anthropology as viewed in reference to recent discoveries. "Eléments de Zoologie," par Dr. P. Gervais. The second and greatly enlarged and improved edition of a work edited by one of the most competent scientific authorities on this subject in Europe. For clearness of views, and sound inductive treatment of the subject, this work deserves the attention of all who desire to obtain some knowledge in zoology.

La Revue des Scientifique de la France et de l'Etranger, October 28, 1871.

This number does not contain any original papers on chemistry, but we call attention to the excellent lecture:—

Phenomena of Respiration.—Dr. Gréhaut.—The continuation of this subject, illustrated by several woodcuts, and treating on the respiration of fishes, extraction of gas from blood, and on hemaglobine.

NOTES AND QUERIES.

Specific Gravity.—Would any of your readers kindly inform me of a method of finding the specific gravity of any liquid by Twaddle's hydrometer, from the lowest to the highest indications, and oblige a tyro.—J. W.

Refining and Bleaching Tallow.—Can any of your readers oblige me with the best and cheapest mode of refining and bleaching tallow for manufacturing purposes? A good colour is wanted.—B.S.O.

Gallic Acid.—Thanks to Hugo Tamm, but he has missed the purport of the enquiry; nor is it at all clear that "the two Hugo's agree splendidly together." If in conforming to a wide formula of genesis, tannic acid is a *di*-gallic acid, and tannin is a *tri* gallic glucoside; then it is next to certain that the radical of gallic acid is ($C_{14}H_5O_8$), and such, I believe, it will be found in any future ammoniacal sulpho-acid, or other substitutional derivatives. Will "H. T" favour the enquirer with his address.—S. E. P.

Law of Compound Proportion.—In the Chemical News some time ago, I think I read a note saying, "That the law which used to be called of 'compound proportion' was not correct." Rather, the words took this form, "That the formula of a compound body cannot be called the 'equivalent' of that body." And it gave an example, naming a salt, and saying that the sum of its components were not the equivalent of that body capable of combining with any other named. Now, is this true, or how far is it true, that the equivalent of a compound is the sum of its components, *i.e.*, the sum of the equivalent of its components?—E. K.

Weighing Deliquescent Substances.—I do not know if I suggest a new detail, but, taking the benefit of the doubt, I wish to mention the following:—Having been repeatedly aggravated by the conduct of deliquesent substances in the balance, I selected a light beaker, and a bit of ground glass to cover it, and, grinding the edge of the beaker, which just admits the crucible, I find that I can weigh with all desirable deliberation, crucible, lid, beaker, and cover. I keep all in the desiccator, and of course know their weights. It is a great relief to my mind not to risk the accuracy of my weighing for the sake of speed.—Marshall Hall.

MEETINGS FOR THE WEEK.

Monday, Nov. 27th.—London Institution, 4. Prof. Huxley, LL.D., F.R.S., on "Smell, Taste, and Touch" (Course of Elementary Physiology).
— Medical, 8.
— Royal Geographical, 8·30.
Tuesday, 28th.—Civil Engineers, 8.
Wednesday, 29th.—Society of Arts, 8.
Thursday, 30th.—London Institution, 7.30. Mr. P. L. Simmonds, F.R.C.I., F.S.S., on "Science and Commerce Illustrated by the Raw Materials of our Manufactures (II.)."
— Royal, 4. Anniversary.

TO CORRESPONDENTS.

A Subscriber.—A book on the subject is in the press.

L. S. L.—Consult the *Proceedings of the Royal Society.*

M.—The best material you can use for greasing stoppers of bottles containing caustic and carbonated alkalies, is raw unrefined paraffin which is still contaminated with tarry matter. The stopper and neck of the bottle should be wiped dry and well ground.

C. R. S.—A work will shortly be announced which will meet your requirements.

NOTICE TO AMERICAN SUBSCRIBERS.

In answer to numerous inquiries, the Publisher begs to state that Subscribers in the United States can be supplied with the CHEMICAL NEWS from this Office, post free, for the sum of £1 2s. 4d. per annum payable in advance.

THE CHEMICAL NEWS.

Terms of Subscription, Post Free.

The Chemical News, will be regularly forwarded direct from the Office to any address within the United Kingdom at the following rates:—

Quarter	£0	5	0
Half-Year	0	10	0
Year	1	0	0

Terms for Advertisements.

One Page	£3	0	0
One Column	1	15	0
Half-Column	1	0	0
Five Lines and under	0	3	6

Contracts made for repeated insertions.

Post Office Orders to be made payable to Henry Gillman, at the Chief Office.

BOY COURT, LUDGATE HILL, LONDON, E.C.

Now ready, price 4s., with coloured frontispiece of the more important of the Spectra.

Inorganic Chemistry, by the late Professor George Wilson, of Edinburgh University; thoroughly revised and brought up to the latest state of the Science by H. G. Madan, M.A., Fellow of Queen's College, Oxford, and Natural Science Master in Eton College.

W. and R. Chambers, London and Edinburgh.

Methylated Spirits.—David Smith Kidd, Licensed Maker, Commercial Street, Shoreditch, N.E. Also FINISH, FUSEL OIL, and RECT. NAPHTHA.

New Laboratory Apparatus:—

CENTRE BLAST BUNSEN, combining a Bunsen, and a very powerful Herapath, 10s. 6d.

HOT-BLAST BLOWPIPE, giving the temperature exceeding the fusing-point of platinum, 9s. 6d.

TABLE FURNACE, without blast, for operations below a white heat, 30s.

The above were awarded the first medal of the Royal Cornwall Polytechnic Society, 1871. Drawings, &c., one stamp.

T. FLETCHER, 15, Bold St., Warrington.

AMSTERDAM EXHIBITION, 1869.

The GRAND DIPLOMA of HONOUR, being the First Prize, and superior to the Gold Medal.

Liebig Company's Extract of Meat.—Paris EXHIBITION, 1867, TWO GOLD MEDALS; HAVRE EXHIBITION, 1868, THE GOLD MEDAL.—Only sort warranted perfect and genuine by Baron Liebig, the Inventor. "A success and a boon."—Medical Press and Circular. One pint of delicious beef-tea for 2½d., which costs 1s. if made fresh from meat. Cheapest and finest-flavoured "stock" for soups, &c.

CAUTION.—Require Baron Liebig's signature upon every jar Sold by all Italian Warehousemen, Grocers, Chemists, and Ships. Store Dealers; all Wholesale Houses; and of LIEBIG'S EXTRACT of MEAT COMPANY (LIMITED), 43, Mark Lane, E.C.

NOTICE.—Various chemical analyses have been published purporting to show a fraction more of moisture to exist in the Company's Extract than in some imitation sorts. It is extremely easy to evaporate the water almost to any extent, but it is quite as certain that the fine meaty flavour which distinguishes the Company's Extract from all others would be destroyed if the concentration of the Extract were carried beyond a certain degree. Beef-tea made from Liebig Company's Extract with *boiling-hot water* will be found to be greatly superior in flavour, strength, and clearness, to any other sort. This explains the universal preference it obtains in the market.

This Extract is supplied to the British, French, Prussian, Russian, and other Governments.

PRACTICAL CHEMISTRY.

Laboratory, 60, Gower Street, Bedford Square, W.C.

Mr. Henry Matthews, F.C.S., is prepared to give Instruction in all branches of PRACTICAL CHEMISTRY, particularly in its application to MEDICINE, AGRICULTURE, and COMMERCE.

The Laboratory is open daily, except Saturday, from ten to five o'clock; on Saturday, from ten till one o'clock.

Mr. Matthews is also prepared to undertake ANALYSES of every description.

For Particulars and Prospectuses, apply to Mr. Henry Matthews, the Laboratory, 60, Gower Street, Bedford Square, W.C.

BERNERS COLLEGE of CHEMISTRY.—EXPERIMENTAL MILITARY and NAVAL SCIENCES, under the direction of Professor E. V. GARDNER, F.E.S., &c.: of the late Royal Polytechnic Institution and the Royal Naval College.

The Laboratory and Class Rooms are open daily.

Especial facilities for persons preparing for Government and other examinations.

Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

For particulars, &c., apply to Prof. E. V. G., 44, Berners-street, W.

North London School of Chemistry, Pharmacy, &c.—For Instruction in Practical Chemistry and Evening Classes for the Study of Chemistry, Botany, Materia Medica, &c. Conducted by Mr. J. C. BRAITHWAITE, *for thirteen years Principal Instructor* in the Laboratories of the Pharmaceutical Society of Great Britain, and Demonstrator of Practical Pharmacy, Pharmaceutical Latin, &c.

Mr. Braithwaite, having taken the premises adjoining his house, has been enabled *nearly to double the size of his Laboratories*, and, at the same time, procure a large piece of ground which *he has had laid out as a Botanic garden.* Every facility is, therefore, offered to Students desirous of acquiring a practical knowledge of this branch of their education.

The Session 1871—1872 will commence on the 2nd of October, when the Laboratories will re-open at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

THE CHEMICAL and TOXICOLOGICAL CLASS will meet as usual every Monday and Thursday evening, commencing October 2nd, at 8 p.m.

The LATIN CLASS for the reading of Physicians' Prescriptions, Cæsar's Commentaries, &c., every Tuesday and Friday evening, commencing October 3rd, at 8 p.m.

The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday evening, commencing October 4th, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will be continued every Saturday, until further notice, at 10 a.m.

Fee to either of the above Classes Half-a-Guinea per Month. Pupils can enter at any period.

Gentlemen Privately Prepared for the Examinations of the Pharmaceutical Society, and the "Modified Examination for Assistants," &c

All Fees must be paid in advance.

Letters of inquiry should be accompanied with a stamped envelope.

Mr. Braithwaite receives a few Pupils to Board in his house.

Address—54, Kentish Town Road, N.W.

ANALYTICAL LABORATORY AND SCHOOL OF TECHNICAL CHEMISTRY.

7 and 9, HACKIN'S HEY, LIVERPOOL.

Conducted by A. NORMAN TATE, Analytical and Consulting Chemist, and Chemical Engineer.

Established for Educational Purposes connected with Chemistry in its practical Applications to Manufactures, Commerce, &c.; for the performance of Analyses, Assays, and Chemical Investigations; and for affording information respecting the construction, &c., of Chemical Manufactories, and the conduct of Chemical Manufacturing Processes.

The Course of Instruction, in addition to the ordinary Chemical studies, comprises, as far as possible, all such other subjects as are necessary to give the scientific and practical information required in the Arrangement, Construction, and Management of Chemical Manufactories, and in the Application of Chemistry to Industrial Pursuits.

Students' Fees may be known on Application.

Plans, &c., for Chemical Apparatus and Manufactories are supplied and the Erection of Plant and Buildings is superintended when required.

Water-glass, or Soluble Silicates of Soda and Potash, in large or small quantities, and either solid or in solution, at ROBERT RUMNEY'S, Ardwick Chemical Works, Manchester.

THE CHEMICAL NEWS.

Vol. XXIV. No. 627.

CONTRIBUTIONS TO THE HISTORY OF THE OPIUM ALKALOIDS.*

By C. R. A. WRIGHT, D.Sc.,
Lecturer on Chemistry in St. Mary's Hospital Medical School.

Part III.

1. *Action of Hydriodic Acid on Codeia in Presence of Phosphorus.*

In Parts I. and II. of these researches the action of hydrobromic acid on codeia and its derivatives has been partially investigated; and as the action of this acid appears to be in some respects similar to, but in others different from that of hydrochloric acid, it appeared to be of interest to examine the action of hydriodic acid also.

Some preliminary experiments on this subject made two or three years ago in conjunction with the late Dr. A. Matthiessen, showed that when codeia is boiled with a large excess of strong hydriodic acid, no appreciable quantity of methyl iodide is evolved even after some hours' treatment; a brown tarry mass containing much free iodine was produced, but at the time nothing fit for analysis was obtained from this; since then, Dr. Matthiessen and Mr. Burnside† have corroborated the non-formation of methyl iodide under these circumstances.

If, however, phosphorus be added simultaneously with the hydriodic acid, so as to prevent the accumulation of free iodine, methyl iodide is evolved at 100° and upwards in quantity close upon that required for the equation—

$$\underbrace{C_{18}H_{21}NO_3}_{\text{Codeia.}} + HI = CH_3I + \underbrace{C_{17}H_{19}NO_3}_{\text{Morphia.}};$$

hitherto, however, no body of this latter formula has been isolated from the products of the reaction, the substances ultimately formed being derived from a base containing H_2 more than morphia.

The hydriodic acid was obtained in the first instance by the action of hydric sulphide on iodide and water; in the dilute acid thus got iodine was dissolved, and the whole digested at a very gentle heat with phosphorus, more iodine solution being added from time to time; finally the whole was distilled several times from potassium iodide. A colourless acid of sp. gr. 1·7 to 1·75, and containing 50 to 55 per cent of HI was thus obtained, and preserved colourless by keeping a stick of phosphorus in the bottle. The codeia used in these experiments was part of a further supply most liberally presented by Messrs. Macfarlane, of Edinburgh.

On heating on the water-bath a mixture of 10 parts codeia, 30 to 50 of this acid, and 1 of phosphorus, the evolution of methyl iodide is noticed in a few minutes; simultaneously the liquid becomes brown, indicating the separation of free iodine; after two or three hours the brown colour disappears, and the evolution of methyl iodide ceases. If the liquid be heated to gentle ebullition, at first the same effects ensue, but more quickly; the resulting product, however, varies in composition according to the temperature at which the reaction was effected.

In one experiment 55 grms. of codeia yielded by condensation 22·5 grms. of methyl iodide, the theoretical yield being 24·6 from crystallised codeia, $C_{18}H_{21}NO_3,H_2O$; hence upwards of 90 per cent of the theoretical yield was obtained. In order to prove the elimination of 1-18th part of the carbon in the form of methyl iodide, 4·3045 grms. of codeia dried at 140° to 150° C., was heated to gentle ebullition with 30 grms. of 55 per cent of hydriodic acid and about 2 of phosphorus; the vapours evolved were passed through a flask to condense aqueous vapour, and then through a combustion-tube filled with red-hot lead chromate, the CO_2 produced being absorbed in the usual way, an aspirator being attached at the far end so as to create a diminished pressure throughout the apparatus, and thus guard against loss of methyl iodide vapour by leakage at any of the numerous corks and joints.* After three hours a current of pure oxygen was let through the apparatus to sweep out the last traces of methyl iodide vapour from the flasks, and ensure the perfect combustion of deposited carbonaceous particles.

4·3045 grs. codeia thus gave 0·617 grm. CO_2.
0·3720 grm. codeia, burnt in the usual way, gave 0·9830 CO_2.

	Found.	Calculated.
(A) Percentage of carbon evolved as CH_3I	3·91	4·013
(B) Percentage of carbon in codeia used	72·07	72·241
Ratio of A to B	$\frac{3·91}{72·07} = \frac{1}{18·4}$	$\frac{4·013}{72·241} = \frac{1}{18}$

In another experiment not carried to a complete conclusion, the CO_2 collected represented 3·7 per cent of the codeia used.

The methyl iodide produced was found, after washing with water, drying over $CaCl_2$, and distillation, to be free from traces of dissolved phosphorus, to boil at 42° to 45° C., and to correspond in every respect with the ordinary methyl iodide.

If the reaction with hydriodic acid takes place on the water-bath, the resulting product appears to have the composition $C_{68}H_{86}I_2N_4O_{12},4HI$: but if the mixture be heated to gentle ebullition throughout, the temperature not being allowed to exceed 110° to 115° from loss of aqueous fluid by evaporation, the substance obtained contains the elements of two molecules of water less, $= C_{68}H_{82}I_2N_4O_{10},4HI$; whilst if the mixture be rapidly boiled, so that by evaporation the boiling-point rises to 130° and upwards, the ultimate product contains less oxygen than this last body, being $C_{68}H_{82}I_2N_4O_6,4HI$. These three formulæ might each be halved; but inasmuch as compounds containing not less than C_{68} have been got from these products by simple treatments, the higher formulæ are more probable.

All three substances are, while moist, colourless tars, drying at 100° to brittle waxy-looking masses, not fusing at 100° when perfectly dry; they are soluble in hot water, a decomposition being thereby produced; while moist they appear to absorb oxygen with avidity, rapidly becoming yellow or orange. They are also extremely hygroscopic, and from the high percentage of iodine contained, the ease with which they decompose on heating, and the difficultly combustible carbon left, their analysis is a matter of some considerable difficulty. From all these circumstances combined, the numbers obtained do not always accord quite as closely as might be expected in the case of crystalline and easily purified substances.

To obtain the compound $C_{68}H_{86}I_2N_4O_{12},4HI$, 10 parts of codeia, 30 of 55 per cent hydriodic acid, and 1 of phosphorus may be heated on the water-bath for three to four hours, at the end of which time the evolution of methyl iodide has entirely ceased: by filtering the syrupy hot liquid through asbestos to separate particles of amorphous phosphorus and addition of a little water when cold, a colourless tar is precipitated, which soon sets to a hard brittle mass; this is broken up and thoroughly washed with water to separate the phosphorus acids produced simultaneously, and finally freed from moisture as far as possible by pressure between filter paper, and dried at 100°.

The same body may also be obtained by dissolving the original substance in slightly warm water, precipitating with sodium carbonate, and extraction of the mass thus thrown down with ether, and agitation of the first portions

* Read before the Royal Society, November 16, 1871.
† *Proceedings of the Royal Society*, vol. xix., p. 71.

* This device may be applied with advantage to the ordinary processes for combustion, blowing out of the tube as well as loss by traces of leakage being thus avoided.

of the ether extract with hydriodic acid: the tar thus got is identical in all respects with the original substance. After drying at 100° the following numbers were obtained:*—

(A) Prepared by the first method:—
0·3785 grm. gave 0·588 CO_2 and 0·173 H_2O.
0·359 grm. gave 0·2535 AgI.

(B) Prepared by ether process:—
0·357 grm. gave 0·5655 CO_2 and 0·165 H_2O.
0·2635 grm. gave 0·1895 AgI.

(C) Another specimen prepared by ether process:—
0·316 grm. gave 0·493 CO_2 and 0·135 H_2O.
0·2865 grm. gave 0·2025 AgI.

	Calculated.		Found. A.	B.	C.	Mean.
C_{68}	816	42·59	42·36	43·20	42·54	42·70
H_{90}	90	4·70	5·08	5·14	4·75	4·99
I_6	762	39·77	38·16	38·87	38·19	38·41
N_4	56	2·92				
O_{12}	192	10·02				
	1916	100·00				

$C_{68}H_{86}I_2N_4O_{12},4HI$.

The falling short in the percentage of iodine found in these specimens is readily accounted for by the action of the water which necessarily adheres to the tarry product got by either of the above processes; it will be subsequently shown that by the action of water on this body the elements of HI are removed from it.

This compound is apparently formed by the reaction—

$$\underbrace{4(C_{18}H_{21}NO_3,HI)}_{\text{Codeia hydriodate.}}+14HI=$$

$$=4CH_3I+I_8+\underbrace{C_{68}H_{86}I_2N_2O_{12},4HI.}_{\text{New body.}}$$

The iodine thus set free is, of course, re-converted into HI by the action of the phosphorus, a mixture of phosphorous and phosphoric acids being thereby produced. The reaction,

$$3I_2+P_2+6H_2O=2H_3PO_3+6HI,$$

requires for 50 grms. of codeia 3·45 grms. of phosphorus to be converted into phosphorous acid; whilst the equation $5I_2+P_2+8H_2O=2H_3PO_4+8HI$ requires 2·07 grms. to be converted into phosphoric acid. In one experiment 2·8 grms. of phosphorus, as nearly as could be estimated, were found to have become converted into the mixture of the two acids, 50 grms. of codeia having been employed.

On attempting to procure the free base $C_{68}H_{86}I_2N_2O_{12}$ from the hydriodate got as above, by precipitation with sodium carbonate, a snow-white mass was obtained containing, besides a small quantity of the desired base (soluble in ether), a large quantity of two other bases derived from this one (but sparingly soluble in ether). The description of the products thus got will be given in a subsequent section.

By treating codeia with hydriodic acid and phosphorus as above described, but at a temperature of gentle ebullition, not rising above 115°, a product is got on filtration through asbestos and precipitation by water containing apparently $2H_2O$ less than the preceding compound. Dried at 100°,

0·302 grm. gave 0·475 CO_2 and 0·135 H_2O.
0·248 grms. gave 0·1845 AgI.

	Calculated.		Found.
C_{68}	816	43·40	42·89
H_{86}	86	4·58	4·97
I_6	762	40·53	40·20
N_4	56	2·98	
O_{10}	160	8·51	
$C_{68}H_{82}I_2N_4O_{10},4HI$	1880	100·00	

* All combustions given in this paper were made with lead chromate and oxygen; and the iodine determinations by boiling with nitric acid and silver nitrate.

Hence this substance is formed from the preceding one by the reaction—

$$C_{68}H_{86}I_2N_4O_{12},4HI=2H_2O+C_{68}H_{82}I_2N_4O_{10},4HI.$$

If codeia, hydriodic acid (3 to 5 parts), and phosphorus be heated to rapid ebullition, so that most of the aqueous portion distils off along with the CH_3I formed, the boiling-point gradually rises to 130°, or a little above, at which temperature the colourless liquid begins again to become slightly brown; on precipitation of the filtered product with water &c., as before, the following numbers were obtained after drying at 100°.

Specimen A. 0·3575 grm. gave 0·589 CO_2 and 0·168 H_2O.
0·402 ,, 0·307 AgI.
Specimen B. 0·358 ,, 0·583 CO_2 and 0·164 H_2O.
0·369 ,, 0·2815 AgI.
Specimen C. 0·3855 ,, 0·635 CO_2 and 0·178 H_2O.
0·363 ,, 0·276 AgI.

	Calculated.		Found. A.	B.	C.	Mean.
C_{68}	816	44·93	44·92	44·41	44·91	44·75
H_{86}	86	4·73	5·22	5·09	5·13	5·15
I_6	762	41·96	41·27	41·23	41·09	41·20
N_4	56	3·09				
O_6	96	5·29				
	1816	100·00				

$C_{68}H_{82}I_2N_4O_6,4HI$

Hence this substance is formed from the preceding one by the reaction—

$$C_{68}H_{82}I_2N_4O_{10}.4HI+8HI=$$
$$=I_8+4H_2O+C_{68}H_{82}I_2N_4O_6,4HI.$$

2. *Action of Water on the foregoing Compounds.*

When either of the two first compounds just described is dissolved in a large bulk of hot water, and the solution allowed to cool, solid white flakes are obtained containing more C and H, and less I, than the original substance. By repeating this treatment several times successively, the same ultimate compound appears to be produced in each case, being apparently formed by the reactions—

$$C_{68}H_{86}I_2N_4O_{12},4HI = 2HI+2H_2O+C_{68}H_{80}N_4O_{10},4HI,$$
$$C_{68}H_{82}I_2N_4O_{10},4HI = 2HI+C_{69}H_{80}N_4O_{10},4HI.$$

The removal of the last traces of basic HI is very difficult; it may be accelerated by adding a few drops of sodium carbonate to the boiling solution and filtering hot from the small amount of precipitated base; the product is apt, however, to be more strongly yellow coloured when obtained in this way than when got by treatment with water alone.

Specimen A. Got from compound $C_{68}H_{82}I_2N_4O_{10},4HI$ by water and a little sodium carbonate:—
0·366 grm. gave 0·672 CO_2 and 0·177 H2O.
0·406 grm. gave 0·227 AgI.

Specimen B. From same compound by water alone:—
0 369 grm. gave 0·674 CO_2 and 0·174 H_2O.
0·4555 grm. gave 0·2675 AgI.

Specimen C. From compound $C_{68}H_{86}I_2N_4O_{12},4HI$ by water alone:—
0·4265 grm. gave 0·762 CO_2 and 0·220 H_2O.
0·3845 grm. gave 0·2275 AgI.

	Calculated.		Found. A.	B.	C.	Mean.
C_{68}	816	50·25	50·08	49·81	48·73	49·54
H_{84}	84	5·17	5·36	5·24	5·73	5·41
N_4	56	3·45	—	—	—	—
O_{10}	160	9·85	—	—	—	—
I_4	508	31·28	30·21	31·74	31·98	31·31
	1624	100·00				

$C_{68}H_{80}N_4O_{10},4HI$.

Specimen A, dissolved in hot water and precipitated by sodium carbonate, yielded a yellowish-white substance,

rapidly becoming darker and finally almost black. Dried rapidly at 100°,—

0·370 grm. gave 0·930 CO and 0·235 H_2O.

About 0·5 grm. examined qualitatively for iodine gave only traces of AgI.

	Calculated.		Found.
C_{68}	816	68·46	68·55
H_{80}	80	6·71	7·05
N_4	56	4·70	
O_{15}	240	20·13	
$C_{68}H_{80}N_4O_{10}+O_5$	1192	100·00	

From these numbers it appears that the free base, like bromo- and chloro-tetra-codeia, rapidly absorbs oxygen from the air.

Probably there exists a compound intermediate between the hydriodate just described and the original body—

$$C_{68}H_{82}I_2N_4O_{10},4HI;$$

thus one batch of flakes got by two treatments with water of this original substance gave the following numbers after drying at 100°:—

0·3225 grm. gave 0·556 CO_2 and 0·153 H_2O.
0·3205 grm. gave 0·212 AgI.

Another specimen obtained similarly—
0·4175 grm. gave 0·269 AgI.

	Calculated.		Found.	
C_{68}	816	46·58	47·02	—
H_{85}	85	4·85	5·27	—
I_5	635	36·24	35·75	34·82
N_4	56	3·20		
O_{10}	160	9·13		
$C_{68}H_{81}IN_4O_{10},4HI$	1752	100·00		

It is not impossible that this substance is not a definite compound, but only a mixture; nevertheless, a free base of this composition and its hydriodate have been obtained by the action of sodium carbonate on the compound

$$C_{68}H_{86}I_2N_4O_{12},4HI,$$

from whence it appears probable that the body analysed is really a definite compound, formed by the reaction.

$$C_{68}H_{86}I_2N_4O_{10},4HI = HI + C_{68}H_{81}IN_4O_{10},4HI.$$

Both the final and intermediate products have a very curious structure under the microscope; although they stimulate in a high degree the appearance of crystals as they separate from a hot aqueous solution, yet on microscopic examination they are found to consist of strings of coalesced globules not unlike the yeast-plant. In qualitative reactions all the bodies hitherto described are very similar: ferric chloride gives no colouration to the aqueous solution of the hydriodate; silver nitrate is reduced on standing, producing a yellow tint; nitric acid gives an intense yellow; sulphuric acid and potassium dichromate only separate iodine; sodium carbonate throws down a white precipitate scarcely soluble in excess, and soon becoming yellow, salmon-colour, and finally dark brown; ammonia gives a similar precipitate somewhat more soluble in excess, while caustic potash readily dissolves the white precipitate first formed. In many of these reactions this group of codeia derivatives utterly differs from the bodies got by the action of HCl or HBr; most of these latter derivatives give colours with ferric chloride and sulphuric acid and dichromate; all give a blood-red with nitric acid, while the free bases turn more or less *green* by exposure to air.

On similarly treating with boiling water the compound $C_{68}H_{82}I_2N_4O_6,4HI$, formed by the action of hydriodic acid on codeia at about 130°, a substance similar in characters to that got from the other two compounds is produced; the final product, however, differs somewhat in its physical characters from those just mentioned; instead of coming out from the hot aqueous solution in solid flakes, it appears in very minute solid oil globules which do not readily subside, and give to the liquid a great resemblance to fresh milk; sometimes the globules do not subside for many days.

Dried at 100° these globules give numbers indicating a compound analogous to that of the non-iodised base just described; it is, however, much more difficult in this instance to remove the last portions of basic HI; moreover, 4 molecules of water appear to be taken up, probably in lieu of the oxygen lost.

Specimen A. Original substance treated three times with large excess of water—
0·3315 grm. gave 0·589 CO_2 and 0·175 H_2O.
0·299 grm. gave 0·178 AgI.

Specimen B. Original with water four times—
0·321 grm. gave 0·585 CO_2 and 0·169 H_2O.
0·411 grm. gave 0·754 CO_2 and 0·218 H_2O.
0·2835 grm. gave 0·165 AgI.

Specimen C. Original with water five times—
0·4095 grm. gave 0·746 CO_2 and 0·219 H_2O.
0·3995 grm. gave 0·237 AgI.

	Calculated.		Found. A.	Found. B.		Found. C.	Mean.
C_{68} ..	816	50·00	48·46	49·71	50·03	49·68	49·47
H_{92} ..	92	5·64	5·87	5·85	5·89	5·94	5·89
I_4 ..	508	31·13	32·17	31·45		32·06	31·86
N_4 ..	56	3·43					
O_{10} ..	160	9·80					
	1632	100·00					

$C_{68}H_{88}N_4O_{10},4HI$.

Hence this compound is formed by the reaction

$$C_{68}H_{82}I_2N_4O_6,4HI + 4H_2O = 2HI + C_{68}H_{88}N_4O_{10},4HI.$$

Carbonate of soda threw down from Specimen C. a white precipitate, becoming yellow on standing: this precipitate contained a small amount of iodine, showing (as the above numbers indicate) that the transformation of the original substance was not absolutely complete.

The qualitative reactions of this substance are the same as those of the bodies previously described.

(To be continued).

ON THE

ESTIMATION OF NITROUS ACID IN NITRO-SULPHURIC ACID.

By GEORGE E. DAVIS.

On page 237 of this journal, Mr. W. Crowder gives a most important and interesting paper upon a subject which must be of great interest to all those interested in technical chemistry. I allude to the paper "On the Estimation of Nitrous Acid in the Commercial Gay-Lussac Acid."

In the month of May last it was part of my work to estimate the amount of nitro-compounds in our acid from the absorbing column daily. A method was put into my hands (which was imported from the Tyne) which was as follows:—

There was a graduated tube or pouret, divided into 100 parts, and etched on the side was 363 grs. 20 grs. of a 35 per cent bleaching-powder was now ground up and mixed with about a pint of water in a large flask; the pouret was filled up to O with the nitrous vitriol and gradually added with constant agitation until a few drops of indigo sulphate produced a permanent blue colouration.

This is the process as I received it, but I found that it was very inconvenient to have to keep and to weigh off every time 20 grs. of the bleaching-powder, so I set to

work and prepared a solution of which 10 c.c. contained exactly 7 grs. of chlorine. On the day upon which I seriously thought of preparing a large quantity of standard solution I met with a sample of bleaching liquor which contained exactly 7 per cent of chlorine; I took of this 10,000 grs. and diluted it to a litre, and prepared a Winchester quart of the solution. The process then became exceedingly rapid, as it was not protracted by the process of weighing, and an estimation occupied about three minutes.

If the number of measures used varied from 60 to 70 the acid was considered very good. In the few spare moments I then possessed my thoughts were, "What do those numbers mean?" but my time being so fully occupied the matter received no attention until the first week in June, when I began to investigate the subject, as I was struck with the similarity of the numbers obtained when the same samples were operated upon, as specimens I give from my note-book.—

	Sample α.	Sample β.	Sample γ.
1st trial	97	74	103
2nd ,, ...	97	76	101
3rd ,, ...	99	76	102
4th ,, ...	98	78	102

Now, the process I have always used for the estimation of nitrous acid (N_2O_3) has been the permanganate process (see Fresenius's "Quantitative Analysis," 1870, p. 166), so I thought I would try this latter process and see if the numbers obtained corresponded at all with the chloride of lime figures. They did not closely correspond, and from pressure of other business I was forced to give the subject up for awhile. I had spoken to several chemists on the subject, and they all agreed with me that the permanganate process seemed the most reliable.

In pursuing the investigation in August, I first thought it necessary to determine whether the nitro-compounds were wholly in the form of nitrogen-trioxide, although my reading, and the assertions of other chemists, assured me that that point had been already determined. Having assured myself that the nitrogen-trioxide alone was present, I commenced to use my decinormal solution of potassium permanganate, but owing to the organic matter which colours the brown vitriol, the end of the reaction is not very definite, the pink colour always going after standing for a few minutes; but if the colour lasts for two minutes I think it may be taken that all the nitrous acid is oxidised.

For one week in August I put down the number of c.c. used to 10 c.c. of the nitrous vitriol, by the side of the number of divisions of vitriol used from the pouret by the chloride of lime method. They were as follows:—

Chloride of lime method.	Permanganate $\frac{N}{10}$ No. of c.c. used.
78	64
71	76
87	59
99	52
89	68
86	61

When these numbers come to be considered it will be seen that there are irregularities which I have found it difficult to explain; for instance, 78 measures contained the nitrous acid which the 20 grs. of bleaching-powder would oxidise, and also the 64 c.c. of the $\frac{N}{10}$ permanganate, whilst in another case that quantity of nitrous acid was contained in 89 divisions of the pouret and required 68 divisions or c.c. of permanganate to oxidise it.

Now, the organic matter which colours the brown oil of vitriol of commerce is partly destroyed by the acid of high density; in fact, the partial destruction forming the colour, and this is readily acted upon by the permanganate; not but what *all* brown vitriol contains organic matter, but some samples may contain a great deal more than others. Then, again, some vitriols may contain more arsenious compounds than others; but of course these would be equally acted upon by permanganate or chlorine.

Then there is another source of error in the permanganate process. It has been shown that a large excess of sulphuric acid interferes with the determination of iron by its use, and it might be supposed that a large quantity of acid would be injurious in this case; the dilution of the nitrous acid also affects the results.

I use the permanganate process thus:—

Take 10 c.c. of the nitrous vitriol and put it into a litre of water in a large flask and agitate it gently so that any nitrous acid which may be given off is again dissolved. This is again, I think, a source of error, for the nitrous acid is in contact with oxygen in the presence of water, and a slight oxidation might take place. When the solution has been prepared, the decinormal solution of permanganate is added until the solution is not decolourised after standing *two minutes*. This precaution was not taken in the experiments just cited, for the addition of permanganate was stopped directly immediate decolouration ceased, as I was afraid that the permanganate would be consumed by the organic matter.

Each c.c. of permanganate made by dissolving 3·162 grms. in the litre = 0·0019 grm. of nitrous acid (N_2O_3), the reaction which takes place being—

$$2K_2Mn_2O_8+6H_2SO_4+5N_2O_3= \\ =2K_2SO_4+4MnSO_4+H_2O+10HNO_3.$$

By following the above instructions results may be obtained which nearly coincide with the chloride of lime method. To return to this latter method. The reaction which takes place between chlorine and nitrous acid may be taken to be $N_2O_3+Cl_4+3H_2O=2HNO_3+4HCl$. 142 grs. of chlorine oxidising 76 grs. of nitrous acid into nitric acid.

By the equation—

$$\frac{7\times 76}{142}=3{\cdot}74$$

we have the quantity of nitrous acid corresponding to the 20 grains of the 35 per cent bleaching-powder, or the 7 grs. of chlorine.

But the pouret contains 363 grs. of *water*; therefore to get the real *weight* we must, of course, take into consideration the specific gravity of the vitriol. Now, in the test experiments, with every precaution taken to ensure accuracy, the following results were obtained, the permanganate being added until the pink colour remained after standing two minutes:—

Chloride of lime method.	C.c. of permanganate used to 10 c.c. of nitrous vitriol.
85	60
85	60
87	57
85	58
86	55
Average, 85·6	58

Now, taking the numbers and expressing the results on the volume, which is the method used I believe in many manufactories, as it dispenses with weighing, we have 3·74 grains of nitrous acid in 85·6 measures of the vitriol, each measure corresponding to 3·63 grs. of water.

The following equation will then give us the percentage of nitrous acid if we leave the specific gravity of the solution out of the question:—

$$\frac{3{\cdot}74\times 100}{3{\cdot}63\times 85{\cdot}6}=1{\cdot}203.$$

Turning now to the average of the permanganate numbers, let us see how it agrees with the chloride of lime average:—

Each c.c. used = 0·0019 grm. of N_2O_3:

$0{\cdot}0019\times 58\times 10=1{\cdot}102$ per cent N_2O_3,

and the specific gravity being 1·74 the true percentage on the weight is—

$$\left.\begin{array}{l}\text{Chloride of lime process, } 0{\cdot}75\\ \text{Permanganate process, } 0{\cdot}63\end{array}\right\}\text{ of } N_2O_3.$$

Although I have said before that the organic matter of the vitriol might be acted upon by the permanganate more readily than the chlorine, yet, in this case, the permanganate gives lower results than the chloride of lime process, and that has led me to suppose that, on adding the nitrous vitriol in small quantity to the large quantity of water (containing, of course, dissolved oxygen), that oxidation takes place to a considerable extent. There is no gas left in the atmosphere of the flask after slight agitation, as with my experiments iodide of potassium and starch paper was not coloured in the slightest degree.

The five trials may then be tabulated thus :—

Chloride of lime, divisions of pouret.	Permanganate c.c.	Volumetric percentage by chloride process.	Volumetric percentage by permanganate.
85	60	1·212	1·140
85	60	1·212	1·140
87	57	1·184	1·083
85	58	1·212	1·102
86	55	1·198	1·045

It will thus be seen that the numbers and necessarily the percentage obtained by the chloride of lime process are very regular; but that method, even in my opinion, is very faulty, for directly the nitrous vitriol is poured into the chloride of lime, although it be greatly diluted, there is a large disengagement of chlorine, which of course is lost. I do not mean to say that such a large quantity is really lost, but that chlorine is escaping is soon rendered evident to the nasal organs, and even a small escape must affect the results.

In using the chloride of lime process it might be supposed that the standard solution of chloride of lime is quickly decomposed; this is not, however, the case if the solution is not directly exposed to the light and kept in a well-stoppered bottle. The first Winchester quart I prepared contained 7 grains of chlorine in 10 c.c.; after one month it was still 7 grs., and after two months, when the bottle was nearly empty, 10 c.c. contained 6·89 grs.

The sources of error in the permanganate process could, I believe, be reduced to a minimum if the nitrous vitriol was added to the permanganate solution. I have these experiments going on now, and I hope soon to lay the results before your readers.

Laboratory, R. Bealey and Co.,
Radcliffe, Manchester.

NOTES OF

DEMONSTRATIONS ON PHYSIOLOGICAL CHEMISTRY AT ST. GEORGE'S HOSPITAL.

By S. W. MOORE.

V.

Fats are compound ethers of the triatomic alcohol glycerine—

$$\left.\begin{array}{l}(C_3H_5)'''\\ H_3\end{array}\right\}O_3.$$

Bases combine with the fatty acids contained in fats and oils, setting free glycerine and forming soap. Steam forced into fats at high pressure decomposes them, forming glycerine and fatty acids; the former being soluble in water is readily separated.

The rancidity of fats is due to an albuminous ferment setting free certain fatty acids present only in small proproportions, such as butyric acid; this rancidity may be removed by washing with water, as the acids producing it are all soluble in that fluid.

Some oils absorb O and form varnishes; this property is called drying: cod-liver oil is the only animal oil acting thus. Oils, and, in fact, most fluids insoluble in water, form when dropped on that liquid figures called by Tomlinson (and described by him fully in his "Cyclopædia of Arts") cohesion figures; each distinct oil has a separate cohesion form, and by a practised eye an admixture of inferior oil may readily be seen when this experiment is performed; the vessel of water should be 6 inches in diameter and a small-bore pipette used to drop the oil from.

The proximate constituents of fats are olein, stearin, palmitin, and margarin. Olein is the fluid portion of oils, and does not solidify at 0° C. Stearin ($C_{57}H_{110}O_6$), a solid fat contained in mutton suet, soluble in boiling alcohol; separates on cooling. Palmitin ($C_{51}H_{98}O_8$) is another solid fat contained in bees'-wax, and is obtained by crystallisation from an etherial solution. Margarin, according to Heintz, is a compound of palmitic and stearic acids.

Natural Animal Fats and Oils.

Sperm oil and whale oil are unimportant.

Cod-liver oil has an importance due to its ready assimilation by the emaciated system of the phthisical patient. This property is due most probably to the bile contained in the oil. It consists chiefly of olein, some acetin, phosphorised fat, I, and Br; the two latter elements may be detected by saponification with KHO, evaporation, incineration, dissolving the ash in water, and testing with suitable reagents. H_2SO_4 acts on the bile resins, giving a crimson colour to the oil.

Butter consists of olein and palmitin, with butyrin, caproin, and caprylin; on saponification the corresponding acids are set free, known by their characteristic pungent odour.

Lard contains mostly olein. Suet contains stearin.

Spermaceti, a solid crystalline fat obtained from the sperm whale, does not yield glycerine when saponified, but ethal ($C_{16}H_{34}O$).

Bees'-wax consists of cerolein, soluble in cold alcohol, and to which the tenacity and odour of wax is due; cerotic acid, soluble in hot alcohol; and myricin, insoluble in alcohol. This latter is a mixture of a complex nature; the colour of wax is due to this.

Cholesterin ($C_{26}H_{44}O,H_2O$). This fat does not saponify; it is contained in bile, the liver, brain, and gall-stones; it crystallises from a solution in alcohol in rhombic plates.

The melting-point of a fat may be ascertained by introducing a capillary tube charged with the fat under consideration into melting paraffin in which a thermometer is placed; as soon as the fat in the tube melts, observe the temperature denoted by the thermometer, and the result is obtained. To charge a capillary tube with fat, melt the material and plunge in the end of the tube; when the melting fat is drawn up remove it, and as soon as it is cold the determinations may be made.

Fatty matters are soluble in ether and benzol.

ON THE

METHOD OF ASSAYING SILVER ADOPTED IN THE ASSAY OFFICES OF H.M. INDIAN MINTS.*

By H. E. BUSTEED, M.D.,

H.M. Madras Army, Officiating Assay Master, Calcutta Mint.

(Concluded from p. 246).

With regard to the weight of the small portion taken to represent the mass, the system prevails in the Indian mints of taking samples for assay by granulating a small portion of the contents of each melting-pot; when the metal is in a thorough state of fusion and has just been well stirred, a small ladleful of the molten metal is quickly poured from a tolerable height into a vessel of water, and the granules so formed received on a strainer, lifted out

* From the *Journal of the Asiatic Society of Bengal.*

and perfectly dried.* The weight of this specimen representing each pot was at first fixed at 24 grs., technically called the "assay pound;" this in the case of pure silver yielded 31·87 grs. of chloride of silver, while the same quantity of Indian standard silver (which is $\frac{11}{12}$ths silver plus $\frac{1}{12}$th copper = 916·66 in 1000) yielded one-twelfth less, or 29·21 grs.; on the weight of chloride being ascertained in each case a table which was calculated and prepared for the purpose was referred to and the equivalent fineness assigned to the ½ dwt., plus the odd grs., when any. But when it became desirable to prepare for the decimal form of notation, a number more convenient than 31·87 was looked for to represent purity or 1000, and 25 was fixed on as a desirable starting-point, particularly as the quantity of pure silver yielding that amount of chloride, viz., 18·825 grs., was quite large enough to represent each pot.†

The weight, therefore, of the "assay pound" in use at present is 18·825 grs. This produces (with chlorine) in the case of pure silver 25 grs. of chloride of silver.‡

But to obviate the necessity of constant reference to a calculated table to find the equivalent in pure silver of the amount of chloride of silver found in each case, it was ingeniously arranged to stamp each of the assay weights not with its actual weight, but with the figures representing the proportion per mille of pure metal which such a weight of chloride so found corresponds to; thus, supposing a melting of five-franc pieces was being assayed, and the chloride resulting from the assay pound operated on, weighed 22·5 grs. (showing the actual pure contents in the sample to be 16·94 grs.), instead of referring to a table to see the equivalent per mille-age of pure silver, that weight which is actually 22·5 grs. has 900 marked on it, and the assayer simply reads the touch from it.

Accordingly the assay weights are as follows:—

Actual weight in Grs.	Figures marked on the weights.
25·000	1000·00
22·910	(Std.) 916·66
22·500	900·00
20·000	800·00
17·500	700·00
15·000	600·00
12·500	500·00
10·000	400·00
7·500	300·00
5·000	200·00
2·500	100·00
1·250	50·00
1·000	40·00
0·750	30·00
0·500	20·00
0·250	10·00
0·125	5·00
0·100	4·00
0·075	3·00
0·050	2·00
0·025	1·00

Assay lb., weight = 18·825 grs.

The assays for the valuation of merchants' bullion are reported to the $\frac{1}{1000}$th part, *i.e.*, the value of our smallest weight, and as the distance from zero to the point (shown by a scale and indicator) at which the balance "breaks" with this weight in either pan is sub-divided into five, the decimals over or under one-thousandth can be read off.

Accordingly assays are reported to the mint office (as a matter of interior economy, for facilitating the alligation arrangements) to 0·4 and 0·6 (*e.g.* "997·4": "900·6"), and the assays of the standard meltings and of the local pyx coins are reported to 0·2. Thus, reports are made with confidence by this process to a little over 1 gr. (1·152) in the troy pound.

Though the whole process can be carried through to completion in the case of a small number of assays within twenty-four hours, still in the ordinary heavy current work of the office, assays are not completed till the third day. Thus, the samples are tendered suppose on Monday; they are "weighed in," dissolved, and precipitated on that day; on the next they are washed and syphoned twice; and on Wednesday they are "potted," dried, and reported. The certificates of value (payable on demand at the Government Bank) are examined and signed by the assay master on the following morning and handed to the merchant or his agent. In like manner samples tendered on Tuesday are, under ordinary circumstances, weighed and reported by the assay master on Thursday, and so the work goes on steadily, under a systematised routine, where each hour has its assigned duty.*

An ordinary day-work consists of eighty assays,† estimating imported bullion to the value of four lacs of rupees, and standard meltings and coins to the value of five lacs. But on emergencies, in time of heavy pressure, by working extra hours, as many as 164 assays have been daily conducted, estimating bullion to the value of eight lacs of rupees, and standard coins and meltings to the value of fourteen lacs.

Such is an outline of the method of assay worked on a large scale; of course successful results from it cannot be expected unless each step in the manipulation be conducted with great care and accuracy, and only then after much practice and experience.

The natives of this country possess great aptitude in acquiring the skill and confident lightness of touch so essential for delicate manipulation; this, added to their characteristic patience, makes them admirable subordinates in an assay laboratory, under judicious supervision;* moreover, their labour is cheap; so that, on the whole, the process seems to be especially suitable for an Indian mint.

When bar silver is imported from the Continent, the assays of it, made here, almost invariably correspond most closely with those previously made of it in Paris by the volumetric method. But were further proof needed of the practical accuracy of our system, it is to be found in the very close proximity to the legal standard, at which the large Indian coinage has been maintained for many years, as annually reported by the assayers to the Royal Mint of Great Britain, who test the fineness of the Indian pyx coins by the French humid process.

* The introduction into the Calcutta Mint of this system of taking musters is, I find, attributable to Dr. Boycott, late Assay Master, and to Dr. Shekelton, who, by a number of interesting experiments, satisfied themselves that samples so taken represent the mass of mixed metal to be valued much more fairly than samples of the same mass cut or gouged from it after it has been poured and allowed to cool in the ingot moulds where a partial separation of the copper from the silver seems to take place; the result being, according to the above experiments, that in the case of ingots cast in upright moulds, all the outside is much below the average fineness of the mass on assay, and the centre much above it. This refers to alloys of silver and copper mixed in or about the proportion of "standard." According to Monsieur Levol, however, it would appear that when an alloy of silver and copper in which the proportion of the latter is very high (viz., over 28 per cent) has been melted, poured, and allowed to cool, an opposite result to the above is found, viz., the outside of the ingots is above the average fineness. An assay therefrom from a granulated sample must give a much nearer approximation to truth than one from a cut sample.

† The average weight of the contents of each melting-pot is 12,500 tolas, or about 390 pounds Troy, so that the specimen taken to represent this is but about the 119,000th part; each sample is assayed in duplicate.

‡ The basis for these numbers was founded on the proportion in which, according to Turner, silver combines with chlorine, viz., 100 parts with 32·80.

* When holidays or Sundays intervene, the current work is so arranged that the chlorides are not allowed to remain an undue time exposed in the bottles, more especially after the second syphoning, when a minimum of acid is present; under such circumstances, the chlorides are found to lose somewhat in weight, becoming finely divided, easily broken, and showing a tendency to adhere to the cups; similar results from allowing the chlorides to remain in the bottles with insufficiency of acid have been found to follow even when the bottles have been the whole time secluded from light. Syphoning too low must also, for similar reasons, be guarded against.

† Exclusive of any gold assays which may be going on.

* The Calcutta Assay Office has been been fortunate in the possession of its Foreman, Mr. Frewin, who, for over 30 years has been actively engaged in assay operations. He was head assistant in the office under Mr. Dodd when the latter was investigating the adaptation of this system, and no doubt Mr. Frewin's intelligence and dexterity contributed to its successful introduction and subsequent working; he has trained numerous subordinates to the laboratory work who have turned out expert manipulators.

Without this method (improved and made more perfect, as it has been, in the hands of successive assay officers), it would, to my mind, have been very difficult for the assay establishments of the Indian mints to have dealt with, in the same time and with the same accuracy, the immense importation of silver to India during the last fifteen years. In the single year 1865-66, there was poured into the Indian mints, and manufactured into coin, silver alone reaching in value to the prodigious amount of over fourteen millions sterling.

The system which enabled the assay officers to value such a rapid and heavy influx with accuracy, and with satisfaction to the importer on the one hand and to the mint (the buyer) on the other, and to faithfully maintain the immense resulting coinage close to legal standard, has been put to a severe test. If success be the criterion of merit, the 20 years' large experience of this method gained in the Indian mints goes, I think, to show that it is worthy of a yet wider field of utility.

Appendix.

(1.) The bottles used in this process are of thin (but strong) white glass and contain about 12 fluid ozs.; about six inches in height and 2½ inches in diameter at the bottom, which should present a perfectly even, level floor; they are without any (abrupt) shoulder, but become gradually pyramidal from about half way up to the neck; this shape favours the easy dropping out of the chloride. The neck is about one inch in length, polished on its inner surface; the stoppers are of ground glass, polished, with globular heads, and are made to fit with the utmost accuracy and smoothness. The bottles and stoppers are numbered, to correspond with the number on the muster board and also on the cups.

(2.) The "cups" are Wedgwood crucibles, smooth and thin, about 1½ inches in height, 1½ inches in diameter above, and a little less than 1 inch in outside diameter at the bottom. The floor should be perfectly level, and neither it nor the sides should present any roughness likely to retain the chloride. The cups are all numbered.

(3.) The porcelain saucers are shallow, ¾ of an inch in depth; the upper diameter is about 4 inches, the lower 2½ inches.

(4.) The turn-table is a circular board of about 3 feet in diameter, fenced by a brass railing (or by a simple ledge); its centre is occupied by a raised platform about 2 feet in diameter, between which and the rail the bottles (26 on each) stand, the round outer edge of the platform having semi-lunar niches cut in it, into which the bottles fit; opposite to each niche on the platform is a little concavity in which the stoppers rest when not in the bottles. Each turn-table is made to revolve on its centre in either direction, and is raised about 6 inches above the long general table on which all are supported; close to each a funnel is fitted into the lower (supporting) table for conducting away the fluid syphoned from each set of bottles.

(5.) The trough is a basin of cast-iron (painted); it may be oblong or round, raised to about the height of 3 feet from the ground; when round and large enough for twenty bottles, space and distilled water may be economised by having a platform insulated in the centre. This is convenient for resting the bottles on after the chlorides have been got out. A trough of this kind may be about 2½ feet in diameter, having a space 7 inches broad and 4 deep all round between the circumference of the basin itself and the outer edge of the island platform. Into this space is poured distilled water to the depth of 3 inches. From the rim of the trough hang as many brass supports as there are bottles to be inverted; these are two circular clasps connected at the back to a bar common to both; one, the larger, is 1½ inches above the smaller and lower one, which is under water; they are open in front (or towards the centre of the basin) to about ¾ of an inch in width. The openings of both are in the same line, owing to the lower (smaller) segment being projected towards the centre by an abrupt curve in the connecting bar, by which they hang from the brim. This arrangement receives and fixes the inverted bottles in the required position. The distilled water is removed from the trough by the withdrawal of a plug. These troughs are sometimes made to revolve on the centre.

(6.) The drop bottle used for washing down the glass rod when breaking up the chlorides, and for sprinkling the surface of the cups, in small sized, round, so as to be easily grasped; it holds about 6 ozs. The stopper is hollow, with two small tubes leading from its head, one opposite to the other. Glass is so liable to break or chip that a hollow silver stopper is now generally substituted.

(7.) The steam-bath is simply a square vessel made of sheet copper, between 3 and 4 inches deep, the top or upper plate of which has a number of circular openings about two-thirds of the diameter of a Wedgwood crucible. There is also a steam escape pipe leading from the centre below to about a foot in height. They are of various sizes to contain from 10 to 150 pots: they are raised or moved by two lateral handles.

(8.) Hot air plate of thin sheet iron bored with holes for the reception of the crucibles, raised by iron feet about 1½ inches above the furnace plate. It is furnished with a square tin cover which fits over it. This is provided with lateral apertures for the escape of heated air, and with a tube from its roof for the reception of a thermometer.

The drying furnace on which the above rest is surmounted by a hood, the door of which (glazed) slides up and down by weights and pulleys; the plate is heated by means of gas jets; it has a good draught to carry off the nitrous fumes, as on it the musters are dissolved in the first instance on a sand bath.

(9.) The forceps for removing the cake of chloride from each cup to the skiff of the balance should not be too sharp in its grasp; it is much improved by having the blades tipped for about an inch from the points with platinum about ⅛ inch in width.

(10.) It is a convenience to have the assay weights arranged in a set of ivory compartments in the weight box; on the floor of each compartment are engraved the figures corresponding to those engraved on the weight which occupies it; by this means the assayer has merely to glance at his weight box to see what weights are in the pan of the balance, and to read off the "touch" when each chloride is counterpoised.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

November 16th, 1871.

Mr. Riley, whose remarks were not fully reported in our notice of the proceedings of the Chemical Society last week, has forwarded the following statement for publication:—

Mr. Riley was sorry he only heard the latter part of the paper just read, and said that the mechanical treatment of iron should be considered quite as much as the chemical composition of the iron. Thus iron that was quite brittle, such as puddler's old rabbles, when piled, heated, and rolled two or three times, became fibrous to a certain extent, and much improved in quality. The best fibrous wrought-iron, after being melted, became very red-short.

Much misconception existed as to the injurious action of the so-called impurities in iron.

He found that excellent tool steel that worked well under the hammer and stood the severest tests (burning off

the skin of cast-steel wheels) contained an amount of silicon that would be very prejudicial in white cast-iron, and make it difficult to puddle.

In reply to Dr. Odling's queries as to sulphur and phosphorus, he considered sulphur mostly injurious, although it made No. 1 pig stronger (the most highly graphitic iron) by reducing it to Nos. 3 or 4, less graphitic pig, which was a stronger iron.

No one would, however, think of using sulphur, as the highly graphitic iron being the most difficult and expensive to produce, there was always sufficient of a lower quality (white or mottled) to mix with No. 1 pig so as to reduce it to Nos. 3 or 4.

He considered that in pig-iron, a certain amount of phosphorus was advantageous, as without it the iron, when puddled, worked red-short; thus the best Swedish pig made a red-short iron, and its quality would be improved by mixing a lower quality containing phosphorus with it, such as Cleveland or Derbyshire pig.

Low Moor and Bowling pig contains uniformly about 0·64 per cent of phosphorus, the amount being the same generally when the best clay iron-stones are used in South Wales either with hot or cold blast; there was no doubt that such pig made the best wrought-iron, and commanded a higher price than Swedish charcoal pig.

Phosphorus in steel is certainly injurious, and anything much over 0·10 per cent he considered very detrimental. The sample referred to contained 2·07 per cent of silicon.

In puddling iron he considered it was essential to have some silicon in the pig; good white forge pig usually contains from ¾ to 1 per cent, whereas inferior white pig frequently contains only 2-10ths to 3-10ths per cent.

Tungsten is being used by Mr. Mushet in his so-called "special" steel; it contains more than 10 per cent, and is an excellent steel for certain kinds of cutting tools; it requires no hardening.

CORRESPONDENCE.

HEAT AND ELECTRICITY.

To the Editor of the Chemical News.

Sir,—It is doubtless true that the heating power of a current is proportional to the square of its strength; but, unless I misunderstand Mr. Highton, he did not measure the strengths of the *currents employed to heat his wires* at all. He measured the currents given by the cells acting against the small resistance of his tangent galvanometer, but surely he does not suppose that the ratio between the currents will remain the same when the resistance of the circuit is altered by introducing a thin wire. That it should do so it would be necessary that the electro-motive forces of the cells should be alike. A single Grove cell will give the same deflection of a tangent galvanometer needle as ten or fifty similar cells, but the heating power will be very different.

Let Mr. Highton repeat his experiments introducing the galvanometer into the *same circuit* with the red-hot wire; he will then, I think, get a result more in accordance with the rule.—I am, &c.,

W. J. Wilson.

Birkbeck Institution, Nov. 27, 1871.

DUMAS'S VAPOUR DENSITY DETERMINATIONS.

To the Editor of the Chemical News.

Sir,—I shall be glad if you will grant me a little space in your journal to notice two errors with reference to Dumas's "Vapour Density Determinations," to be found in most of the text-books which treat of the subject, which I mentioned in the *Journal of the Chemical Society* last year, but to which Dr. W. M. Watts has again called attention in your issue of November 10th.

The first error alluded to is that no directions are given to observe the atmospheric temperature and pressure at the second weighing. This error has, no doubt, crept in and remained unnoticed owing to the fact that, as a rule, the height of the barometer and the temperature of the balance room would not vary perceptibly in the short time required for a determination, and that they would therefore be practically the same at both weighings.

Dumas's bulbs displace 10 to 20 c.c. of air, which weigh under ordinary circumstances 12 to 24 milligrammes (not by any means an *extremely small* quantity), but this quantity may be disregarded except in extreme cases, seeing that a variation of 5° C. in the temperature or 12 m.m. in the pressure will only affect the apparent weight of the bulb to the extent of 0·2 to 0·4 milligrammes. If, however, it is necessary to make allowance for variation of temperature or pressure the following correction must be applied to the formula:—

Let P = apparent weight of globe at $t°$ C. and H m.m.
P' = apparent weight of globe and vapour at $t'°$ and H'.
D = density of material of which the globe is composed (water = 1).
(aH) = weight of c.c. of air at $t°$ and H.
$(a'H')$ = weight of c.c. of air at $t'°$ and H'.
V = capacity of globe in c.c.
v = volume of residual air.

Then the absolute weight of globe $= P+\frac{P}{D}(aH)$.

And the absolute weight of globe and vapour =

$$P'+(V-v)(a'H')+\frac{P}{D}(a'H').$$

And the absolute weight of vapour =

$$(P'-P)+(V-v)(a'H')+\frac{P}{D}((a'H')-(aH)).$$

Which only differs from the numerator of the Dumas formula by the quantity $\frac{P}{D}((a'H')-(aH))$.

The second error alluded to is that an incorrect expression is given for the actual weight of the bulb. This error is liable to mislead the student, although it will not affect the result, as it does not occur in the formula for the density but only in the verbose explanations. Those, therefore, who use the formula without troubling themselves about its construction will not introduce the error into their work.

If absolute accuracy were required in weighing, and if the balances generally used would weigh to 0·05 milligramme, it would, of course, be necessary to take into account the effect of the atmospheric variations on the apparent value of the weights themselves.—I am, &c.,

James J. Brown.

Sudbury, Harrow,
Nov. 21, 1871.

MISCELLANEOUS.

The Royal Society.—The annual meeting of the Fellows of this society was held yesterday at Burlington House, when Lieut.-General Sir Edward Sabine, R.A., K.C.B., resigned the high office of President, which he has so worthily filled since 1861, and the Astronomer Royal, who, by his untiring zeal and energy, has contributed largely to the advancement of science, was elected to fill the Presidential Chair. The Copley Medal was awarded to Dr. Julius Robert Mayer, and the two Royal Medals were presented to Drs. Stenhouse and Busk. The following gentlemen were appointed officers and council for the ensuing year:—*President*—George Biddell Airy, M.A., D.C.L., LL.D., Astronomer Royal. *Treasurer*—William Spottiswoode, M.A. *Secretaries*—William Sharpey, M.D., LL.D.; Professor George Gabriel Stokes, M.A., D.C.L,

LL.D. *Foreign Secretary*—Professor William Hallowes Miller, M.A., LL.D. *Other Members of the Council*—George James Allman, M.D.; John Ball, M.A.; George Burrows, M.D.; Mr. George Busk, P.R.C.S.; Professor Robert Bellamy Clifton, M.A.; Heinrich Debus, Ph.D.; Professor Peter Martin Duncan, M.B.; Professor George Carey Foster, B.A.; Mr. Francis Galton; Thomas Archer Hirst, Ph.D.; Sir John Lubbock, Bart; Sir James Paget, Bart., D.C.L.; The Earl of Rosse, D.C.L.; General Sir E. Sabine, R.A., K.C.B.; Isaac Todhunter, M.A.; Sir Charles Wheatstone, D.C.L.

Royal Institution of Great Britain.—The following are the Lecture arrangements for 1871-72:—The Christmas Lectures, adapted to a juvenile auditory, will be delivered by Prof. Tyndall, LL.D., F.R.S., "On Ice, Water, Vapour, and Air," on December 28, 30, 1871; January 2, 4, 6, 9, 1872, at three o'clock. The other lectures before Easter, 1872, are:—Ten lectures "On the Nervous and Circulatory Systems," by Dr. W. Rutherford, F.R.S.E., on Tuesdays, January 16 to March 19. Ten lectures "On the Chemistry of Alkalies and Alkali Manufacture," by Professor Odling, F.R.S., on Thursdays, January 18 to March 21. Six lectures "On Literature," by W. G. Donne, Esq., on Saturdays, January 20 to February 24. Four lectures "On Demonology," by Moncure D. Conway, Esq., on Saturdays, March 2 to 23. The Friday Evening Discourses before Easter will probably be given by Mr. W. R. Grove, Q.C., the Archbishop of Westminster, Professors Odling and Humphry, Dr. Gladstone, Messrs. C. W. Siemens, R. Liebreich, and John Evans, and Professor Tyndall; the first meeting will be on January 13, 1872. After Easter the lectures will comprise—Three lectures "On Statistics, Social Science, and Political Economy," by Dr. Wm. A. Guy, F.R.S., on Tuesdays, April 9, 16, and 23. Six lectures "On the Development of Belief and Custom amongst the Lower Races of Mankind," by Ed. B. Tylor, Esq., F.R.S., on Tuesdays, April 30 to June 4. Nine lectures, by Professor Tyndall, LL.D., F.R.S., on Thursdays, April 11 to June 6. Five lectures "On Star Depths," by R. A. Proctor, Esq., B.A., F.R.A.S., on Saturdays, April 13 to May 11. Four lectures "On the Chemical Action of Light," by Professor Roscoe, F.R.S., on Saturdays, May 18 to June 8.

The Royal Polytechnic.—On Monday evening last, Mr. T. W. Tobin, who was captain of Mr. Streeter's expedition to the diamond fields of South Africa, delivered an exhaustive lecture on this discovery. Mr. Tobin's practical knowledge of the subject, together with his series of original sketches and the specimens of diamonds, rubies, and garnets (which were magnified), made the lecture an instructive one, and from the applause which followed its delivery it was evident that the large audience was much interested. Professor Pepper presided, and during the lecture practically demonstrated that the diamond is identical in composition with ordinary charcoal. The lecture will, we believe, be repeated daily.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 15, 1871.

This number contains the following original papers and memoirs:—

Contribution to our Knowledge of the Cinchona Barks.—O. Hesse.—In the introduction to this paper, the author calls attention to the fact that Grahl's test for detecting the genuineness of cinchona barks does not rigorously apply, inasmuch as with any bark which contains more or less of the cinchona alkaloids—even though such bark be not, in botanical and pharmacognostical sense, a cinchona bark—the reaction discovered by Grahl is observed. The reaction alluded to is that when a piece of a cinchona bark, or one which contains cinchona alkaloids, is gently heated in a test-tube held in a horizontal position, so that it gives off tarry matter, that fluid is carmine-red coloured, a reaction which Batka states always takes place when cinchona alkaloids are heated along with pure cellulose. The greater portion of this paper is devoted to the description of the results of some experiments made with a new kind of cinchona bark, which has been named *China cuprea* on account of its fine red colour, bluish red in the state of powder. The ammoniacal solution of this bark has a purple-red colour; this solution tinges white filtering-paper rose-red. The tannic acid present in this bark appears to be different from that found in the genuine cinchona barks; the quantity of alkaloids found in this bark amounts to from 2·12 to 2·25 per cent, viz.:—Quinine (pure alkaloid), 1·26; conchinin, 0·46; cinchonin, 0·22; amorphous bases, 0·34; chinidin and paricin are not as yet found in the *China cuprea;* the amorphous bases are present as such in this bark, and are not the result of decomposition of other alkaloids by the action of reagents.

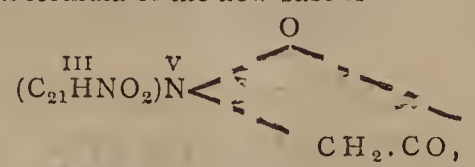
New Base from Strychnine.—A. Strecker.—3 parts of finely pulverised strychnine and 1 part of monochloracetic acid were first heated to 180° for a period of four to five hours. The cooled mass, having been dissolved in water, was saturated with ammonia, and the mixture filtered, the filtrate yielding, on evaporation, a crystalline mass, the new base, a body difficultly soluble in cold but more readily so in hot water, also in alcohol, but not at all in ether. On analysis, results were obtained leading to the formula $C_{23}H_{24}N_2O_4$, confirmed by the analysis of the platinum double salt of this substance, which yields with acids salts, some of which (the nitrate and oxalate) are very difficultly soluble in water. The formation of this base is illustrated by the following formula:—

$$C_{21}H_{22}N_2O_2+C_2H_3ClO_2=C_{23}H_{25}N_2O_4Cl.C_{23}H_{25}N_2O_4Cl+NH_3=$$
$$=C_{23}H_{24}N_2O_4+NH_4Cl.$$

This base is distinguished from brucine by 2H less, while the new base contains $C_2H_2O_2$ more, than strychnine. With bichromate of potassa and concentrated sulphuric acid, this new base yields the same reaction as strychnine. Taking the constitutional formula of strychnine as—

$$(C_{21}H_{23}NO_2)\overset{III}{N},$$

the constitutional formula of the new base is—



and the name of the new base is glycol-strychnine.

On Hexyl-Alcohol from Heracleum Oil.—A. Franchimont and Th. Zincke.—After first referring at some length to some former experiments on this subject, the authors describe a series of experiments made with Heracleum oil, from which they obtained by fractional distillation and treating with alcoholic potassa solution, a hexyl-alcohol, $C_6H_{14}O$, a liquid not miscible with water; sp. gr. = 0·819; boils at 156·6°; by oxidation, it yields an acid containing the same quantity of carbon. The hexyl-iodide, the acetate, and the capronate of this body have been prepared by the authors, and described. The iodide, $C_6H_{13}I$, is a colourless liquid, insoluble in water, but miscible with alcohol and ether; sp. gr. = 1·4115; boils at 179·5°. The acetate, $C_6H_{13}.(C_2H_3O)$, is a very pleasant-smelling fluid; sp. gr. = 0·889; boils at 168·7°. The capronate, $C_6H_{13}(C_6H_{11}O)O$, is a fluid oil almost devoid of smell; sp. gr. = 0·865; boils at 245·6°. From carefully-made comparative researches, the authors infer that the hexyl-alcohol alluded to is a hitherto unknown body.

Researches on the Invisible Photographic Image.—H. Vogel.—We regret that it is not possible to give an abstract of this excellent paper, owing to the fact that it would require the reproduction of a large number of formulæ.

Decomposition of Nitric Acid by Heat.—L. Carius.—This lengthy and exhaustive essay, being illustrated by a woodcut and several tabulated forms exhibiting results of experiments, does not admit of any suitable abstraction, notwithstanding its intrinsic merits.

Some Nitrogenous Compounds of Milk-Sugar.—R. Sachsse.—After briefly referring to the experiments made by Dusart, Thenard, and Schützenberger, on the action of ammonia upon the carbohydrates, the author gives a preliminary account of some experiments made by him on the action of aniline upon carbohydrates, and, in the first place, upon milk-sugar: hereby are at least two different compounds formed; one of these was found, by elementary analysis, to give results leading to the formula $C_{30}H_{49}NO_{21}$, while the other's formula was ascertained to be $C_{36}H_{54}N_2O_{20}$. The formation of these bodies may be illustrated by the following formulæ:—

$$\text{(I)}.\ C_{24}H_{44}O_{22}+C_6H_7N=C_{30}H_{49}NO_{21}+H_2O.$$
$$\text{(II)}.\ C_{24}H_{44}O_{22}+2C_6H_7N=C_{36}H_{54}N_2O_{20}+2H_2O.$$

Contribution to our Knowledge on the Benzoin Series.—Th. Zincke.—An exhaustive and very lengthy memoir on the constitutional formulæ of this very extensive series. Notwithstanding the very great scientific value of this essay, its contents, elucidated by a large number of complex formulæ, are not suited for abstraction.

Application of the Second Main Point of the Mechanical Theory of Heat to Chemical Phenomena.—A. Horstmann.

Acetnaphthalid and some of its Derivatives.—P. Rother.—Acetnaphthalid ($C_{10}H_7.NH.C_2H_3O$), obtained by heating for several consecutive days naphthylamine and glacial acetic acid, is a solid crystalline body, insoluble in cold, readily soluble in hot, water and alcohol; fuses at 159°; treated with fuming nitric acid in the cold, it yields binitro-acetnaphthalid ($C_{10}H_5(NO_2)_2.NH.C_2H_3O$). This new compound is almost totally insoluble in water either cold or hot, soluble in alcohol, but insoluble in ether, benzol, chloroform, and glacial acetic acid. Acetnaphthalid combines with bromine, forming a monobromide ($C_{10}H_6Br.NH.C_2H_3O$), insoluble in water, but soluble in boiling alcohol; from the alcoholic solution this body crystallises readily. By the action of caustic potassa solution upon this last compound, there is formed monobrom-naphthylamin ($C_{10}H_6Br.NH_2$), fusing at 94°, and combining with acids to form salts.

Preliminary Notice on the Reaction between Oxychloride of Phosphorus and Phosphoric Anhydride,—G. Gustavson.—When equivalent quantities of phosphoric anhydride and oxychloride of phosphorus are heated in a sealed tube at 200° for some thirty-six hours, there is formed a thickish transparent mass, probably the chloride of the metaphosphoric acid, formed according to the following formula:—$P_2O_5+POCl_3=3PO_2Cl$. The author is still engaged in these experiments.

La Revue des Scientifique de la France et de l'Etranger, November 11, 1871.

This number does not contain any original papers on chemistry, but we call attention to the following excellent memoirs:—

Freedom of Superior Instruction.—M. Lorain.—A well written and digested essay on the higher branches of education, and the duties of the state in respect thereof.

Poisoning with Carbonic Oxide Gas.—M. Gréhaut.—This memoir, illustrated by engravings, is an excellent specimen of experimental physiology, as taught by the author at the Practical Lectures of the Medical Faculty of Paris.

November 18, 1871.

In addition to an essay to be presently more fully alluded to, this number contains the following original papers which, although not strictly relating to chemistry, deserve attention:—

Middle Class Education in France.—M. Lorain.

The Regulators (Régulateurs) of Human Life in a Physiological Sense.—Dr. J. Moleschott.—This is the author's opening lecture of his course of physiology at the University of Turin; for clearness, distinctness, and eloquent mode of treating the subject (a general review of the principal functions of the human body), this lecture deserves the attention of all interested in this matter.

Excretion of Urea by the Kidneys.—Dr. Gréhaut.—A great portion of this lecture is devoted to anatomy and physiology, but, speaking of the quantitative estimation of urea, the author states that he has improved Millon's process for this purpose, the advantages of the author's mode of operating being that—(1). It is not necessary that the urea be pure; it may be even contaminated with albuminoid matters, salts, and fatty matters. (2). No weighing is required, since the gases (nitrogen and carbonic oxide) resulting from the decomposition of the urea are completely collected in graduated tubes. (3). The process is very correct, because the author's apparatus (unfortunately this cannot be well understood without reproduction of woodcuts) enables the operation to be performed in a vacuum, and even 1 centigrm. of urea may be successfully operated upon. This excellent and very complete paper also treats on the estimation and detection of urea in blood, while, moreover, an ingenious apparatus for accelerating evaporation of liquids at a high temperature is described and illustrated by an engraving.

November 25, 1871.

This number does not contain any original papers relating to chemistry, but we must not omit to quote the title of the following essay:—

Electric Properties of the Nerves and Muscles During the State of Embryonic Life and During the State of Putrefaction.—Dr. Valentin.—An experimental physiological essay.

Polytechnisches Journal von Dingler, second number for October, 1871.

This number contains the following original papers and memoirs relating to chemistry and allied subjects:—

Studies on Blast-Furnaces and Pig-Iron Production.—C. Schinz.—Continuation of this exhaustive memoir. This portion consists of a series of tabulated forms exhibiting the results obtained by the actual working of blast-furnaces.

Volumetrical Estimation of Iron and Ferrocyanogen.—H. Rheineck.—This paper treats on the quantitative estimation of iron and Berlin blue in liquids used in dye-works, but the contents are not suited for any useful abstraction.

Method for Testing Bleaching-Powder (Hypochlorite of Lime).—Dr. Graeger.—The author prepares a very dilute and strongly acidified solution of protosulphate of iron, which is exactly titrated with 1-10th solution of permanganate of potassa. Into this solution, kept in a bottle, the solution of bleaching powder is poured by the aid of a pipette, and, the bottle having been stoppered, the mixture is shaken up, and afterwards the undecomposed iron salt estimated by the aid of permanganate; 100 c.c. of that solution correspond to 3·546 grms. chlorine and to 0·8 grm. oxygen. To 1 grm. of bleaching-powder, considered as containing 3·3546 grms. chlorine, is required 0·278 grm. sulphate of iron, but it is best to take 0·4 to 0·5 grms. of that salt. The ammonio-sulphate of iron cannot be used on account of the danger consequent upon the formation of chloride of nitrogen.

Extraction of Sugar from Molasses by the Aid of Baryta.—Dr. G. Lunge.—An excellent practical treatise on this subject. Saccharate of baryta is formed, and this salt decomposed by carbonic acid, and the carbonate of baryta again converted into caustic baryta.

Preservation of Timber Used in Mines, Coal-Pits, and Quarries.—Dr. Dingler.—This lengthy essay contains the results of a series of practical experiments made with various kinds of wood and almost all substances which have been used to impregnate wood for the purposes of preserving it. It appears that wood thoroughly impregnated with a strong brine (solution of common salt) keeps very well underground.

Relative Goodness and Durability of Timber Felled in Winter or in Summer.—M. Burckhardt.—This subject has never been very much investigated, and the author states, therefore, that very possibly this question cannot be answered. He is inclined to the belief that if trees felled in summer are shelled (the bark stripped off), immediately after having been cut down, the timber thus obtained is in no ways inferior to that obtained from trees cut down in winter.

Journal für Praktische Chemie, No. 17, 1871.

The following original papers are published in this number:—

On Uramidobenzoic Acid Ethyl-Ether and Carboxamidobenzoic Acid Ethyl-Ether.—P. Griess.—After referring to some researches made about three years ago on uramidobenzoic acid, urea, and carboxamidobenzoic acid, the author describes the following bodies:—Ether of uramidobenzoic acid, $C_8H_7N_2O_3,C_2H_5$, a solid body, difficultly soluble in water, fuses at 176°; carboxamidobenzoic acid ether—

$$C_{15}H_{10}N_2O_5(C_2H_5)_2\left\{\begin{array}{l} C_7H_4,N\left\{\begin{array}{l} HO_2,C_2H_5 \\ CO \end{array}\right. \\ C_7H_4,N\left\{\begin{array}{l} HO_2,C_2H_5 \end{array}\right. \end{array}\right.$$

a solid crystalline body, insoluble in water, readily soluble in warm alcohol and ether, fuses at 162°, decomposed by boiling alcoholic caustic potassa solution into alcohol and carboxamidobenzoic acid.

Origin and Properties of Monochlorcitramalic Acid.—Dr. J. Gottlieb.—This exhaustive and very lengthy memoir contains the following sections:—Preparation of monochlorcitramalic acid; hydrate of monochlorcitramalic acid, silver, baryta, and lead salts of this acid, $C_5H_7ClO_5$.

Rational Composition of Chlorcitramalic Acid.—H. Kolbe.—Notwithstanding the high scientific value of this paper, its contents are not suited for useful abstraction, on account of the fact that the value of this paper rests entirely upon a series of very lengthy and complicated formulæ. The author incidentally observes that citraconic acid should not be treated with liquid hyponitric acid; the author while doing this, in the expectation of thus obtaining dinitropyrotartaric acid, witnessed the most violent explosion which, to his knowledge, could occur in a chemical laboratory; although the quantity of material was only small, the effects were of a most serious nature, though fortunately nobody was hurt.

On some of the Nitrogen Compounds of Anthrachinon.—R. Bœttger and T. Petersen.—The first instalment of a lengthy essay on this subject, divided into the following sections:—α dinitro-anthrachinon, $C_{14}H_6(NO_2)2O_2$; α diamido-anthrachinon,

$$C_{14}H_6(NH_2)_2O_2;$$

behaviour of α diamido-anthrachinon with nitric acid; behaviour of α dinitro-anthrachinon with concentrated sulphuric acid.

Les Mondes, November 23, 1871.

Experiments in the Mont Cenis Tunnel.—Rev. A. Secchi, S.J., accompanied by Dr. Diamilla-Muller and the Rev. Denza, S.J.—The eminent *savants* just named have paid a visit to the tunnel alluded to with the view of inspecting that work, wherein already exists a large room hewn laterally out of the rock, to ascertain how far it will be possible to make a series of experiments (pendulum for gravity, magnetic, on the temperature of the rock, &c.) in the tunnel, as well as on the mountains through which it is bored. The experimenting party have already ascertained that the passage of railway trains through the tunnel does not perceptibly affect the accuracy of the experiments intended to be made, and of which a full and complete programme will be drawn up during this winter and all necessary arrangements made for execution next summer. The railway companies have promised every assistance in this work, the preliminaries of which will be made at Rome during this winter.

New Process of Panification.—Dr. Sézille.—The wheat is first deprived of its epispermum (outer cover, or husk) by means of properly constructed machinery; the decorticated grain is next several times acted upon by tepid water (about 80° for the first bath and 40° for the subsequent ones), whereby the gummo-resinous cover of the grain is dissolved and removed. This removal is necessary on account of the fact that this substance becomes very deep brown, almost blackish, coloured by fermentation of the dough; the grain at the same time absorbs from 65 to 70 per cent of water, and is then reduced to a paste by means of machinery very similar to that used in chocolate mills. This perfectly white paste is next leavened, and after fermentation ready for baking. By this process, from the same quantity of grain

which by the usual process only yields 108 to 110 kilos. of bread, the yield is increased to 145 kilos. of very superior quality and far greater nutritive power; moreover, a very considerable saving of labour and expenses connected therewith is effected by the application of this new process, which has been thoroughly tested by competent and independent scientific as well as practical men.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, November 16, 1871.

Toepler's Electrical Machine.—Dr. Albertier.—The detailed description, accompanied by woodcuts, of a peculiar and greatly improved electrical machine (friction) whereby the machine charges itself with negative electricity.

Continuation of the Chemical Researches on Nutritive Substances.—C. Mène.—This portion of the essay treats on the action of the saliva in the digestion.

Bibliography.—Under this heading we meet here with a brief review of "Eléments de Chimie Organique," par M. le Dr. Sacc, Professor of Chemistry at the University of Neufchâtel, published at Paris by Lacroix. This work, specially intended for students who commence to learn organic chemistry, is highly spoken of on account of the clear style and excellent classification of the subject.

Zeitschrift für Chemie von Beilstein, No. 11, 1871.

This number contains the following original papers:—

Chlorhydrates of Hydroxylamin.—W. Lossen.—In addition to the monochlorhydrate of hydroxylamin, NH_3O,HCl, there have been discovered by the author a semichlorhydrate, $2NH_3O,HCl$, and sesquichlorhydrate of the base just named, $3NH_3O,2HCl$. The former of these two bodies is prepared by adding to the monochlorhydrate of hydroxylamin in concentrated aqueous solution an equivalent quantity of hydroxylamin dissolved in absolute alcohol; while the sesquichlorhydrate is prepared by mixing the mono- and semi-chlorhydrate, and dissolving them in the smallest possible quantity of tepid water. The new salt crystallises from this solution. The two new salts are deliquescent, very soluble in water and weak alcohol, hardly so in absolute alcohol, and insoluble in ether. The semichlorhydrate fuses at 85°, the sesquichlorhydrate at 95°. The reactions exhibited by these substances correspond very closely to those of hydroxylamin.

On an Isomeric Chloro-Nitro-Phenol.—A. Faust.—The author describes briefly the following substances obtained by a complicated process from dinitro-chlorphenol, first converted into amido and then into diazo compounds:—Hydrochlorate β amido-nitro-chlorphenol, $C_6H_3ClNH_2NO_2O.HCl$, a yellow-coloured crystalline body soluble in water. Sulphate amido-nitro-chlorphenol—

$$(C_6H_3ClNH_2NO_2O)_2SO_4H_2,$$

also crystalline and readily soluble in water; the baryta salt of this compound, $(C_6H_2ClNH_2NO_2O)2Ba+4H_2O$, is a crystalline substance, and its aqueous solution exhibits a deep brown colour. β chlornitro-phenol, $C_6H_4ClNO_2O$, is crystalline, soluble in water, ether, alcohol, and chloroform, and fuses at 111°; its potassa salt, $C_6H_3NO_2ClO.K+H_2O$, is a brown-coloured crystalline salt soluble in water. Hydrochlorate of amido-chlorphenol, $C_6H_4ClNH_2O.HCl$, obtained from β chlornitro-phenol by reduction with tin and hydrochloric acid and removal of tin by sulphuretted hydrogen—

$$C_6H_4ClNH_2O.HCl,$$

a yellow-coloured crystalline substance soluble in water.

Frangulinic Acid, a Derivative from Anthracen.—A. Faust.—By treating frangulinic acid, $C_{14}H_{10}O_5+H_2O$, with zinc-dust at a high temperature anthracen was obtained; and consequently the author states that he is now busy with experiments to ascertain whether the formula of the acid just alluded to should be—

$$C_{14}H_7(OH)_3O_2 \text{ or } C_{14}H_5(OH)_3O_2.$$

Journal für Gasbeleuchtung und Wasserversorgung, No. 20, 1871.

This number does not contain any original papers other than those relating to gas- and water-works' management and engineering, but we call attention to the—

Gas-Meter Testing Regulations of the North German Confederation, and Instruction to the Gas-Meter Inspectors.—Evidently arranged with very great care and extensive scientific, as well as sound practical, knowledge on this subject.

Annalen der Chemie und Pharmacie, October, 1871.

This number contains the following original papers and memoirs:—

Dissociation and Restoration (Rückbildung) of Carbamate of Ammonium.—A. Naumann.—This exhaustive memoir, elucidated by a series of tabulated forms, contains the following sections:—Introductory observations; experimental proof of the non-volatility of carbamate of ammonium in undecomposed state; density of the gases derived from carbamate of ammonium; mode of experimenting on, observing, and of making the required corrections in phenomena attending the dissociation of carbamate of ammonium; dissociation and rapidity of re-construction of carbamate of ammonium at the ordinary temperature, at 34°, 42°, 46°, and at 20°; rapidity of dissociation of carbamate of ammonium at −3·8°.

Combinations of Oxide of Bismuth with Sulphuric Acid.—A. Leist.—After first referring to the researches of Dr. Heintz made twenty-seven years ago, and published in *Pogg. Ann.*, vol. lxiii., p. 77, and the researches lately made by Dr. Schultz-Sellack on this subject, the author describes at length the mode of preparation and properties of the following compounds of oxide of bismuth and sulphuric acid:—$Bi_2O_3,4SO_3+9H_2O$, in 100 parts—Oxide of bismuth, 49·05; sulphuric acid, 33·83; water driven off at 110°, 12·420; water driven off at red heat, 6·387. $4Bi_2O_3,3SO_3+15HO$, in 100 parts—Oxide of bismuth, 78·040; sulphuric acid, 9·80; water at 110°, 3·539; water at red heat, 8·621. $Bi_2O_3,2SO_3+2H_2O$, in 100 parts—Oxide of bismuth, 69·023; sulphuric acid, 25·499; water at 110°, 4·291; water at red heat, 1·187.

Diethyliden-Lactamidic Acid.—Dr. W. Heintz.—By a rather complicated and not very clearly described process, the author first prepares diethyliden-lactamidate of copper, which, having been treated with hydrosulphuric acid, yields diethyliden-lactamidic acid, which is obtained from its aqueous solution in small-sized needle-shaped crystals, soluble in dilute but not in absolute alcohol. The crystals are anhydrous, and consist of $C_6H_{11}NO_4$; the formula of the copper salt is $C_6H_9CuNO_4$.

Behaviour of Starch and Dextrine towards Iodine and Tannic Acid.—V. Griessmayer.—The contents of this lengthy essay record a series of experiments made with the view to elucidate the reactions of the bodies alluded to.

Derivatives from Phthalic Acid.—A. Faust.—This exhaustive essay is divided into the following sections:—Introduction; nitro-phthalic acid and its salts; amido-benzoic acid from nitro-phthalic acid; bromo-phthalic acid and salts; dichloro-phthalic acid and salts.

Derivatives from Naphthaline.—A. Faust and E. Saame.—This memoir contains two main sections, viz., the description of the products of addition to naphthaline, and that of the substitution-products of naphthaline; but, notwithstanding the high scientific value of this, as well as of the foregoing memoir, it is not well suited for useful abstraction, an observation also applying to the following exhaustive and very lengthy memoir.

Origin and Properties of Monochlor-Citramalic Acid.—J. Gottlieb.—Introduction; monochlor-citramalic acid hydrate; salts of monochlor-citramalic acid.

NOTES AND QUERIES.

Coagulation of Clay.—Can any of your readers refer me to information respecting the coagulation of clayey water by the addition of salts or other ingredients. It is well known that alum will do this, but I want to know if experiments are on record tried with other substances?—X. Y. Z.

Twaddell and Beaumé.—In answer to J. W.'s query, to obtain the sp. gr. of a liquid by Twaddell's hydrometer, multiply the number of degrees by 5 and add 1000 to the product; for instance—

$$115\times5=575+1000=1575 \text{ sp. gr.}$$

Exact specific gravities can only be determined by weighing.—H. B. Yardley.

Specific Gravity.—(Reply to J. W.)—The degrees of Twaddell are easily turned into sp. gr. numbers, a quality which makes it preferable to any other hydrometer in use. The rule is to multiply the indicated degree by 5 and add 1000 to the product; for example, 9° Tw. = 1·045 sp. gr., 25° Tw. = 1·125 sp. gr. To bring specific gravities to degrees of Twaddell, substract 1000 and divide the remainder by 5; for example, 1·100 sp. gr. = 20° Tw. An instrument so much in use should be correct in its indications, but there are very erroneous ones offered for sale, and purchasers should only trust to an instrument made by some well-known and established house.

MEETINGS FOR THE WEEK.

Monday, Dec. 4th.—London Institution, 4. Prof. Huxley, LL.D., F.R.S., on "The Physiology of Bodily Motion and Consciousness" (VI.).
— Medical, 8.
— Royal Institution, 2. General Monthly Meeting.
— Anthropological, 8.
Tuesday, 5th.—Civil Engineers, 8.
— Zoological, 9.
Wednesday, 6th.—Society of Arts, 8.
— Geological, 8.
— Microscopical, 8.
— Pharmaceutical, 8.
Thursday, 7th.—London Institution, 7.30. Paper and Discussion.
— Chemical, 8. Dr. Gladstone, "On Essential Oils."
— Royal, 8.30.
— Royal Society Club, 6.
Friday, 8th.—Astronomical, 8.
— Quekett Microscopical Club, 8.

NOTICE TO AMERICAN SUBSCRIBERS.

In answer to numerous inquiries, the Publisher begs to state that Subscribers in the United States can be supplied with the CHEMICAL NEWS from this Office, post free, for the sum of £1 2s. 4d. per annum payable in advance.

ROYAL INSTITUTION OF GREAT BRITAIN,

ALBEMARLE STREET, PICCADILLY, W.

LECTURE ARRANGEMENTS FOR 1871-72.

Subscribers of Two Guineas are admitted to all the Courses. A Single Course, One Guinea or Half-a-Guinea.

LECTURE HOUR, THREE O'CLOCK.

CHRISTMAS LECTURES (adapted to a Juvenile Auditory).

PROFESSOR TYNDALL, LL.D., F.R.S. Six Lectures. "On Ice, Water, Vapour, and Air." On December 28th and 30th, 1871; January 2nd, 4th, 6th, and 9th, 1872.

BEFORE EASTER, 1872.

Dr. W. RUTHERFORD, F.R.S.E. Ten Lectures. "On the Nervous and Circulatory Systems." On Tuesdays, January 16th to March 19th.

PROFESSOR ODLING, F.R.S. Ten Lectures. "On the Chemistry of Alkalies and Alkali Manufacture." On Thursdays, January 18th to March 21st.

W. G. DONNE, Esq. Six Lectures. "On Literature." On Saturdays, January 20th to February 24th.

MONCURE D. CONWAY, Esq. Four Lectures. "On Demonology." On Saturdays, March 2nd to 23rd.

The Friday Evening Meetings will commence on January 13th.

The Friday Evening Discourses *before Easter* will *probably* be given by Mr. W. R. Grove, Q.C., the Archbishop of Westminster, Professors Odling and Humphry, Dr. Gladstone, Messrs. C. W. Siemens, R. Liebreich, and John Evans, and Professor Tyndall.

To the Friday Evening Meetings Members and their Friends only are admitted.

AFTER EASTER.

Dr. WILLIAM A. GUY, F.R.S. Three Lectures. "On Statistics' Social Science, and Political Economy." On Tuesdays, April 9th' 16th, and 23rd.

EDWARD B. TYLOR, Esq., F.R.S. Six Lectures. "On the Development of Belief and Custom amongst the Lower Races of Mankind." On Tuesdays, April 30th to June 4th.

PROFESSOR TYNDALL, LL.D., F.R.S. Nine Lectures. On Thursdays, April 11th to June 6th.

R. A. PROCTOR, Esq., B.A., F.R.A.S. Five Lectures. "On Star Depths." On Saturdays, April 13th to May 11th.

PROFESSOR ROSCOE, F.R.S. Four Lectures. "On the Chemical Action of Light." On Saturdays, May 18th to June 8th.

To Non-Members, the admission to all these Courses of Lectures is Two Guineas; to a Single Course of Lectures, One Guinea or Half-a-Guinea, according to the length of the Course.

Gentlemen desirous of becoming Members are requested to apply to the Secretary.

New Members can be proposed at any Monthly Meeting. When proposed, they are admitted to all the Lectures, to the Friday Evening Meetings, and to the Library and Reading Rooms; and their Families are admitted to the Lectures at a reduced charge. Payment:—First year, Ten Guineas; afterwards, Five Guineas a year; or a composition of Sixty Guineas.

Prospectuses (when prepared) may be had in the hall.

H. BENCE JONES, Hon. Sec.

Chemical Technology, or Chemistry in its Applications to the Arts and Manufactures. By THOMAS RICHARDSON and HENRY WATTS. Second Edition, illustrated with numerous Wood Engravings.

Vol. I., Parts 1 and 2, price 36s., with more than 400 Illustrations.

Nature and Properties of Fuel: Secondary Products obtained from Fuel: Production of Light: Secondary Products of the Gas Manufacture.

Vol. I., Part 3, price 33s., with more than 300 Illustrations.

Sulphur and its Compounds: Acidimetry: Chlorine and its Bleaching Compounds: Soda, Potash: Alkalimetry: Grease.

Vol. I., Part 4, price 21s., 300 Illustrations.

Aluminium and Sodium: Stannates, Tungstates, Chromates, and Silicates of Potash and Soda: Phosphorus, Borax: Nitre: Gun-Powder: Gun Cotton.

Vol. I., Part 5, price 36s.

Prussiate of Potash: Oxalic, Tartaric, and Citric Acids, and Appendices containing the latest information and specifications relating to the materials described in Parts 3 and 4.

BAILLIERE AND CO., 20, King William Street, Strand.

PRACTICAL CHEMISTRY.

Laboratory, 60, Gower Street, Bedford Square, W.C.

Mr. Henry Matthews, F.C.S., is prepared to give Instruction in all branches of PRACTICAL CHEMISTRY, particularly in its application to MEDICINE, AGRICULTURE, and COMMERCE.

The Laboratory is open daily, except Saturday, from ten to five o'clock; on Saturday, from ten till one o'clock.

Mr. Matthews is also prepared to undertake ANALYSES of every description.

For Particulars and Prospectuses, apply to Mr. Henry Matthews, the Laboratory, 60, Gower Street, Bedford Square, W.C.

BERNERS COLLEGE of CHEMISTRY.—EXPERIMENTAL MILITARY and NAVAL SCIENCES, under the direction of Professor E. V. GARDNER, F.E.S., &c.: of the late Royal Polytechnic Institution and the Royal Naval College.

The Laboratory and Class Rooms are open daily.

Especial facilities for persons preparing for Government and other examinations.

Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

For particulars, &c., apply to Prof. E. V. G., 44, Berners-street, W.

ANALYTICAL LABORATORY AND SCHOOL OF TECHNICAL CHEMISTRY.

7 and 9, HACKIN'S HEY, LIVERPOOL.

Conducted by A. NORMAN TATE, Analytical and Consulting Chemist, and Chemical Engineer.

Established for Educational Purposes connected with Chemistry in its practical Applications to Manufactures, Commerce, &c.; for the performance of Analyses, Assays, and Chemical Investigations; and for affording information respecting the construction, &c., of Chemical Manufactories, and the conduct of Chemical Manufacturing Processes.

The Course of Instruction, in addition to the ordinary Chemical studies, comprises, as far as possible, all such other subjects as are necessary to give the scientific and practical information required in the Arrangement, Construction, and Management of Chemical Manufactories, and in the Application of Chemistry to Industrial Pursuits.

Students' Fees may be known on Application.

Plans, &c., for Chemical Apparatus and Manufactories are supplied and the erection of Plant and Buildings is superintended when required.

New Laboratory Apparatus:—

CENTRE BLAST BUNSEN, combining a Bunsen, and a very powerful Herapath, 10s. 6d.

HOT-BLAST BLOWPIPE, giving the temperature exceeding the fusing-point of platinum, 9s. 6d.

TABLE FURNACE, without blast, for operations below a white heat, 30s.

The above were awarded the first medal of the Royal Cornwall Polytechnic Society, 1871. Drawings, &c., one stamp.

T. FLETCHER, 15, BOLD ST., WARRINGTON.

AMSTERDAM EXHIBITION, 1869.

The GRAND DIPLOMA of HONOUR, being the First Prize, and SUPERIOR to the Gold Medal.

Liebig Company's Extract of Meat.—Paris EXHIBITION, 1867, TWO GOLD MEDALS; HAVRE EXHIBITION, 1868, THE GOLD MEDAL.—Only sort warranted perfect and genuine by BARON LIEBIG, the Inventor. "A success and a boon."—Medical Press and Circular. One pint of delicious beef-tea for 2½d., which costs 1s. if made fresh from meat. Cheapest and finest-flavoured "stock" for soups, &c.

CAUTION.—Require BARON LIEBIG'S signature upon every jar Sold by all Italian Warehousemen, Grocers, Chemists, and Ships. Store Dealers; all Wholesale Houses; and of LIEBIG'S EXTRACT of MEAT COMPANY (LIMITED), 43, Mark Lane, E.C.

NOTICE.—Various chemical analyses have been published purporting to show a fraction more of moisture to exist in the Company's Extract than in some imitation sorts. It is extremely easy to evaporate the water almost to any extent, but it is quite as certain that the fine meaty flavour which distinguishes the Company's Extract from all others would be destroyed if the concentration of the Extract were carried beyond a certain degree. Beef-tea made from Liebig Company's Extract with *boiling-hot water* will be found to be greatly superior in flavour, strength, clearness, to any other sort. This explains the universal preference it obtains in the market.

This Extract is supplied to the British French, Prussian, Russian' and other Governments.

Methylated Spirits.—David Smith Kidd, Licensed Maker, Commercial Street, Shoreditch, N.E. Also FINISH, FUSEL OIL, and RECT. NAPHTHA.

THE CHEMICAL NEWS.

Vol. XXIV. No. 628.

CONTRIBUTIONS TO THE HISTORY OF THE OPIUM ALKALOIDS.*

By C. R. A. WRIGHT, D.Sc.,
Lecturer on Chemistry in St. Mary's Hospital Medical School.

(Concluded from p. 257).

3. *Action of Sodium Carbonate on the Compound* $C_{68}H_{86}I_2N_4O_{12},4HI$.

On adding sodium carbonate to the scarcely warm aqueous solution of this compound a voluminous white precipitate is produced, which is apparently a mixture of three bases, two of which contain iodine, whilst the third is free from that ingredient. The first one, which forms only a small fraction of the whole, is the free base of the original compound, $C_{68}H_{86}I_2N_4O_{12}$; this is readily soluble in ether, and may be obtained as hydriodate (as previously stated) by digesting the precipitate with ether, and agitation of the extract with hydriodic acid, whereby the original substance is reproduced. To prevent frothing, the precipitate must be well drained from the aqueous portion. By continuing the extraction until some 6 litres of ether have been employed for exhausting the precipitate from 40 grms. of original substance, the whole of this base is removed, or nearly so. Attempts to prepare the base itself by evaporation of the ether yielded only a tarry substance which could not be removed from the vessel employed; treatment with water or alcohol more or less decomposes it.

By employing a large bulk of ether after this first base has been almost wholly removed, an extract is obtained from which on evaporation solid flakes separate; these are much less soluble in ether than the first base, and after drying at 100° gave the following numbers, indicating the formula $C_{68}H_{81}IN_4O_{10}$.

0·1985 grm. gave 0·4705 CO_2 and 0·119 H_2O.
0·1210 grm. gave 0·2600 AgI.

		Calculated.		Found.
C_{68}	816	65·81		64·65
H_{81}	81	6·53		6 66
I	127	10·24		11·61
N_4	56	4·52		
O_{10}	160	12·90		
$C_{68}H_{81}IN_4O_{10}$	1240	100·00		

Apparently these flakes still retained a trace of the first base; the mother-liquor from which they separated, when evaporated to dryness, left a small amount of residue containing 14·18 per cent of iodine. Treated with hydriodic acid, these flakes gave a hydriodate yielding these numbers after drying at 100°:—

0·3675 grm. gave 0·6335 CO_2 and 0·181 H_2O.
0·371 grm. gave 0·2405 AgI.

		Calculated.		Found.
C_{68}	816	46·58		47·00
H_{85}	85	4·85		5·47
I_5	635	36·24		35·02
N_4	56	3·20		
O_{10}	160	9·13		
$C_{68}H_{81}IN_4O_{10},4HI$	1752	100·00		

Evidently a slight loss of iodine has occurred from the action of the adhering moisture while drying, as the original flakes contained rather too high a percentage of iodine. This base is formed from the original one by the reaction—

$$C_{68}H_{86}I_2N_4O_{12},4HI = 2H_2O + HI + C_{68}H_{81}IN_4O_{10},4HI,$$

identical with that taking place on treatment with water.

A portion of the substance left after extraction with ether was treated several times successively with large bulks of ether (about 4 litres of ether to 10 grms. of precipitate each extraction). After the majority of the substance had thus been dissolved, a portion of the last ether extracts was evaporated down and yielded flakes agreeing approximately with the composition required for a mixture of 1 molecule of $C_{68}H_{81}IN_4O_{10}$, and 2 molecules of $C_{68}H_{80}N_4O_{10}$.

0·3565 grm. gave 0·926 CO_2 and 0·237 H_2O.
0·376 grm. gave 0·255 AgI.
0·2455 grm. gave 0·170 AgI.

	Calculated.	Found.	
C	70·67	70·84	
H	6·96	7·39	
I	3·67	3·66	3·73

From the foregoing experiments it is clear that the action of sodium carbonate on the compound

$$C_{68}H_{86}I_2N_4O_{12},4HI$$

is identical with that of water described in (2), the two bases, $C_{68}H_{81}IN_4O_{10}$ and $C_{68}H_{80}N_4O_{10}$, being the principal products.

On precipitating in a similar way the compound

$$C_{68}H_{82}I_2N_4O_{10},4HI,$$

the same reaction appears to take place; from the precipitate ether extracts only traces at first, indicating probably that the base $C_{68}H_{82}I_2N_4O_{10}$ is not produced in any quantity; as apparently the more highly iodised bases are more soluble in ether.

On treating the compound $C_{68}H_{82}I_2N_4O_6,4HI$ in the same way, an analogous reaction seems to ensue; the precipitate is very sparingly soluble in ether, and on treatment with hydriodic acid furnished a hydriodate of which 0·233 grm. dried at 100° gave 0·142 AgI; hence I = 29·94 per cent; the compound $C_{68}H_{88}N_2O_{10},4HI$ requires 31·13 per cent, whilst the original substance requires 40·53 per cent.

4. *Action of Hydriodic Acid on some of the foregoing substances.*

As the action of water on the three compounds first described is to remove the elements of HI associated with the carbon radicals of the bases, it was thought probable that by treating the products of the action of water on these compounds with strong boiling hydriodic acid, the HI thus lost might be again added on. A reaction of this nature does indeed take place, but does not always stop at the reproduction of the original bodies, another equivalent of HI being also added on; moreover, in some instances a number of molecules of H_2O are likewise taken up, and are not separated from the compounds ultimately formed even by some days' exposure to a temperature of 100°.

On treating the compound $C_{68}H_{80}N_4O_{10}.4HI$ with about ten parts of 55 per cent of hydriodic acid (a little piece of phosphorus being also added to prevent separation of iodine from the HI by the heat) and heating to boiling, a syrupy liquid is obtained, from which water precipitates (after filtration of phosphorus) a tar resembling in all its physical characters the compound $C_{68}H_{86}I_2N_4O_{12},4HI$; it contains, however, the elements of $HI + 10H_2O$ more than this substance. The same substance apparently is generated by treating the intermediate compound

$$C_{68}H_{81}IN_4O_{12},4HI$$

with hydriodic acid in the same manner.

* Read before the Royal Society, November 16, 1871.

(A.) From the compound $C_{68}H_{80}N_4O_{10},4I$; dried at 100° till constant:

0·3565 grm. gave 0·483 CO_2 and 0·158 H_2O.
0·3835 grm. gave 0·278 AgI.

(B.) (A) dried twelve hours more at 100°, had turned a much darker colour, probably indicating absorption of oxygen:

0·329 grm. gave 0·434 CO_2 and 0·155 H_2O.
0·561 grm. gave 0·419 AgI.

(C.) From the compound $C_{68}H_{81}IN_4O_{10},4HI$:

0·377 grm. gave 0·485 CO_2 and 0·175 H_2O.
0·387 grm. gave 0·2855 AgI.

	Calculated.		Found. A.	B.	C.	Mean.
C_{68}	816	36·69	36·95	35·98	35·09	36·01
H_{111}	111	4·98	4·93	5·24	5·16	5·11
I_7	889	39·98	39·16	40·35	39·87	39·79
N_4	56	2·52				
O_{22}	352	15·83				
	2224	100·00				

$C_{68}H_{107}I_3N_4O_{22},4HI$.

Hence this body is formed by the equations—

$$C_{68}H_{80}N_4O_{10},4HI+3HI+12H_2O=$$
$$=C_{68}H_{107}I_3N_4O_{22},4HI.$$

$$C_{68}H_{81}IN_4O_{10},4HI+2HI+12H_2O=$$
$$=C_{68}H_{107}I_3N_4O_{22},4HI.$$

On treating the compound $C_{68}H_{88}I_3N_4O_{10},4HI$ in the same way a product is obtained only differing from the original substance by one equivalent of HI; dried at 100°:

0·3995 grm. gave 0·6800 CO_2 and 0·197 H_2O.
0·3215 grm. gave 0·2200 AgI.

	Calculated.		Found.
C_{68}	816	46·36	46·41
H_{93}	93	5·28	5·48
I_5	635	36·09	36·97
N_4	56	3·18	
O_{10}	160	9·09	
$C_{68}H_{89}IN_4O_{10},4HI$	1760	100·00	

Hence this body appears to have been formed by the reaction $C_{68}H_{88}N_4O_{10},4HI + HI = C_{68}H_{89}IN_4O_{10},4HI$, no water having been taken up; whilst in the case of the other non-iodised base, 3 molecules of HI and 12 of H_2O are assimilated.

In order to see if the combined action of phosphorus and hydriodic acid would transform the compound

$$C_{68}H_{86}I_2N_4O_{12},4HI$$

into the body $C_{68}H_{82}I_2N_4O_6,4HI$, the former compound was dissolved in about 10 parts of 55 per cent hydriodic acid, and boiled until most of the acid had volatilised; a considerable quantity of phosphoric acid was formed during the reaction, and on precipitating the compound produced with water, and drying at 100°, the following numbers were obtained:—

0·2795 grm. gave 0·3900 CO_2 and 0·136 H_2O.
0·4195 grm. gave 0·327 AgI.
0·4225 grm. gave 0·333 AgI.

	Calculated.		Found.	
C_{68}	816	38·42	38·06	
H_{107}	107	5·04	5·41	
I_7	889	41·85	42·12	42·59
N_4	56	2·64		
O_{16}	256	12·05		
$C_{68}H_{103}I_3N_4O_{16},4HI$	2124	100·00		

From these numbers it appears that the substance produced may be considered as formed by the reactions,

$$C_{68}H_{86}I_2N_4O_{12},4HI+8HI=$$
$$=I_8+6H_2O+C_{68}H_{82}I_2N_4O_6,4HI.$$

$$C_{68}H_{82}I_2N_4O_6,4HI+HI+10H_2O=$$
$$=C_{68}H_{103}I_3N_4O_{16},4HI.$$

It is not easy to explain why the reaction should stop short at the end of the first stage, when codeia is treated with hydriodic acid and boiled up to 130°; possibly the presence of a much larger quantity of phosphorus acids in this case may tend to prevent the second reaction ensuing.

5. *Discussion of the Foregoing Results.*

From the complex constitution of the substances described above, it is at present thought unadvisable to attempt to give names to them. All the bodies previously mentioned may be regarded as being derived from one or other of the two bases $C_{17}H_{21}NO_3$ and $C_{17}H_{21}NO_2$ by multiplication of the molecule, and addition or subtraction of the elements of water and of hydriodic acid.

These two (hypothetical) bases contain H_2 more than morphia and deoxymorphia respectively; denoting the first by the symbol X, and the second by Y, the following general formulæ will indicate all the compounds previously described:—

$$4X+mHI\pm nH_2O,$$
$$4Y+mHI\pm nH_2O.$$

Thus the following table illustrates the mutual relations of the compounds described:—

Source of Compound.	Formulæ.
(A) Codeia, HI, and P at 150°.	$C_{68}H_{86}I_2N_4O_{12},4HI=4X+6HI$
(B) Do. 110° to 115° ..	$C_{68}H_{82}I_2N_4O_{104}HI=4X+6HI-2H_2O$.
(C) (A) treated with water or Na_2CO_3..	$C_{68}H_{81}IN_4O_{10},4HI=4X+5HI-2H_2O$.
(D) Free base of (C). (A) treated with Na_2CO_3	$C_{68}H_{81}IN4O_{10},=4X+HI-2H_2O$.
(E) Further action of water on (C)	$C_{68}H_{80}N_4O_{10},4HI=4X+4HI-2H_2O$.
(F) Action of HI on (E)	$C_{68}H_{107}I_3N_4O_{22},4HI=4X+7HI+10H_2O$.
(G) Codeia, HI, and P at 135°	$C_{68}H_{82}I_2N_4O_6,4HI=4Y+6HI-2H_2O$.
(H) Action of water on (G)	$C_{68}H_{88}N_4O_{10},4HI=4Y+4HI+2H_2O$.
(I) Action of HI on (H)	$C_{68}H_{89}IN_4O_{10},4HI=4Y+5HI+2H_2O$.
(J) Action of HI on (A)	$C_{68}H_{103}I_3N_4O_{16},4HI=4Y+7HI+8H_2O$.

Although it may well happen that further researches may show that some of the above formulæ require some slight correction, the analytical numbers not always agreeing together absolutely accurately, yet the following points may be considered established:—

(1). The action of hydriodic acid on codeia polymerises it, the ultimate compounds formed being derived from at least four molecules of codeia. Hydrobromic acid also polymerises codeia, but not so completely as hydriodic acid, there being found, in addition to the tetra-bases, compounds which (from their crystalline character and other physical properties) are apparently derived from 1 molecule only of codeia. Hydrochloric acid does not appear to have a marked polymerising effect on codeia.

(2). Hydriodic, hydrobromic, and hydrochloric acids all eliminate methyl from codeia, forming ultimately compounds containing nC_{17}.

(3). The compounds got by the action of hydriodic acid in presence of phosphorus indicate that the carbon groups contained in codeia are in an eminently "unsaturated" condition, being capable of taking up several molecules of HI and of H_2O, forming compounds not decomposed at 100°; 2 equivalents of hydrogen for every C_{17} being also added on in every case.

ASSAY FOR GOLD AND SILVER.

By T. M. BLOSSOM, E. M.

(Continued from p. 44).

4. *Weighing the Bead.*—The bead of gold and silver is detached from the cupel with pincers, thoroughly cleansed, and weighed. The balance used for this purpose is exceedingly delicate, it being possible to read with it down to tenths of a milligramme.

5. *Inquartation and Parting.*—The separation of gold from silver is termed *parting*. It is effected, generally, by means of nitric acid, which dissolves the silver and leaves the gold, in the assay of ores, in a loosely adherent spongy mass, or a dull powder. It is essential that a certain relation should exist between the amount of gold in the alloy and that of the silver. If there be too little silver present, it will not be dissolved completely, but a part of it will be so enveloped in the gold as to escape the action of the strongest acid. If, on the other hand, too much silver be present, the gold is too highly diluted, and is obtained in leaves so fine and light as to occasion a loss in the subsequent washing. The silver should be from 2·5 to 3 times the amount of gold. The assayer must judge by the colour of the bead as to the proportion of silver contained; and if it be too small he must supply the deficiency with pure silver. In assaying ores, no attempt is made at an adjustment when the silver is in excess, but great care is necessary in the parting. This is a matter of more importance in bullion assay. This adjustment of the proportion of silver is called "Inquartation" or "Quartation," and will be treated more fully under "Assay of Alloys." Silver is kept on hand in thin foil, from which little bits can easily be cut with pliers. The bead and the silver are fused well together, to effect complete distribution of the silver. The fusion is made most conveniently on charcoal by means of the blowpipe, if a few beads only are being treated. If a large number are to be treated, it may save time to wrap the bead and silver in a cornet of lead-foil and cupel it, since several can be fused at the same time. The inquartated bead is flattened on the anvil and treated in a porcelain capsule with pure nitric acid of 1·16 sp. gr. Enough acid is added to cover the bead completely. Heat gently, taking care not to boil violently and scatter the gold. It is to prevent the occurrence of the latter that we do not employ at first a very strong acid, which might create too brisk an action and break up the gold. The acid must be free from chlorine, which would precipitate the silver. When all action of the first acid has ceased, it is decanted gently, and some fresh acid of 1·26 sp. gr. is added. Heat for several minutes, then pour off the acid, wash thoroughly with distilled water and dry the residue of gold. It is well to apply a high heat before attempting to remove the gold, for the spongy mass is thus rendered adherent and may be removed without crumbling. The gold residue is now detached with a knife, transferred to a cornet of lead, and cupelled.

6. *Weighing the Gold Bead.*—The gold bead obtained from the last cupellation is weighed, and the assay is completed. It remains only to calculate the results.

Calculation of Results.

This is a simple operation and hardly needs explanation. As already stated, the milligrammes of precious metal obtained per assay ton of ore correspond to ounces in the ton of 2000 lbs. av. Let us take, however, the special example of an ore containing metallic gold or silver finely disseminated throughout the ore, and occurring in scales which remain upon the sieve. This will embrace and suggest all cases likely to arise in ordinary practice. It may be necessary to state here, that the treatment of the scales consists only of a cupellation, or of scorification and cupellation combined, according to the nature of the material (Assay of Alloys).

Let us suppose that the sample presented for assay gave, on being pulverised and passed through a sieve of 80 meshes to the linear inch, the following weights:—

A. Sifted ore	1458·32 grms.
B. Scales of metal	40·75 ,,
C. Total	1499·07 grms.

It being known from the mineralogical composition of the sample that it was a rich ore, ⅓ A.T. was taken for an assay of the sifted portion (A). The residue of metallic scales, &c. (B), was scorified with test-lead, and yielded a button weighing 60·35 grms. of the lead alloy. This button was rolled out, and two average samples, of 10 grms. each, were cupelled.

The following results were obtained from the complete assays:—

A. Sifted Ore.—*Crucible Assay.*

One-third assay ton, 9·722 grms., yielded:—

	1.	2.	Average.
Au + Ag.	0·19355	0·19275	0·19315
Au (by parting)	0·00025	0·00025	0·00025
Ag.	0·19330	0·19250	0·19280
Ag in litharge*	0·00067	0·00067	0·00067
Ag. in ore	0·19263	0·19183	0·19213

B. Metallic Scales.

Ten grms. of the scorified button yielded—

	1.	2.	Average.
Au + Ag.	5·0625	5·0620	5·0622
Au (by parting)	0·0020	0·0020	0·0020
Ag.	5·0605	5·0600	5·0602
Ag. in test-lead	none	none	none

A. Sifted ore .. $1458·32 \times \frac{0·19213}{9·722} = 28·819$ Ag.

B. Metallic scales $40·75 \; \frac{5·0602}{10} \times 60·35 = 30·538$ Ag.

C. Total ore .. 1499·07 59·357 T'l Ag.

$29166·66 \times \frac{59·357}{1499·07}$ 1154·71 ozs. per 2000 lbs.

A. Sifted ore .. $1458·32 \times \frac{0·00025}{9·722} = 0·0375$ Au.

B. Metallic scales $40·75 \; \frac{0·002}{10} \times 60·35 = 0·0121$ Au.

C. Total ore .. 1499·07 0·0496 T'l Au.

$29166·66 \times \frac{0·0496}{1499·07} = 0·97$ ozs. per 2000 lbs.

Result per 2000 lbs. Ore.

	Ozs.		Dols.	Dols.
Silver	1154·71	at	1.29 ..	1489.58
Gold	0·97	at	20.67 ..	20.04
Total bullion	1155·97			1509.62

Galena.—*Special Method.*—It is best and most convenient always to make a scorification assay of galena. If, however, it be desirable for any reason to make a crucible assay, a charge of nitre and carbonate of soda is

* The litharge yielded 1 milligrm. silver per assay ton, and two-thirds assay ton were employed.

generally employed instead of roasting the ore. Twenty grms. of nitre per assay ton of ore are required for pure galena; this amount diminishing, of course as the gangue increases in quantity, or the amount of sulphur is lessened. Employ the same weight of carbonate of soda as of ore. If there be any doubt as to the amount of nitre required, make a preliminary assay with an assumed charge, and modify the regular charge according to the result.

Concluding Remarks concerning the Assay of Ores.

Any of the substances mentioned under the head of "Ores and Minerals" can be assayed by either the foregoing methods (*a*) Crucible and (*b*) Scorification. There is only one practical limit in the case of scorification involved, as before mentioned, in the richness of the ore. The latter method is preferable whenever it can be used conveniently. It yields higher results and requires no preliminary assay. There is a roasting period in the operation, but it is simple, and is free from many of the disagreeable features of a preliminary roasting. No oxysulphurets are formed, or, if formed, are decomposed during the operation; whereas, in the crucible assay, they may escape decomposition, even at a white-heat. It is a better method for very rich copper ores; the action of scorification is oxidising, that of the crucible reducing; hence, in the latter case, much copper will enter the lead-button that, in the former case, would be oxidised and enter the slag.

NOTE ON THE SPECTRUM OF THE AURORA.

By G. F. BARKER.

On the evening of November 9th, there appeared one of the most magnificent crimson auroras ever seen at this place. When first observed, at about a quarter before six, p.m., it consisted of a brilliant streamer shooting up from the north-western horizon; this was continued in a brilliant red, but rather nebulous, mass of light, passing upward and to the north. Its highest points were from 30° to 40° in altitude. A white aurora, consisting of bright streamers, appeared simultaneously, and extended round to the north-east.*

The crimson aurora was examined with a spectroscope at six o'clock. The instrument used was a single glass-prism spectroscope, made by Duboscq, of Paris. On directing the slit towards the brilliant streamer above mentioned, a bright spectrum was observed, consisting of five well-marked lines. A millimetre scale attached to the instrument was then illuminated with a gas-flame, the auroral lines being readily measured, even when the numbers on the scale were bright enough to be read distinctly. The sodium line was used to adjust the scale, being equally divided by the division 100; the width of the slit was about one millimetre. As thus arranged, the five auroral lines, beginning at the red end, had the following positions:—Scale-Nos. 90, 110·5, 130, 138, 149. The brightness of the lines was, following the above order, 3, 1, 5, 2, 4, the second line from the red end of the spectrum being the brightest. The line marked 90 and the one marked 110·5 were sharp and well-defined; the others were all nebulous on the edges.

Before the measurements were completely verified by a second comparison, the crimson aurora entirely vanished, having endured less than a half hour. In the white aurora which remained, the spectroscope showed four of the five lines given; the crimson line alone was absent. The measurements are exact to half a division of the scale.

To determine the approximate wave-length of these lines comparison was made both with certain metallic lines and with the lines of the solar spectrum. On the scale of this instrument, the metallic lines employed read as follows:—

Ka 63, Lia 79, Srβ 80, H(*c*) 82, Caa 91, Sra 96, Caβ 113, H(*f*) 146·5, Srδ 163, Csβ 165, Csa 167, Rba and β 200, Kβ 218.

The Fraünhofer lines measured as follows:—

a 70·5, B 76, C 82, D 100, E 124·5, *b* 130, F 146·5, G 189.

Direct interpolation was used in comparing the wave-length of the auroral lines with those given above, the wave lengths of the Fraünhofer and elemental lines being taken from Gibbs's tables (*Am. Journ. Sci.*, II., xliii., 1; xlvii., 194). This method was believed capable of giving results as close as the instrumental measurements. In this way the wave-lengths of the five auroral lines were obtained as given in the following table:—

Line.	Scale number.	Wave-length.	Auroral lines.	Other measurements.
B	76·0	687		
C	82·0	656		
(1)	90·0	623	623	627 Zöllner.
D	100·0	589		
(2)	110·5	562	562	556 Angström.
E	124·5	527		
(3)	130·0	517	517	520 Winlock.
b	130·0	517		
(4)	138·0	502	502	
F	146·5	486		
(5)	149·0	482	482	485 Alvan Clark, Jr.
G	189·0	431		

In this table. column 1 gives the auroral and the Fraünhofer lines; column 2, the number of these are measured upon the scale of the spectroscope used; column 3, the wave-lengths of these lines obtained as above stated; column 4, the wave-lengths of the auroral lines, given by themselves; and column 5, the wave-lengths of what I assume to be the same lines, with their wave-lengths as measured by the observers mentioned.

The point of particular interest in this observation is the fact that the line (4) of wave-length 502 is not laid down in any authority accessible to me as having been observed in the auroral spectrum. Indeed, no previous observer, so far as I know, has seen any auroral line between the Fraünhofer lines *b* and F. Professor C. A, Young (*Am. Journ. Sci.*, III., ii., 332, Nov. 1871) gives two lines—Nos. 56 and 57, or 1866·8 and 1870·3 of Kirchhoff—observed by him in the sun's chromosphere and also by Rayet in the eclipse of 1868, one of which may coincide with this fourth auroral line.—*American Journal of Science.*

New Haven, Nov. 13, 1871.

* Professor Newton informs me that he observed an equally brilliant red patch of auroral light in the north-east, five or ten minutes earlier. Since the lower end of the red streamers was much lower than that of the white, it would seem as if the red were seen through the white, the red being most remote.

ON THE EVAPORATION TO DRYNESS OF GELATINOUS PRECIPITATES.

By THOMAS M. CHATARD.

In a former paper* I called attention to the fact that many gelatinous precipitates, when evaporated to dryness, became very granular and easy to filter. I gave some examples then and have since tested several others.

* *Am. Journ. Sci.*, vol. i., p. 247.

Titanic Acid.—Rutile was fused with sodic disulphate, the titanic acid precipitated by ammonic hydrate and evaporated to dryness. It became quite sandy and washed with great rapidity and thoroughness.

Glucina.—Pure glucina was dissolved in chlorhydric acid, precipitated by ammonic hydrate and exaporated to dryness. In this case, as glucina is soluble in ammoniacal salts, it was necessary to ignite the dry mass to expel these. This was done in the platinum dish in which the evaporation was carried on. The residual glucina was sandy and washed with great ease; *zirconic*, *niobic*, and *tantalic acids* when thus treated gave results which were all that could be desired.

Ceric, lanthanic, and didymic oxalates, when treated with sulphuric acid, and ammonic hydrate added, gave also perfectly satisfactory results.

In conclusion, there seems to be no doubt that almost any gelatinous precipitate can be successfully treated in this manner.—*American Journal of Science.*

HERRESHOFF'S METHOD FOR VALUING BLEACHING-POWDER.

By A. H. MASSEY,
Student at King's College, London.

The standard solutions were the same in every respect as those described in the Chemical News (vol. xxiii., p. 293). The method of preparing the solution of powder consisted in weighing 10 grms. of the sample and triturating in a mortar with water. The solution so obtained was poured into a graduated flask, and filled up to one litre. The clear liquid was drawn off, 100 c.c. were taken, 50 to 100 c.c. of water and 10 c.c. of hydrochloric acid added. A few drops of starch and iodide of potassium prepared the solution for titration with potassic dichromate.

Four samples of the same powder gave the following percentages of available chlorine :—

24·92 per cent.
24·70 ,,
24·80 ,,
25·00 ,,

The author has not found any difficulty in purifying arsenious acid by sublimation, or in preparing solutions of arsenite of soda for volumetric estimations of chlorine.

Three samples of the same powder previously valued by Herreshoff's method gave by Penot's method the following results :—

Active Chlorine.
24·76 per cent.
24·70 ,,
24·59 ,,

These numbers show that both processes may be considered equally accurate.

ON THE GASES OCCLUDED IN COAL.

By Dr. E. MEYER.

I desire this paper to be considered only as a preliminary notice, it being my intention to extend these researches. Since, so far as I am acquainted, the question whether any at all, and, if so, what kind of gases are occluded in coal has not been experimentally dealt with, it occurred to me to test Zwickau coals (Saxony) in this respect.

Lumps of hard and compact coal the size of a walnut were put into a flask, previously partly filled with thoroughly well-boiled and hot distilled water, the flask was next closed with a perforated caoutchouc stopper wherein a glass tube was fitted, which, serving as gas-conveying tube, was carried into a vessel filled with water deprived of air. The apparatus thus arranged was kept at boiling heat for some time in order thereby to eliminate the film of air which mechanically adheres to the coal. The boiling was further continued after the gas-conducting tube had been placed over a graduated glass tube, previously filled with distilled water freed from air and placed on a pneumatic trough. The gas thus collected (constantly evolved from the lumps of coal) was analysed according to Bunsen's method, and found to consist in the first sample operated upon, percentically, of:—Carbonic acid, 16·9; marsh-gas, 20·4; nitrogen, 53·3; oxygen, 1·7; heavy carburetted hydrogens absorbable by fuming sulphuric acid 7·7. Second sample—Carbonic acid, 22·4; marsh-gas, 22·3; nitrogen, 48·0; oxygen, 4·1; heavy carburetted hydrogens absorbable by fuming sulphuric acid. The large quantity of nitrogen and the small quantity of oxygen deserve special notice. The samples of coal experimented with had been kept in a cellar for a period of several months in contact with air so that it would appear that the oxygen of the air absorbed has served for the oxidation of the coal and formation of carbonic acid.

I may not also neglect to call attention to the heavy carburetted hydrogens which, as far as I am aware, have not been hitherto noticed as being occluded in coal. It might be surmised, yet it is very improbable, that these heavy carburetted hydrogens have been formed by the heating of the coal under water at 100°. I intend to elucidate this point by exhausting the gases from coal with the aid of a mercurial air-pump at the ordinary temperature of the air in order to ascertain whether the same kind of coal will then also yield carburetted hydrogens absorbable by fuming sulphuric acid. These researches will be continued and extended to other kinds of coal. The results of my experiments I shall publish at a future date.—*Journal für Praktische Chemie.*

NOTES OF

DEMONSTRATIONS ON PHYSIOLOGICAL CHEMISTRY AT ST. GEORGE'S HOSPITAL.

By S. W. MOORE.

VI.

I purpose here classifying briefly the various data obtained at previous demonstrations, so that they may be applied for clinical purposes or otherwise to the fluids and solids of animal production.

Fluids.

(α). Note whether any solid particles are suspended, and if so, filter; frequently in hydrocele and ovarian cyst fluids, fibrin in flocculi, or plates of cholesterine occur.

(β). Observe the colour; if practicable apply spectroscope. The most frequent pigments are those of blood and bile; blood may be distinguished by the microscope, and bile by adding HNO_3, which causes chameleonic changes of colour.

(γ). Take the sp. gr. if possible by some form of hydrometer; many fluids require the sp. gr. bottle for accurate determination. If much fat be present, as in milk, the sp. gr. does not indicate much of importance.

(δ). Evaporate a portion to dryness, and incinerate the residue, testing the ash in the ordinary way or by the spectroscope.

(ε). Ascertain whether acid or alkaline with test-papers if acid, albuminous bodies will probably be absent; i alkaline, note whether from putrefaction.

(ζ). Add HCl to the fluid; if a precipitate occur, slightly acidulate a portion of the original and boil; a precipitate

indicates albumin. If no precipitate occurs on boiling, add acetic acid; a precipitate indicates casein. If, however, a precipitate did occur in the original fluid on boiling, then filter, and treat the filtrate as above.

(η). Evaporate a portion of the liquid, freed from albuminous matter, to $\frac{1}{4}$th of its original bulk; if allantoin be present it will separate, as will leucin; add HCl, if hippuric or uric acids be present they will precipitate. Hippuric acid on burning gives off fumes of benzoic acid; uric acid is proved by the murexid test.

(θ). Evaporate a portion to dryness, powder, and boil with ether or benzol to remove fat.

Palmitin, stearin, and olein saponify, whilst cholesterin and serolin (?) do not.

(ι). Evaporate to $\frac{1}{4}$th bulk, and add HNO_3; if urea be present it separates as nitrate of urea; alcohol takes up urea, bilin, &c.

(κ). Proof-spirit takes up sugars, NaCl, &c. The presence of sugar in the spirit extract may be proved by the formation of melassic acid with KHO, also with the copper test.

The application of these principles is exceedingly simple, and, though anything but a delicate system of analysis, will yield very useful results to the inquirer.

A few watch-glasses, some test-tubes, a piece of platinum foil, a urinometer, and some filtering and test-papers, are all the apparatus needed for ordinary work of this kind.

Solids.

These are generally pathological products, but a very similar course may be applied to their analysis, thus:

First incinerate to ascertain if wholly organic, and then boil successively in water, alcohol, spirit, benzol, acid (acetic), and alkali, and to the products apply the test as directed above.

LETTERS FROM M. LAVOISIER TO DR. BLACK.

Through the kindness of Professor Andrews, we are able to publish the letters to which he referred in his address to the Chemical Section of the British Association, October 3rd, 1871. The following passage from Dr. Andrews's address forms a fitting introduction to these letters:—

"Whatever may be the true value of the Stahlian views, there can be no doubt that the discoveries which have shed so bright a lustre round the name of Black mark an epoch in the history of science, and gave a mighty impulse to human progress. A recent attempt to ignore the labours of Black and his great contemporaries, and to attribute the foundation of modern chemistry to Lavoisier alone, has already been amply refuted in an able inaugural address delivered a short time ago from the chair formally occupied by Black. The statements of Dr. Crum Brown may, indeed, be confirmed on the authority of Lavoisier himself. Through the kindness of Dr. Black's representatives, I have been permitted to examine his correspondence, which has been carefully preserved, and I have been so fortunate as to find in it three original letters from Lavoisier to Dr. Black. They were written in 1789 and 1790, and they appear to comprise the whole of the correspondence on the part of Lavoisier which passed between those distinguished men. Some extracts from these letters were published soon after Dr. Black's death by his friends Dr. Adam Ferguson and Dr. Robison; but the letters themselves, as far as I know, have never appeared in an entire form. I will crave permission to have them printed as an appendix to this address. Lavoisier, it will be seen, addresses Black as one whom he is accustomed to regard as his master, and whose discoveries had produced important revolutions in science. It may, indeed, be said with truth that Lavoisier completed the foundation on which the grand structure of modern chemistry has since arisen; but Black, Priestley, Scheele, and Cavendish were before Lavoisier, and their claims to a share in the great work are not inferior to those of the illustrious French chemist."

Letters from M. Lavoisier to Dr. Black.

Paris, le 19 Septembre, 1789.

Monsieur,—C'est un membre de l'académie Royale des Sciences de Paris qui vous écrit à titre de Confrére: c'est un des plus zélés admirateurs de la profondeur de votre génie et des importantes révolutions que vos découvertes ont occasionnées dans les Sciences, qui profite, pour avoir l'honneur de vous écrire, de l'occasion de M. de Boullogne qui va finir son éducation à Edimbourg. Permettez-moi de vous le recommander. Il joint á d'heureuses dispositions un grand désir de s'instruire et il regarde comme un grand bonheur pour lui d'avoir une occasion pour se présenter à vous. Il a bien voulu, Monsieur, se charger de vous remettre un exemplaire d'un ouvrage que je viens de publier; vous y trouverez une partie des idées dont vous avez jetté le premier germe: si vous avez la bonté de donner quelques instants à sa lecture, vous y trouverez le développement d'un Doctrine nouvelle que je crois plus simple et plus d'accord avec les faits que celle du Phlogistique. Ce n'est au surplus qu'en tremblant que je le soumets au premier de mes juges et à celui dont j'ambitionnerais le plus le suffrage.—J'ai l'honneur d'être très-respectueusement, Monsieur, Votre très-humble et très-obéissant Serviteur,—Lavoisier.

Paris, 24 Juillet, 1790

Monsieur,—J'apprends avec une joye inexprimable que vous voulez bien attacher quelque mérite aux idées qui j'ai professé le premier contre la doctrine du phlogistique. Plus confiant dans vos idées que dans les miennes propres, accoutumé à vous regarder comme mon maitre, j'étois en défiance contre moi-même tant que je me suis écarté sans votre aveu de la route que vous avez si glorieusement suivie. Votre approbation, Monsieur, dissipe mes inquiétudes et me donne un nouveau courage. Cette Lettre, Monsieur, vous sera remise par M. Terray intendant de Lyon neveu du Ministre des finances de ce même nom et mon parent; il conduit à Edimbourg son fils, jeune homme d'espérance et destiné a posséder une grande fortune, pour y finir son éducation et suivre les leçons des professeurs célèbres de l'université d'Edimbourg. Permettez-moi, Monsieur, de vous le recommander. L'intérêt que vous voudrez bien prendre à lui sera un premier titre qui l'annoncera d'une manière avantageuse et j'ai lieu de croire qu'il ne se rendra pas indigne de vos bontés. Je ne serai pas content jasque'à ce que les circonstances me permettent de vous aller porter moi-même le témoignage de mon admiration et de me ranger au nombre de vos disciples. La révolution qui s'opére en France devant naturellement rendre inutile une partie de ceux attachés à l'ancienne administration, il est possible que je jouisse de plus de liberté; et le premier usage que j'en ferai sera de voyager et de voyager surtout en Angleterre et à Edimbourg pour vous y voir, pour vous y entendre et profiter de vos lumières et de vos conseils. J'ai commencé un grand nombre d'ouvrages et de travaux et j'aspire à un Etat de tranquillité qui me permette d'y mettre la dernière main. J'ai l'honneur d'être tres-respectueusement.—Monsieur, Votre très-humble et très-obéissant serviteur.—Lavoisier, De l'académie des sciences.

Paris, le 19 Novembre, 1790.

M. Terray, Monsieur, m'a remis, en arrivant à Paris la lettre que vous m'avez fait l'honneur de m'écrire le 24 Octobre; il ne pouvait me faire un présent qui me fût plus agréable. J'ai cru que vous ne désapprouveriez pas que je la communiquasse à l'Académie des Sciences; elle n'a pas moins admiré l'élégance du style que la profondeur de philosophie et la candeur qui règne dans votre lettre, et elle a même désiré qu'elle fût déposée dans ses regis-

tres ; mais je n'y ai consenti, qu'à condition qu'il m'en sera t remis une copie certifiée du secrétaire. J'ai une autre grace à vous demander, mais sur laquelle je dois attendre votre aveu ; c'est de vouloir bien me permettre d'en publier la traduction dans les Annales de Chimie. M. Gillan a été témoin, depuis son séjour à Paris, de quelques expériences que j'ai faites sur la respiration et il a bien voulu y concourir. Nous nous sommes assurés des faites suivans.

1. La quantité d'air vital ou gaz oxigène qu'un homme en repos et à jeun consomme, ou plutot convertit en air fixe ou acide carbonique, pendant une heure est de 1200 pouces cubiques de France environ, quand il est placé dans une température de 26 degrés.

2. Cette quantité s'élève à 1400 pouces, dans les mêmes circonstances, si la personne est placée dans une température de 12 degrés seulement.

3. La quantité de gaz oxigène consommée, ou convertie en acide carbonique, augmente pendant le tems de la digestion et s'élève à 1800 ou 1900 pouces.

4. Par le mouvement et l'exercice on la porte jusqu'à 4000 pouces par heure et même davantage.

5. La chaleur animale est constamment la même, dans tous ces cas.

6. Les animaux peuvent vivre dans de l'air vital ou gaz oxigène, qui ne se renouvelle pas, aussi longtems que l'on le juge à propos, pourvu qu'on ait soin d'absorber, par de l'alcali caustique en liqueur, le gaz acide carbonique, à mesure qu'il se forme ; en sorte que ce gaz n'a pas besoin, comme on le croyait, pour être salubre et propre à la respiration d'être mélangé avec une certaine portion de gaz azote ou Mophete.

7. Les animaux ne paroissent pas souffrir dans un mélange de 15 parties de gaz azote et d'une partie de gaz oxigène, pourvu qu'on ait de même la précaution d'absorber le gaz acide carbonique, par le moyen de l'alcali caustique, à mesure qu'il est formé.

8. La consommation du gaz oxigène et sa conversion en acide carbonique est la même dans le gaz oxigène pur et dans le gaz oxigène mêlé de gaz azote, en sorte que la respiration n'est nullement accélérée en raison de la pureté de l'air.

9. Les animaux vivent assez longtems dans un mélange de deux parties de gaz inflammable et d'une de gaz oxigène.

10. Le gaz azote ne sert absolument à rien dans l'acte de la respiration et il ressort du poumon en même quantité et qualité qu'il y est entré.

11. Lorsque par l'exercice et le mouvement on augmente la consommation de gaz oxigène dans le poumon, la circulation s'accélère ; ce dont il est facile de s'assurer par le battement du poulx : et en général lorsque la personne respire sans se gêner, la quantité de gaz oxigène consommée est proportionnelle à l'augmentation du nombre des pulsations multiplié par le nombre des inspirations.

Il est bien juste, Monsieur, que vous soyez un des premiers informés des progrès qui se font dans une carrière que vous avez ouverte, et dans laquelle nous nous regardons tous comme vos disciples. Nous suivons les mêmes expériences, et j'aurai l'honneur de vous faire part de mes découvertes ultèrieures. J'ai l'honneur d'être avec un respectueux attachement, Monsieur, votre très-humble et très-obéissant serviteur,—Lavoisier.

ASSIMILATION OF KREATINE BY PLANTS.

By CHARLES A. CAMERON, M.D., &c.

Wagner, in *Versuchs Stationer Organ*, xiii., 69 to 75, and 218 to 222, describes the results of his experiments with kreatine as a source of nitrogen for plants. Maize plants grew and developed seeds in a solution in which kreatine was the only nitrogenous substance present. The kreatine was absorbed unchanged, and was detected in the plants. Wagner refers to the fact that Hampe had found that urea is absorbed unaltered by plants. The same observation was made by me in 1857, and was reported in the *Transactions of the British Association* for that year, in the *Chemist* for November, 1858, and in the *Repertoire de Chemie, Pur et Appliquée*, Paris, December, 1858. I find that plants can absorb unchanged, and apparently derive nitrogen from, potassic nitrite, potassic cyanurate, and potassic ferrocyanide.

NOTICES OF BOOKS.

Inorganic Chemistry for Elementary Classes. By W. A. Snaith, M.A., Ph.D., F.C.S., F.E.J.S.

This little book contains in a concise form all that pupils require to know in order to pass the Examination of the Science and Art Department. So says the preface, and the description is strictly correct. Science teachers who wish to earn money in the May Examinations in Chemistry could not possibly pursue a more effectual course than to make their pupils get up the subject from this book. The first seven pages give definitions of Elements and Compounds ; Atoms and Molecules ; Absolute, Active, and Latent Atomicity ; Simple and Compound Radicals ; Acids, Bases, and Salts ; Oxacids, Hydracids, and Sulphacids ; Glyptic, Graphic, Symbolic, Empirical, Rational, and Constitutional Formulæ. Then follow a Glossary of Chemical Terms—the Laws of Boyle, Ampère, and Gay-Lussac, &c. ; a Table of the Elements classified into Perissads and Artiads ; a table, occupying thirteen pages, of constitutional formulæ ; and an explanation of graphical formulæ.

These subjects occupy two-thirds of the book ; the last third contains statements of chemical facts concerning hydrogen, chlorine, oxygen, boron, carbon, nitrogen, sulphur, and their compounds. Candidates who know this book off by heart will, we repeat, be almost sure of success at the Examination of the Science and Art Department. If, however, the object of the teacher be really to teach chemistry—and not merely to "pass" his pupils, the case is somewhat different, and Dr. Snaith's little book can hardly be recommended. Indeed, we can conceive no more effectual method of disgusting a pupil with the whole subject than to require him to commit to memory the definitions and formulæ which constitute the bulk of this book before entering on the study of the properties of the elements and their compounds.

It is, no doubt, important that the examiner for so influential an agency as the Science and Art Department should be one of the most eminent men in his profession, but it is clearly unfortunate for the interests of science when he is devoted to such a hobby as this system of graphical formulæ, and shows by his papers that a knowledge of the theories of the constitution of bodies is more highly regarded than a knowledge of the properties of those bodies. The existence of the book before us is a significant illustration of the working of the system of "payment on results" by which the Department seeks to assist science.

In 1870, £20,000 was paid by Government to science teachers. We venture to assert that if this sum were expended each year in founding a genuine school of science with efficient teachers, the benefit really rendered to science would be many times greater than that at present attained.

Still, for the object it proposes to secure, this little book is by no means badly compiled. It is cheap—is very well printed, and, in most cases, gives fairly good explanations.

Some of the definitions, however, are scarcely satisfactory, as the following quotations will show :—

Allotropic.—A *body* having different forms.

Deflagration.—The vivid *combustion* that is produced when the nitrates and some other salts are exposed to a red heat.

Precipitate.—The substance *dissolved* in a fluid which falls to the bottom on the addition of a reagent, and is left on the filter in the act of filtration.

Sublimation.—A process by which volatile bodies are *condensed by cold* into a solid form.

Carbonic Anhydride.—A colourless gas, with a slightly acid taste and *smell.*

On the Sanitary Improvement of Towns and the Utilisation of the Refuse. London: Waterlow and Sons, 1871.

This is a pamphlet illustrative of the Goux system of utilising and collecting the excreta of towns. The system, as applied to portions of the camp at Aldershot, has received very favourable reports; it has also been largely adopted at Halifax. The principle of the system consists in allowing the excreta to fall upon an absorbent material, which takes up the liquids and withdraws them from the action of the oxygen of the air. The absorbents employed are chaff, chopped or broken straw, damaged or refuse hay, coarse grasses, moor grass, dry street sweepings, dry horse-dung and litter, sweepings of markets, wool and hair, charcoal dust, dry fern, &c. Any or all of these are mixed in such proportion as may be most convenient, together with a small percentage of sulphate of iron or sulphate of lime. The receptacle may be a wooden tub, the sides and bottom being lined with the absorbent material. The system appears easily adaptable, the cost of conversion or fixing in the Borough of Halifax averaging from 7 to 35 shillings each house according to the style of fitting, &c. The system can also be employed in the case of receptacles of kitchen refuse. The agricultural value of the manure is said to be considerably above the average, while the dry nature of the contents of the tubs facilitates transport. The closets on this system are well adapted to factory purposes.

An Introduction to Practical Chemistry, including Analysis. By John E. Bowman, F.C.S., late Professor of Practical Chemistry in King's College, London. Edited by Charles L. Bloxam, F.C.S., Professor of Chemistry in King's College, London. Sixth Edition. London, J. and A. Churchill, 1871.

The author of this work selected for a prefatory note the celebrated quotation from Whewell's "Philosophy," "Facts are the materials of science, but all facts involve ideas. Since, in observing facts, we cannot exclude ideas, we must, for the purposes of science, take care that the ideas are clear and rigorously applied." This view has, indeed, been rigorously followed by both the author and the editor, and the result is a most comprehensive manual. This sixth edition presents many important additions. The entire course of qualitative analysis has been revised, and many of the examples in quantitative analysis are new, the weights employed being given in terms of the French as well as of the English standard. True to its title the work is essentially practical. It recommends itself to students by showing how chemistry may be thoroughly studied at a minimum of expense. The most practical chapter is, perhaps, that upon the methods of improvising reagents. Given the *primary* chemicals, as they are termed, or those indispensable to the analyst's cabinet, and consisting of sulphuric acid (vitriol), carbonate of soda (washing soda), chloride of sodium (common salt), nitrate of potash (saltpetre), sulphur (brimstone), ammonia (hartshorn), lime, biborate of soda (borax), ferrocyanide of potassium (prussiate of potash), carbonate or sulphate of baryta (heavy spar, barytes), sulphate of magnesia (Epsom salts), litmus (Archil); the work explains how, with such common materials as may be everywhere procured, all the reagents absolutely necessary for qualitative analysis can be improvised. For instance, acetate of lead may be prepared by leaving scraps of lead or shot in an open bottle partly covered with vinegar until the latter is distinctly sweet. The preparation of hydrochloric and nitric acids is in a similar manner left to the student, who thus acquires a far more practical knowledge of his subject than can ensue from the employment of purchased reagents. Not a less important chapter, in its way, is that detailing the blowing of the several minor glass vessels used in analysis. The author and editor have, in short, done their best to make the student independent by placing before him an epitome of their extended experience couched in the simplest language. Besides the qualitative and quantitative estimation of the most commonly occurring substances, there are included tables of the solubility of salts; the percentage of anhydrous acid in dilute sulphuric acid as estimated by specific gravity; similar tables for nitric and hydrochloric acids; for anhydrous potash in solutions of potash, soda, ammonia; absolute alcohol in dilute alcohol; and the specific gravities of mixtures of ether and alcohol in different proportions. The work is concluded with a glossary of chemical terms, and an alphabetical table showing the action of reagents on oxides and acids. The manual cannot be too strongly recommended to the notice of the student.

CORRESPONDENCE.

RELATION OF HEAT TO ELECTRICITY.

To the Editor of the Chemical News.

Sir,—In the absence of any information as to the internal resistance and electromotive force of the cells employed by Mr. Highton, it is difficult to hazard an explanation of his results. It seems probable, however, that the internal resistance of the iron-carbon cell was the greatest, and also its electromotive force, the latter owing, perhaps, to the polarisation of the platinum. Under these circumstances the zinc-platinum pair would give the greater current with the small resistance of the galvanometer. while, against the large resistance of the platinum wire, the conditions would be revested.

Mr. Highton must be aware that current-strength is dependent on resistance, yet he does not seem to have taken this at all into account. I venture to believe that if he will include the tangent galvanometer in the circuit, with such a length of platinum wire in each case as to reduce the current to the same amount, the temperatures will be sensibly equal. The *length* of wire heated is, of course, dependent not on the heating effect of a given current, but on the power of the cell to overcome resistance.

In conclusion I would suggest that it would give much more confidence in Mr. Highton's results, if before questioning laws which are the result of much patient and accurate investigation, he would make careful quantitative measurement of all the elements involved.—I am, &c.,

Henry R. Procter.

North Shields,
November 28, 1871.

EQUIVALENTS *VERSUS* ATOMS.

To the Editor of the Chemical News.

Sir,—I notice in the last number of the *Journal of the Chemical Society* that a great liberty has been taken with

a paper published by M. Berthelot, the well-known Professor of Organic Chemistry in Paris, inasmuch as the whole of the equivalent formulæ in this paper have been changed into the atomic notation, *which he never uses.* Now, as Berthelot, Henri St. Claire Deville, Boussingault, Fremy, Regnault, Cahours, and a considerable number of eminent chemists not only in France, but also in Germany, Switzerland, America, and even in England, *never use the atomic notation*, but adhere to the simpler method of equivalent formulæ, perhaps you will allow me to protest against the extraordinary custom of changing the formula used by any author in making abstracts of his papers.

It will be urged, perhaps, that it is done for the sake of uniformity, but in the *Bulletin* of the Chemical Society of Paris—the model journal—such an extraordinary liberty is never taken, though a more enthusiastic atomic chemist than M. Wurtz it would be difficult to find. But as a man of talent and experience M. Wurtz is aware that our science is in a state of rapid transition, and, perhaps, he feels that it is more than probable the atomic notation now in fashion with so many of the younger and less illustrious of organic chemists (who are constantly writing, but rarely making discoveries) will ere long cease to exist; nay, that a return to the old equivalent dualistic notation of Berzelius by them would not be without its advantages. However that may be, let them look up to M. Berthelot as their great model—let them rest assured that he sees further into chemical futurity than any of them do—and, above all, let them study his writings *in the original* if the "abstractors" of the Chemical Society's *Journal* are to mutilate and disfigure them as aforesaid.—I am, &c.,

EQUIVALENT.

Burlington House,
Dec. 4, 1871.

MISCELLANEOUS.

Smoke Drainage.—The Rev. B. W. Gibsone, M.A. B.Sc., has forwarded us a letter of his which appeared in the *Times* of Nov. 24. In it he asks "Why we should use chimney-stacks at all; one downward flue terminating in the water-drains would suffice to each house for the removal of its smoke." In reply to the objection —heated air will ascend and cannot be induced to descend without great external constraint—he says that if the drains of any district or block of houses are connected with a ventilating furnace having a lofty ornamental shaft, there would be at once obtained the motive current of air, and a means of destroying the noxious gases of our underground system, while the central furnace would supply warm air or water, or even gas, to all the contiguous dwellings, and the heavy fuliginous matters would be condensed chiefly in the sewers; the result would be— 1. Absence of smoke in a city atmosphere. 2. Diminution of cost in construction of various chimney-stacks. 3. Absence of architectural disfigurements, such as zinc cowls and red cylindric pots. 4. Saving of fuel by total consumption of the smoke in the grate, the fire burning downwards instead of upwards. 5. Greater ease in cleansing the flue from soot, and in the removal of ashes. 6. Steadiness and irreversibility of air-draught, and power of thoroughly ventilating a room even when unfurnished with a fire. Mr. Gibsone's idea is not a novel one; the same idea occurred many years ago to Mr Spence, of Manchester, but the difficulty of getting sufficient draught was so great that it could not be carried out. A tower of an impracticable diameter would have to be erected, and the leakages into the sewers would be so numerous that, at a distance of 100 yards from the tower, no appreciable effect would be produced.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 16, 1871.

This number opens with the announcement of the death of Dr. Adolph Strecker, a well and deservedly known *savant* and scientific chemist, a member of this society, author of an excellent work on chemistry, and a constant contributor to the scientific periodicals of the German Empire. The deceased was Professor at Würzburg (Bavaria), and had just completed his fiftieth year.

This number contains the following original papers and memoirs:—

Formation of the Chrysanissic Acid and of an Acid Isomeric with it Belonging to the Meta Group.—H. Salkowsky.—While the formula of the chrysanissic acid was found by the author, in earlier researches on this subject to be—

$$C_6H_2\left\{\begin{array}{l}NH_2\\(NO_2)_2\\COOH\end{array}\right.$$

the origin of this acid, by the nitration of nitro-anissic acid, remained unexplained. The continued investigation of this subject has led to the discovery that the formation of chrysanissic acid is due to the presence of dinitro-anissic acid present in the crude product of the nitration of the nitro-anissic acid, the dinitro-anissic acid having been separated from that crude material, by treating it first with a very dilute solution of carbonic acid, and next precipitation by means of carbonate of soda and purifying with alcohol. The dinitro-anissic acid exhibits a crystalline mass, of a somewhat yellowish colour, insoluble in water, fusing at about 172°, and composed of—

$$C_6H_2(NO_2)_2.OCH_3.COOH.$$

Ammonia converts this acid into chrysanissic acid, while alkalies convert dinitro-anissic acid into that kind of dinitro-oxybenzoic acid which is derived from chrysanissic acid. This substance is, therefore, to be considered as dinitro-para-amidobenzoic acid, and the oxy-acid derived from it as dinitro-para-oxybenzoic acid.

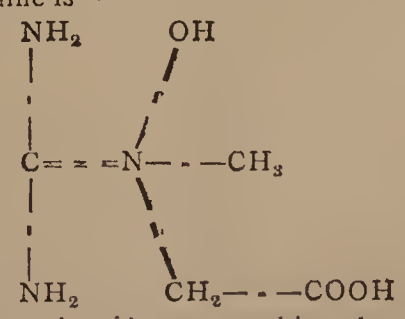
Contribution to our Knowledge of the Direct Formation of Aromatic Amido-Derivatives.—H. Salkowsky.—The contents of this paper partake of the nature of a preliminary notice, and bear upon the formation of some of the amido-derivatives of the aromatic series, viz., picramide, trinitro-aniline from trinitro-benzol, chloranilamide, and chloranilaminic acid from tetrachlorchinon. The author has extended the researches on this subject to those nitrated compounds of benzol which yet contain the remnants OCH_3 and OC_2H_5 of alcohol; thus picric acid ether, $C_6H_2(NO_2)_3.OC_2H_5$, and trinitro-anisol—

$$C_6H_2(NO_2)_3.OCH,$$

form, when treated with ammonia, picramide.

Composition of Minerals Containing Tantalum and Niobium. —C. Rammelsberg.—This paper contains an epitome of the author's extensive researches on this subject. We regret that, owing to the necessity of reproduction of a large number of complex formulæ, we cannot enter into details on the contents of this essay.

Behaviour of Monochloro-Acetic Acid with Methyl-Guanidin and other similar Compounds.—H. Huppert.—In the introduction to this essay, the author discusses, and illustrates with a series of complex formulæ, the constitution of kreatine, and its synthesis from sarkosin and cyanamide. When an aqueous solution of chloro-acetate of methyl-guanidine is heated during twelve hours to 120°, next boiled with hydrated oxide of lead, the liquid filtered, and the lead from the filtrate removed by sulphuretted hydrogen, the liquid again filtered, and next evaporated to the consistency of a syrup, a crystalline mass is obtained, $C_4H_{11}N_2O_3$, a body readily soluble in water, fusing without decomposition at a higher temperature, combining with acids, and the chlorhydrate forming, with platinic chloride, a double salt. This new body differs from kreatine by containing H_2O more. The constitutional formula of this substance, which is named glykolyl-methyl-guanidine is—



By the action of chloro-acetic acid upon morphine, the author obtained a crystalline compound, readily soluble in water, which appears to belong to the same class of substances.

The concluding pages of this number are devoted to an exhaustive biography of the late Dr. George Cajetan Kaiser, an eminent German *savant* widely known for his sound and extensive knowledge of technology and pharmacy as well as chemistry and mineralogy. The deceased was an excellent lecturer, and occupied for a series of years the Chair of Chemistry at the Lyceum at Landshut, Bavaria.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, August, 1871.

This number opens with a very exhaustive memoir :—

Report on Leaden Pipes Coated Inside with a Thin but Continuous Layer of Block-Tin.—M. Tresca.—Although this subject does not belong to chemistry, we call attention to this memoir, which enters exhaustively into the particulars of an industry which is carried on in Paris by M. Hamon, who has succeeded in making the tubes alluded to by a greatly improved process, so that the thickness of the tin is reduced to ½ millim., while yet all the advantages of block-tin pipes are obtained. This memoir is illustrated by engravings.

This number does not contain any original papers on chemistry, but we notice the following essay:—

Cultivation of the Chinese Nettle (Urtica Nivea), Mode of Preparation of the Bark of this Plant, and Application of the Textile Fibres it Yields.—M. Ramon de la Sagra.

Les Mondes, November 30, 1871.

Hydrometre Clauzolles.—A brief description is given of a water-meter invented by the author just named, which instrument is stated to be the most perfect and accurate of its kind hitherto brought out, yet, at the same time, simple in action, and capable of working under very low as well as very high pressure without failing to give correct indications.

Description of a Newly-Invented Colorimeter.—M. Salleron. —Without the reproduction of the woodcut annexed to this paper it is not possible to enter into details on this instrument, but the results of the experiments made by the excellent Editor of this paper prove it to be very superior, as may be inferred from the following quotations (the quantities of the undermentioned substances refer to weight [grms.] in 1 litre of water, while the next following figure designates the the quantity of the substance first mentioned and detected by the instrument);—Caramel, 2·5, 0·0012; fuchsine, 0·01, 0·000007; aniline blue, 1·01, 0·000005; cochineal, 0·1, 0·0002; Prussian blue, 0·05, 0·00004; sap green, 0·2, 0·0006; gamboge, 0·2, 0·00006; logwood extract, 0·2, 0·00002; indigo, 0·02, 0·00002; tincture of litmus, 0·02, 0·00003.

Journal de Pharmacie et de Chimie, October, 1871.

This number contains the following original papers and memoirs:—

On Bromide of Potassium.—Dr. Falières.—A great portion of this memoir relates strictly to therapeutics, but, as regards the testing of the purity of bromide of potassium and its preparation more especially for medicinal purposes, the following suggestions are made:—1 grm. of bromide of potassium, previously pulverised, and put into a glass-stoppered bottle, is dissolved in from 30 to 40 grms. of distilled water. To this solution is added a solution of nitrate of silver, containing 1·427 grms. of that salt. When the precipitate has settled, there is added to the liquid, by means of a burette, a drop of a decinormal solution of nitrate of silver, which, if the bromide is pure, will not produce any further precipitate—the fact being that 1 grm. of the bromide requires precisely 1·427 grms. of nitrate of silver for precipitation, while 1 grm. of chloride of potassium requires 2·279 grms. of the argentic nitrate. It is clear, however, that the bromide will have to be tested for the absence of iodide, carbonate, and sulphate of potassium, and of nitrate of soda. As regards the preparation of bromide of potassium, the author proposes the following process:—100 grms. of bicarbonate of potassa are dissolved in 500 grms. of water; to this solution, 80 grms. of pure bromine are added, and, as soon as the effervescence ceases, there is also added a mixture of 90 parts of pure distilled water and 30 parts of liquid ammonia (sp. gr. = 0·875). The liquid is next evaporated to dryness, care being taken to apply a gentle heat as long as any vapours of carbonate of ammonia are given off. The residual saline mass is next ignited, so as to convert the bromate of potassa into bromide of potassium; the salt thus obtained is, after cooling, re-dissolved in pure distilled water, an aqueous solution of bromine added to this solution, which is next evaporated for crystallisation. By the addition of the ammonia, bromide of ammonium is first formed, and this salt, acting upon the undecomposed carbonate of potassa, converts it into bromide, while carbonate of ammonia is volatilised.

Preparation of Neutral Sulphate of Eserine.—A. Petit.—The hydro-alcoholic extract of Calabar beans is dissolved in water *q. s.* (1 part of the extract to 4 of water). This solution is filtered, and to it is, for every 20 grms. of extract, added 1 grm. of bicarbonate of potassa; there is next added an excess of ether, with which the liquor is thoroughly mixed, by shaking in a glass-stoppered bottle. The ether is gently decanted from the aqueous fluid, an operation best performed by a funnel, to the neck of which a tap is fitted. To the ethereal fluid, which contains eserine, is first added some distilled water, and next, drop by drop, dilute sulphuric acid (strength, 40 grms. of monohydrated sulphuric acid to 1 litre of distilled water), so that one drop = 0·05 grm. of acid, corresponds with the necessary quantity of eserine to form 0·01 grm. of neutral sulphate of eserine. The aqueous acid solution is next evaporated to dryness upon a water-bath, leaving the crystalline compound of sulphate of eserine.

Vienna Yeast.—Dr. Vigla.—This yeast is prepared in the following manner:—Previously-malted barley, maïs, and rye are ground up and mixed, next put into water at a temperature of from 65° to 75°; after a few hours, the saccharine liquid is decanted from the dregs, and the clear liquid brought into a state of fermentation, by the aid of some yeast. The fermentation becomes very strong, and, by the force of the carbonic acid which is evolved, the yeast globules (the size of which averages from 10 to 12 millims.) are carried to the surface of the liquid, and, forming a thick scum, that substance is removed by a skimmer, placed on cloth filters, drained, washed with a little distilled water, and next pressed into any desired shape by means of hydraulic pressure, and covered with a strong and stout tightly-woven canvas. This kind of yeast keeps for from eight to fourteen days according to the season, and is, both for bakers and brewers, very superior to that ordinarily used; the extra good qualities of Vienna beer and bread are partly due to the use made of this yeast in preparing these articles.

Annalen der Physik und Chemie, von Dr. J. C. Poggendorff, No. 9 1871.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

On Electrolysis and Conductibility through Fluids.—G. Quincke.—An algebraico-physical essay.

On Apparatus and Methods of Observing for Crystallographico-Optical Researches.—P. Groth.—This memoir, illustrated by a series of engravings, is divided into the following sections:—Polarisation instrument; the stauroscope; apparatus for determining the axial angles; goniometer.

Intrinsic Nature of Gases.—G. Hansemann.—An algebraico-physical essay; an observation also bearing upon the following paper:—

Influence of Astronomic Motion on Optical Phenomena.—E. Ketteler.

On Anomalous Dispersion, viz., of Rays of Light.—A. Kundt. —The third portion of an optical essay, illustrated by several engravings.

Method of Filling Barometer Tubes without the Necessity of Boiling the Mercury and without the Danger of Breaking the Tube.—H. Wild.—The author describes at length, and illustrates by engravings, an ingenious method of filling barometer tubes; while the second part of the paper refers to the purifying of mercury. Take 1000 grms. of that metal, pour it into a strong flask capable of holding 2000 grms. of waters. Take, next, 30 grms. of a solution of chloride of iron (made up of 1 part of the dry salt and 3 parts of water), add this to the mercury, and, after having closed the flask with a cork, shake it vigorously until the metal is so finely divided that with the naked eye no more globules can be seen. Water is next poured into the flask, and the contents, having been well agitated, are left for a moment to settle, and the impure solution poured off; this operation is repeated twice, after which the greyish mass of very finely divided metal is poured into a porcelain basin, which, having been placed on a water-bath, is made dry, and next brought to its normal state of aggregation by rubbing in a glazed porcelain mortar. The metal is next filtered through good tough writing-paper wherein a perforation has been made with a needle.

Contribution to Micro-Mineralogy.—Dr. A. von Lasaulx.—A paper illustrated by a series of engravings exhibiting magnified figures of crystals.

Sitzüngsberichte der Mathematisch-Physikalischen Classe der Königlich Bayerischen Akademie der Wissenschaften zu München, vol. ii., 1871.

The original papers and essays relating to chemistry published in this volume are the following:—

Fat Contained in Beer-Yeast.—Dr. Vogel.—After referring first to the fact that all cereals contain a larger or smaller quantity of fatty matter, which is an essential constituent of the grain, the author describes at length his experiments made for the purpose of extracting, by means of ether, the fat contained in beer-yeast, an oil boiling at about 200°; sp. gr. = 0·901; decomposed when heated above 300°, and yielding acrolein. The quantity of this oil found in 1 litre of the yeast amounts to from 0·2 to 0·3 grms. It appears that that this oil is in most respects akin to the fatty matter found in barley. The greater part of the contents of this paper bears particularly on zymotechny.

Fossil Resin which perhaps Belongs to the Flora of the Amber.—H. Spirgatis.—The author obtained a specimen of a kind of soft substance, occasionally found along with amber in that portion of the Baltic (situated near the coast of East Prussia) where dredging for amber is regularly carried on. This soft material is vulgarly known as unripe amber, a soft semi-elastic substance, which hardens gradually by exposure to air; sp. gr. = 0·934; insoluble in caustic alkalies, oil of turpentine, alcohol, and also insoluble in chloroform, sulphide of carbon, and petroleum, which have the effect, however, of softening this substance and making it swell; benzol only dissolves out a small portion of an essential oil, while ether, in addition to the latter, also dissolves some of the resin, which was found on analysis to consist, in

100 parts, of:—Carbon, 86·02; hydrogen, 10·93; oxygen, 3·05; formula, $C_{40}H_{62}O$. The author observes that the composition of this resin is very different from that of amber (which contains, after deducting ash, in 100 parts, according to Schrötter:—Carbon, 78·60; hydrogen, 10·19; the rest being O), while the composition of this resin is more like that of the fossil resin of Settling-Stones, which, according to the late Professor Johnston, contains, in 100 parts:—Carbon, 85·25; hydrogen, 11·03.

On Rammelsbergite.—F. Sandberger.—This rather rare mineral, also known as Weissnickelkies, was found to have a sp. gr. = 7·19, and consists, in 100 parts, of:—Arsenic, 63·30; nickel, 26·65; iron, 2·06; bismuth, 2·662; with traces of copper, cobalt, and sulphur.

Influence of the Germination Process on the Fat Contained in the Seeds.—Dr. Vogel.—From the contents of this essay it appears that, by the process of germination, the quantity of fat contained in seeds decreases in the ratio of from 0·094 to 0·320 per cent; average, 0·156 per cent.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, November 23, 1871.

This number contains the following original matter:—

Notice on Glue, Cements, Lutes, &c., in Reference to their Mode of Application.—Dr. Sibon.—The contents of this paper are chiefly of interest to those whose daily vocation is the use of cements for the purpose either of mending glass, china, small articles made of wood, horn, &c., or the use of the materials alluded to in the construction, for instance, of physical instruments wherein it is required to unite glass and metals together.

Description of a New Telegraphic Instrument.—M. Chambrier.

Magneto-Electric Explosion Apparatus.—J. Breguet.—Illustrated by a woodcut. A very ingeniously-devised instrument constructed for the explosion of gunpowder, dynamite, nitro-glycerine, and gun-cotton, in mines, quarries, and also in warlike operations.

Resistance Offered by Air Against the Motion of an Air-Balloon.—H. Mangon and D. Claye.—A mechanico-physical paper, recording the results of some experiments made at the Orléans railway-station with two air-balloons, respectively of 6 and of 10·75 metres diameter.

NOTES AND QUERIES.

Naphthalic Acid.—Will some reader please tell me the readiest way to make naphthalic acid?—Naphthaline.

Comparative Tables of Hydrometers.—Can any of your readers inform me where I can procure a good book or journal giving the comparative tables of Twaddell's hydrometer with that of Baumé.—L. C.

Spence's Process of Treating Mineral Phosphates in the Manufacture of Artificial Manure.—I shall be glad if some of your readers will give more details of this process than are contained in your brief report of Dr. Wallace's Address at the Glasgow Philosophical Society, on Monday, Nov. 6.—W. L.

Apparatus for the Liquefaction of Gases.—I should feel obliged if any of your correspondents would give, or refer me to, a good detailed description of the valve to the receiver in Natterer's apparatus for the liquefaction of gases. There is a description in Ganot's "Physics," p. 260, but it is too general for my purpose.—S. T.

Gas-Proof Fabric.—Can any of your numerous readers inform me, through the medium of your "Notes and Queries," how I can make linen or cotton fabric gas-proof? I have made a large gas-bag of cotton cloth, and want an oil-varnish of some sort that will render it as impervious to gas as oiled silk is. India-rubber varnish will not do, as it is liable to become soft and adhesive after a time if moisture come in contact with it.—L.R.C.P. Edin.

Adulterations in Food and Drink.—Can any of your correspondents tell me if there is any book or books which give simple but trustworthy directions for detecting adulteration in food and drink? The processes given by Hassall and Normandy are long and complicated, and often imperfect. The food analysts appointed by various towns and counties must have some such processes, as they are required by the Act of Parliament to complete their analyses in a very short time.—An Amateur Chemist.

Test for Starch.—I do not know if it has escaped the notice of chemists that iodine is not a test for starch in solutions of sugar, brewer's wort, albumen, &c. It is customary with some brewers to test their wort for starch, which, though very likely to be present, they never find. I have added starch to wort before testing with iodine, and you may guess my surprise on applying the test at not having the usual reaction. The starch was not at once converted, for on the application of a stiff dose of SO_3 I had the starch reaction. My solutions were cold and acid.—Alfred Terry.

Coagulation of Clay.—(Reply to X. Y. Z.).—Chloride of iron and carbonate of soda, in the proportion of 32 kilos. of the former salt and 84·5 of the latter to a quantity of water equal to 1000 cubic metres, has been found a most valuable and quite innocuous means of purifying water, even such as is otherwise quite unfit for drinking purposes and could not be rendered so by alum. The salts alluded to are best previously dissolved in some pure water, and the solutions, that of iron first, poured into the tank containing the water intended to be operated upon. The soda solution is not added until after a few moments, the water being first vigorously stirred. The soda solution having been added, the fluid is stirred again, and then left quiet for the purpose of allowing the very bulky and flocculent sediment to deposit; this takes considerable time—from twenty-four to thirty-six hours. The *strychnos potatorum* is used in India for purifying clayey water.

The Milanese Sewerage System.—This is recommended by Mr. Child, of Oxford, as being suitable for small towns and country villages. Its essential feature is the drainage of the houses into water-tight cesspools, which are emptied frequently, efficiently, and quite inoffensively by means of a barrel-cart, previously exhausted of air, and a hose. The barrel-cart then conveys the sewage to a depot at a convenient distance, where all that is saleable is sold to farmers, and the rest is manufactured into a kind of dry artificial guano. Many of our little towns and villages lie on dead flats or at the bottom of deep valleys, where ordinary sewerage works could not be established without an expensive provision for raising the sewage in order to render it available for irrigation. In such places the Milanese system might be carried out with ease and at comparatively small outlay. A certain number of cesspools must be rendered water-tight—a process not very expensive. One cesspool would serve for several cottages, and frequent emptying would be better than large size. Two Milanese barrel-carts must be procured, and these, with a small steam-engine at the depot to work the air-pump, would, together with about three men and two horses, form the whole of the apparatus required for testing the system upon a small but sufficient scale. On the day on which Mr. Child visited the depot near Milan, farmers' carts were waiting there literally in scores to obtain their supply of it, and he feels sure that if landed proprietors or farmers were to give the system a trial in this country they would find it well worth adoption.—*The Garden.*

MEETINGS FOR THE WEEK.

Monday, Dec. 11th.—London Institution, 4. Prof. Huxley, LL.D. F.R.S., on "Elementary Physiology."
— Medical, 8.
— Royal Geographical, 8.30.
Tuesday, 12th.—Civil Engineers, 8.
— Photographic, 8.
Wednesday, 13th.—Society of Arts, 8.
Thursday, 14th.—Royal, 8.30.
— Royal Society Club, 6.

TO CORRESPONDENTS.

*** Vol. XXIII. of The Chemical News, containing a copious index, is now ready, price 11s. 4d., by post, 12s., 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. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxiv. commenced on July 7th, and will be complete in twenty-six numbers. Reading Cases, price 1s. 6d. each, post free, may also be obtained at the Office.

Erratum.—Vol. xxiv., p. 156, line 32 from top, *for* "2 atoms of nitrogen" *read* "4 atoms of nitrogen."

G. H. B.—Watts's "Dictionary of Chemistry."

A. T. Jones, Bilbao.—A work containing the information you require is in the press; it will be duly announced in our columns.

BOOKS RECEIVED.

Elementary Treatise on Physics, Experimental and Applied, for the Use of Colleges and Schools. Translated and Edited from Ganot's Elements de Physique. By E. Atkinson, Ph.D., F.C.S. London; Longmans, Green, and Co.

New Remedies; a Quarterly Retrospect of Therapeutics, Pharmacy, and Allied Subjects. By Horatia C. W. Wood, jun., M.D. New York: William Wood and Co.

The Journal of the Iron and Steel Institute, vol. ii. London; E. and F. N. Spon, Charing-Cross.

Tobacco; an Essay. By Henry Gibbons, M.D. London; James Burns.

Asiatic Cholera in Bristol in 1866. By William Budd, M.D., F.R.S. Bristol: T. Kerslake and Co.

NOTICE TO AMERICAN SUBSCRIBERS.

In answer to numerous inquiries, the Publisher begs to state that Subscribers in the United States can be supplied with the CHEMICAL NEWS from this Office, post free, for the sum of £1 2s. 4d. per annum payable in advance.

TEXT-BOOKS OF SCIENCE.

On Tuesday, December 19th, in small 8vo., price 3s. 6d.,

The Theory of Heat. B. J. Clerk Maxwell, M.A., F.R.SS. L. & E., Professor of Experimental Physics in the University of Cambridge.

Being the Sixth of the New Series of Elementary Works on Mechanical and Physical Science in course of publication, edited by Professor T. M. Goodeve, M.A.

Text-Books previously published, price 3s. 6d. each :—

1. GOODEVE'S MECHANISM.
2. BLOXAM'S METALS.
3. MILLER'S INORGANIC CHEMISTRY.
4. GRIFFIN'S ALGEBRA AND TRIGONOMETRY.
5. WATSON'S PLANE AND SOLID GEOMETRY.

London; Longmans, Green, and Co., Paternoster Row.

Now ready, Vol.I., New Series, cloth 8vo., price 21s., Illustrated with Chromolithograph, 4 Page Plates, and 81 Woodcuts,

The Quarterly Journal of Science, and Annals of Mining, Metallurgy, Engineering, Industrial Arts, Manufactures, and Technology. Edited by William Crookes, F.R.S., &c.

London: Offices of the Quarterly Journal of Science, 3, Horse-Shoe Court, Ludgate Hill, E.C.

Royal 8vo., with 7 Lithographs and 50 Woodcuts, price 6s. cloth,

Microscopical Manipulation; being the subject matter of a Course of Lectures delivered before the Quekett Microscopical Club, January—April, 1869. By W. T. Suffolk, F.R.M.S.

London: Henry Gillman, Boy Court, Ludgate Hill.

Just published, demy 8vo., with 42 woodcuts, price 14s.,

The Antiseptic System: A Treatise on Carbolic Acid and its Compounds, with an Inquiry into the Germ-Theories of Putrefaction, Fermentation, and Infection, the Theory and Practice of Disinfection, and the Employment of Antiseptics in Practical Medicine and Surgery. By A. E. Sansom, M.D., London, M.R.C.P.

London: Henry Gillman, Boy Court, Ludgate Hill, E.C.

PRACTICAL CHEMISTRY.

Laboratory, 60, Gower Street, Bedford Square, W.C.

Mr. Henry Matthews, F.C.S., is prepared to give Instruction in all branches of PRACTICAL CHEMISTRY, particularly in its application to MEDICINE, AGRICULTURE, and COMMERCE.

The Laboratory is open daily, except Saturday, from ten to five o'clock; on Saturday, from ten till one o'clock.

Mr. Matthews is also prepared to undertake ANALYSES of every description.

For Particulars and Prospectuses, apply to Mr. Henry Matthews, the Laboratory, 60, Gower Street, Bedford Square, W.C.

BERNERS COLLEGE of CHEMISTRY.—EXPERIMENTAL MILITARY and NAVAL SCIENCES, under the direction of Professor E. V. GARDNER, F.E.S., &c.: of the late Royal Polytechnic Institution and the Royal Naval College.

The Laboratory and Class Rooms are open daily.

Especial facilities for persons preparing for Government and other examinations.

Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

For particulars, &c., apply to Prof. E. V. G., 44, Berners-street, W.

Silicates of Soda and Potash in the state of Soluble glass, or in CONCENTRATED SOLUTION of first quality, suited for the manufacture of Soap and other purposes, supplied on best terms by W. GOSSAGE and Sons, Widnes Soapery, Warrington.

London Agents, CLARKE and COSTE, 19 and 20, Water Lane, Tower Street, E.C. who hold stock ready for delivery.

Royal Polytechnic.—Professor Pepper's New Lecture, "ALL ABOUT GUN-COTTON," Dynamite, and Lithofracteur; with brilliant and *noiseless* Experiments, and Graphic Illustrations of the CATASTROPHE at STOWMARKET, by Vick and Deazeley.—Mr. George Grossmith, junr.'s New Sketch, THE SILVER WEDDING! with humorous and musical illustrations.—A perfectly new and unique Illusion called the ARABIAN MYSTERY.—Novel and marvellous effects of the ELECTRIC LIGHT UNDER WATER, by Messrs. Heinke and Davis.—Occasionally, PARIS: as it Was and Is! by J. L. King, Esq., with Songs by Miss Alice Barth.—Open daily from 12 to 5, and 7 to 10.—Admission One Shilling.

ANALYTICAL LABORATORY AND SCHOOL OF TECHNICAL CHEMISTRY.

7 and 9, HACKIN'S HEY, LIVERPOOL.

Conducted by A. NORMAN TATE, Analytical and Consulting Chemist, and Chemical Engineer.

Established for Educational Purposes connected with Chemistry in its practical Applications to Manufactures, Commerce, &c.; for the performance of Analyses, Assays, and Chemical Investigations; and for affording information respecting the construction, &c., of Chemical Manufactories, and the conduct of Chemical Manufacturing Processes.

The Course of Instruction, in addition to the ordinary Chemical studies, comprises, as far as possible, all such other subjects as are necessary to give the scientific and practical information required in the Arrangement, Construction, and Management of Chemical Manufactories, and in the Application of Chemistry to Industrial Pursuits.

Students' Fees may be known on Application.

Plans, &c., for Chemical Apparatus and Manufactories are supplied and the erection of Plant and Buildings is superintended when required.

North London School of Chemistry, Pharmacy, &c.—For Instruction in Practical Chemistry and Evening Classes for the Study of Chemistry, Botany, Materia Medica, &c. Conducted by Mr. J. C. BRAITHWAITE, *for thirteen years Principal Instructor* in the Laboratories of the Pharmaceutical Society of Great Britain, and Demonstrator of Practical Pharmacy, Pharmaceutical Latin, &c.

Mr. Braithwaite, having taken the premises adjoining his house, has been enabled *nearly to double the size of his Laboratories*, and, at the same time, procure a large piece of ground which *he has had laid out as a Botanic garden*. Every facility is, therefore, offered to Students desirous of acquiring a practical knowledge of this branch of their education.

The Session 1871—1872 will commence on the 2nd of October, when the Laboratories will re-open at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

THE CHEMICAL and TOXICOLOGICAL CLASS will meet as usual every Monday and Thursday evening, commencing October 2nd, at 8 p.m.

The LATIN CLASS for the reading of Physicians' Prescriptions, Cæsar's Commentaries, &c., every Tuesday and Friday evening, commencing October 3rd, at 8 p.m.

The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday evening, commencing October 4th, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will be continued every Saturday, until further notice, at 10 a.m.

Fee to either of the above Classes Half-a-Guinea per Month. Pupils can enter at any period.

Gentlemen Privately Prepared for the Examinations of the Pharmaceutical Society, and the "Modified Examination for Assistants," &c

All Fees must be paid in advance.

Letters of inquiry should be accompanied with a stamped envelope.

Mr. Braithwaite receives a few Pupils to Board in his house.

Address—54, Kentish Town Road, N.W.

AMSTERDAM EXHIBITION, 1869.

The GRAND DIPLOMA of HONOUR, being the First Prize, and SUPERIOR to the Gold Medal.

Liebig Company's Extract of Meat.—Paris EXHIBITION, 1867, TWO GOLD MEDALS; HAVRE EXHIBITION, 1868, THE GOLD MEDAL.—Only sort warranted perfect and genuine by Baron Liebig, the Inventor. "A success and a boon."—Medical Press and Circular. One pint of delicious beef-tea for 2½d., which costs 1s. if made fresh from meat. Cheapest and finest-flavoured "stock" for soups, &c.

CAUTION.—Require Baron Liebig's signature upon every jar Sold by all Italian Warehousemen, Grocers, Chemists, and Ships. Store Dealers; all Wholesale Houses; and of LIEBIG'S EXTRACT of MEAT COMPANY (LIMITED), 43, Mark Lane, E.C.

NOTICE.—Various chemical analyses have been published purporting to show a fraction more of moisture to exist in the Company's Extract than in some imitation sorts. It is extremely easy to evaporate the water almost to any extent, but it is quite as certain that the fine meaty flavour which distinguishes the Company's Extract from all others would be destroyed if the concentration of the Extract were carried beyond a certain degree. Beef-tea made from Liebig Company's Extract with *boiling-hot water* will be found to be greatly superior in flavour, strength, clearness, to any other sort. This explains the universal preference it obtains in the market.

This Extract is supplied to the British French, Prussian, Russian, and other Governments.

Now ready, price 6d.,

Notes of Professor Odling's Juvenile Lectures on BURNING AND UNBURNING, delivered at the Royal Institution of Great Britain, Christmas, 1870-71.

London; Henry Gillman, Boy Court, Ludgate Hill, E.C.

THE CHEMICAL NEWS.

Vol. XXIV. No. 629.

ON THE

CHEMICAL CONSTITUTION OF GLYCOLIC ALCOHOL AND ITS HETEROLOGUES,

AS VIEWED IN THE NEW LIGHT OF THE "TYPO-NUCLEUS" THEORY.*

By OTTO RICHTER, Ph.D.

The common saying, that "a tree is known by its fruits," applies with equal force to scientific pursuits, no matter whether these pursuits are carried on in the practical or in the theoretical department of human knowledge. The art and science of chemistry, from being a plain and simple record of systematically arranged facts, is now fast approaching that period of its development when, as a rational science, it will gain for itself a position fully as noble and imposing as that of astronomy, mechanics, optics, and other branches of applied mathematics. In pondering the various questions and problems which require to be solved before we can hope to attain this most desirable object, I was not slow in discovering that the garden of science enclosed within its precints one of those rare and precious trees which, under judicious culture, might be made to furnish a plentiful crop of novel and original conceptions. It is now more than twenty years since I bethought myself of investigating the singular configuration and structure of that wonderful tree, as well as the internal organisation of its multifarious and matchless productions. Considering that it is imperative upon me to approach my subject in a spirit of the utmost fairness and candour, I feel it my duty to inform you that at no great distance from my own favourite tree of chemical knowledge there stands another and much older tree of chemical knowledge, which has for a considerable period enjoyed the privilege, or I should rather call it the monopoly, of supplying the chemical market with its bright and showy, but, upon the whole, spurious and unpalatable, productions.

The two trees of chemical knowledge above alluded to are in reality two different chemical theories, which, with many connecting links and points of resemblance between them, are nevertheless in their leading doctrines and principles vitally opposed to one another. The younger of these theories, which may appropriately be designated the "typo-nucleus" theory, is the offspring of my private meditations. Its general tenets and principles were first promulgated by me at the meeting of the British Association in Norwich in the year 1868, and a small pamphlet, entitled "General Outline of an Original System of Chemical Philosophy, comprising a determination of the Volume-Equivalents, as also a New Theory of the Specific Volumes of Liquid and Solid Substances," soon afterwards appeared in print, and was made known by means of advertisements. The older of these two theories, which may appropriately be designated the "typo-radical" theory, is, I scarcely need to tell you, the dominant and all but universally adopted system of our modern chemical schools and laboratories.

It is with the sincere and anxious desire of furthering the cause of scientific progress, which the founders of this world-famed Institution have chosen for their motto, that I have sought and obtained the kind permission of your Committee to lay before you a variety of experimental evidence in support of the validity of my assertions, which, if it does not convince you on the spot, will at least, I flatter myself, set you to ponder and ruminate. The subject of my present discourse, by the aid of which I hope to illustrate a few of the many salient points which distinguish the "typo-nucleus" theory from its full-grown and powerful rival, bears for its title "The Chemical Constitution of Glycolic Alcohol and its Heterologues, as viewed in the new light of the 'Typo-nucleus' theory." But in order to enable you more fully to comprehend the scientific bearing and significance of these novel conceptions and doctrines, it is requisite that I should first of all explain to you the precise meaning of the compound terms "typo-nucleus" and "typo-radical." As regards the first of these components you may perhaps imagine that the word "typo" expresses one and the same idea in both theories. Let me at once disabuse you of this mistake. In my chemical system the seven principal types enumerated therein represent as many distinct and separate forms of molecular arrangement, and it is of importance to add that each one of these types embraces and characterises one single order of chemical compounds, and this order exclusively. In the "typo-radical" system, on the other hand, the word "typo" bears an essential different meaning, for it implies that, in accordance with the general law of substitution, chemical compounds may be systematically distributed over a few simple patterns, models, or types. The so-called rational formulæ employed for these types are meant to convey to the mind a more or less clear and definite idea of the relative position of the component elements, and likewise of their leading chemical properties and functions. The substances, whose chemical formulæ have been employed, or, I should rather say, "perverted" for this purpose are hydrogen, water, ammonia, chloride of ammonium, carbon, and marsh-gas. As regards the second of these compounds, namely, the expressions "nucleus" and "radical," a few remarks will suffice for determining the precise meaning of these critical and portentous epithets. Observe, then, first of all, that the two types of the simple hydrocarbon molecules and of the simple normal acid molecules are regarded in my system as the first self-supporting productions of the chemical forces, and that the various species of elementary molecules are all supposed to belong to the class of non-enveloped acid nuclei, and it is under this latter form that they occupy the first place in the series of normal acid molecules, and that like the rest of these members, they are believed to possess the power of uniting with the bases. The nuclei of the normal acids are further supposed to occur not singly, but always in pairs, in other words, as twin nuclei, and it is one of the distinguishing characteristics of their component nuclei that they cannot be represented by more than one bivalent molecule. You will, moreover, bear in mind that the other members of the acid series are produced from these twin nuclei by the successive intromission of one or two chemically similar elementary molecules into that particular region of the atomic edifice to which, from its contiguity to the nucleus compartment the term "envelope" has perhaps not unfitly been applied. The expression "radical" is commonly understood to refer to that section of a given atomic system which in the various chemical processes is observed to remain either totally unaltered, or to become modified in such a manner that, for every component molecule of one kind which is taken away, an equivalent molecule of another kind is supposed to step into its place so as to fill up the vacancy. Unfortunately this definition of the word "radical" holds good under the above restrictions only, and necessitates the exchange of one radical for another as often as the result of the experiment testifies to the fact that the loss of constituents in the radical has not been compensated by the accession of new elements. It is, therefore, not to be wondered at if this tendency to fluctuation in what ought to be the most stable and enduring portion of the atomic edifice continues to prove a source of serious trouble and embarrassment to the devisers and advocates of the typo-radical theory.

* Abstract of a Paper read before the British Association, Edinburgh Meeting, 1871.

In the language of one set of interpreters the atoms are said to be furnished with a variable number of movable poles or points of attraction, which they are able to turn in every direction, nay, if needful, even the one against the other; while in the language of a different set of interpreters, mere units of affinity are talked of and employed in their calculations. It is further alleged that the saturating capacity of the elementary molecules is exactly commensurate to the number of poles or units of affinity thus stored up within them. I, for my part, must confess that I cannot reconcile myself to either of these modes of interpretation, and more especially not to that grotesque and ludicrous exhibition of capers and summersaults which these *soi-disant* poles are made to perform within the walls of their globular dwelling. Let us now suppose that some of my hearers, impressed with the awkwardness of the situation, put this question to me: What would you advise us to do in order to extricate theoretical chemistry from its present unbecoming and ungraceful attitude? To this question I can return a ready and straightforward answer, and I will give it in the language of a musician who knows that in the strict style of contrapuncta1 writing, every discord ought to be duly prepared and resolved, and every licence avoided in order to produce in all the parts an agreeable and harmonious effusion of musical sounds. I boldly declare and maintain before this meeting that when this very ingenious and plausible, but philosophically untenable, polar hypothesis was, as it were, by way of licence, and without due preparation, brought to bear upon Gay-Lussac's famous law, that aëriform elementary substances are capable of combining, in certain simple ratios of their specific volumes, a grave and fatal error was committed by our chemical guides and advisers. I must, therefore, strenuously protest against any further attempts of screening and propagating this error, which has been productive of incalculable mischief, inasmuch as it has laid the foundation for that narrow, hasty, and superficial style of arguing which our modern theorists, in their eagerness to establish rational formulæ, have thought proper to cultivate—a style which, in its wild and precipitous efforts to tear asunder in these formulæ, and to dislocate what, by Nature herself, is and ought to remain united, finds no parallel in the whole wide domain of natural philosophy. What, then, I ask in sober earnest, are the boasted advantages, which have accrued to theoretical chemistry from this incessant hunting and racing after multivalences and atomicities? I, for my part, can see none, and I must, therefore, denounce the whole movement, which is now in full swing, and which appears to be headed and fomented by a few highly-gifted, but rather overweening intellects, as being in reality a movement in a circle which, if persisted in, will simply land you at the same point from which you were starting some years ago, on what I cannot help stigmatising as a "wild goose chase," after the self-begotten phantoms of your own over-heated imagination. Thus, then, it has come to pass that the main problem of modern chemistry, the satisfactory solution of which will not fail to inaugurate a new era of scientific progress, has been utterly ignored and lost sight of. This problem may be stated as follows:—What is the truest, safest, and most trustworthy test and criterion for discriminating between the essential and the non-essential constituents of complex molecules, as well as for distinguishing between the various modes and forms of chemical union, whereby the essential constituents are cemented to each other and typically grouped together in conformity with the general law of chemical rank-order, representing, so to speak, the very bone and marrow of the molecular organism, while the non-essential constituents, from their greater mobility and readiness to dissociate themselves from that organism, are evidently connected with the former by much looser and more fragile ties of chemical affinity? And here I take the liberty of reading my translation from the German, of what may be considered a sort of public confession of the chemical creed and convictions entertained by one of our most eminent continental chemists and philosophers. Professor Kolbe, of Leipzig, says in one of his numerous essays—I allude to the paper where he dilates on the derivatives of cyanamide:—"I have gained my point," says the learned Professor, "if I can succeed in convincing the reader how far those chemists have gone astray from the path of truth who flatter themselves that they have actually solved the problem of the chemical constitution of substances after they have managed to link together in due form and order all the elementary constituents of a given compound, but who fail to perceive that every group or constellation of atoms requires a ruling head or principal, around which the other members are destined to occupy a more or less subordinate position. The cause of this oversight is the erroneous impression, or, I should rather call it, the fashionable delusion that chemical combinations are comparable to sets of chains, open or closed, as the case may be, and whose component links are all equal in point of rank and superiority. I, for my part, would rather prefer likening these combinations to a regularly organised community, say, for instance, to a regiment of soldiers, which is composed of a colonel, subalterns, and commoners, In such a regiment the common soldiers are lower in rank than the lieutenants and captains, while the colonel is the highest in command, and every one must obey his orders." These, gentlemen, are the clearly expressed views and sentiments of one of our most intelligent and distinguished chemists, and I myself for one am ready to acknowledge their general veracity and correctness. But I must go one step farther by saying that although there is a strong resemblance between my acid twin nucleus with its subordinate adjuncts, and the commander of a regiment with its staff of adjutant officers, there is this vast and vital difference between us, that I have shaken myself entirely free from the shackels and trammels of the dominant school philosophy, while our esteemed colleague, who in his own person happens to be a mighty leader and spokesman on the typo-radical side, must be supposed to be still deeply enamoured of his long-courted and idolised mistress. After these rather lengthy but unavoidable preliminaries, I shall now do myself the honour of discussing before you the main subject of this paper. which bears for its title, "The Chemical Constitution of Glycolic Alcohol and its Heterologues, as viewed in the new light of the typo-nucleus theory."

(To be continued).

ON THE

IRIDIUM COMPOUNDS ANALOGOUS TO THE ETHYLEN AND PROTOCHLORIDE OF PLATINUM SALTS.*

By Professor SAMUEL P. SADTLER, Ph.D.,
Pennsylvania College, Gettysburg, Pa.

Among the compounds which we are accustomed to call *organo-metallic*, those of $PtCl_4$ and $PtCl_2$ play, perhaps, the most important part. We can separate them, however, into the two great classes—those where the $PtCl_4$ and $PtCl_2$ enter by substitution into compound ammonia atoms, and thus form bases more or less complex, but having still a certain connection; and those where the $PtCl_4$ and $PtCl_2$ take up organic radicals of different degrees of valence to form saturated compounds.

The range of this last class, as can be seen, is very wide; one of the most prominent of these compounds, however, and one which exercised for some time a very

* Extract from an Inaugural Dissertation at the Univ. of Göttingen, April, 1871.

considerable influence upon the theoretical views held at that time, is the compound of $PtCl_2$, known as Zeise's salt, and discovered and investigated by him in 1830.

It is not necessary to recount here the controversy which took place between Zeise and Liebig on the subject. Suffice it to say that, by subsequent investigations of Griess and Martius and of Birnbaum, its formula is definitely settled as $PtCl_4,C_2H_4+KCl$.

The investigation I now undertook was to see if a similar base of iridium could be prepared. Various considerations, stated at length in my original paper, led me to believe that iridium might not combine exactly as platinum did in the formation of these salts.

After obtaining the double chloride of iridium and ammonium in the usual way, by decomposing the osm-iridium, I made some tests as to the manner of formation of the salt. An attempt to form it by taking the double chloride of iridium and ammonium in solution, and, passing a stream of chlorine through to break up the chloride of ammonium, to then conduct ethylen gas into it, was unsuccessful. The method which succeeded most perfectly was to act upon iridium chloride. This was obtained by igniting the double chloride of iridium and ammonium, thus obtaining iridium oxide and metallic iridium, which was then heated with aqua regia in sealed tubes of Bohemian glass to 180° or 200° C. This solution of $IrCl_4$ I then treated with absolute alcohol. On adding KCl, and allowing it to crystallise out, I got the greenish-brown crystals of the iridium-ethylen base. On subjecting them to an organic combustion, I obtained as products carbonic acid and water. They burned with a luminous flame, and answered, in short, all the tests applied to Zeise's platinum salt.

Another experiment, to see if ethylen gas would act directly upon the $IrCl_4$, reducing it and uniting at the same time, was unsuccessful.

It will thus be seen, that the only method of preparing the iridium-base is by the reducing action of alcohol on iridium chloride, according to the reaction:—

$$\underbrace{\underbrace{IrCl_2}\ \underbrace{Cl_2}+\underbrace{\begin{matrix}CH_3\\|\\CH_2OH\end{matrix}}+\left|\begin{matrix}CH_2\\|\\CH_2\end{matrix}\right|\begin{matrix}H\\\\OH\end{matrix}}$$

$$=IrCl_2,C_2H_4+2HCl+\begin{matrix}CH_3\\|\\COH\end{matrix}+H_2O,$$

the products of which are iridium-ethylen-protochloride, hydrochloric acid, aldehyde, and water.

The purifying of the necessary iridium was found to be a very long and tedious operation, the last traces of platinum sticking very pertinaciously to the iridium salt. The processes in use also leave much to be desired in the way of completeness and expedition.

The method selected for separation was the method of Birnbaum, grounded upon the distinct and separate crystallisation of the double cyanides of iridium and barium, and platinum and barium. To convert the double chlorides of iridium and ammonium, and platinum and ammonium, into the double cyanides of iridium and potassium, and platinum and potassium, after trying Wöhler's and Muckle's method and obtaining unsatisfactory results, I had recourse to Martius's method. This consists in mixing the dry impure chloride of iridium and ammonium with powdered cyanide of potassium, and fusing and then taking up with water the fused mass. After working some time with this method, with rather poor results, owing to the high heat required to bring the mass to fusion and the invariable decomposition of the newly formed double cyanides, resulting from the application of such a heat, I modified the method in several particulars. I found, on trying, that the black iridium oxide went very readily into solution in the fused cyanide of potassium. Taking, therefore, the double chloride of iridium and ammonium and igniting it to transform it into the iridium oxide, I proceeded after the following manner:—

Covering the bottom of the crucible with a bed of powdered KCy, I then added a mixture of KCy and iridium oxide, and exposed it to the flame of the blast-lamp. The fusing cyanide takes up quite readily the metallic oxide, and is soon in calm fusion. A reduction still takes place, but by no means to the extent experienced before. This is occasioned by the strong heat which has to be applied to get the mass into full fusion. Another modification which I then made has some advantages over this just described. It is to bring a few pieces of KCy to full fusion, and then keeping it so, to add a previously prepared mixture of the iridium oxide and finely pulverised cyanide of potassium to it, in small quantities at a time. The advantage here is, that, when the KCy has once been brought to fusion, it can be kept there with a comparatively small flame, and the reduction of the double cyanides does not occur so readily. It is true, that adding the iridium so slowly, the compound is kept in the fused state longer. My experience, however, leads me to prefer this latter plan, and I generally used it as giving the largest yield. Birnbaum's method proper is now used. The solution of the double cyanides, filtered off from any unattacked iridium oxide, contains a tolerably large excess of free KCy. This is destroyed by adding dilute HCl. When neutral, a concentrated solution of copper vitriol is added. The violet-coloured precipitate of mixed double cyanides of iridium and platinum with copper is washed by decantation with boiling water. While suspended therein, a strong solution of caustic baryta is added. The copper is thrown down as brown oxide of copper, and the double cyanides of iridium and platinum with barium are formed, which remain in solution. When the fluid reacts distinctly alkaline, after a minute or so boiling, it is filtered off, and then CO_2 is passed through, until a neutral reaction is obtained. Filter off the precipitate of $BaCO_3$, and then concentrate for crystallisation. The yellow platinum salt crystallises out first in small crystals, with a play of colours from yellow to blue, being similar in their dichroic effects to most of the other double cyanides of platinum. The iridium salt crystallises then in larger colourless prisms, which can be easily separated mechanically from the platinum crystals. The iridium crystals I ignited in a porcelain crucible, and having thus completely broken up the compound, drew out the baryta with boiling water. The iridium, after being well washed and ignited to completely oxidise it, was heated as before with aqua regia in a sealed tube to 200° C. The $IrCl_4$ solution obtained was again treated with absolute alcohol, and, on addition of KCl and NH_4Cl, the crystallised salts were obtained.

However, the compounds which were now formed were, contrary to my expectations, not the ethylen salts pure and alone, but there was a simultaneous formation of what appear to be several distinct compounds. Although in one preparation of ammonium salt analysed, the ethylen-protochloride-salt was isolated tolerably pure, yet, in the majority of the analyses, I had to do with a mixture difficult to separate even under the lens. The readiness with which these compounds decompose when subjected to re-crystallisation, even although one observes the precaution of keeping the solution distinctly acid, prevents any successful purifying that way. The preparation, therefore, had to be prepared for analysis by drying between bibulous paper, and then over H_2SO_4 or at 100°, according as I wished to determine the percentage of water or not. A certain amount of HCl from the acid solutions, therefore, adhering to the crystals, made the Cl determinations as a rule high. Still the results approximate sufficiently, these circumstances being taken into consideration, to the formulæ given, to show that several distinct compounds are here formed. My first crystallisation consisted of brownish-red octahedra, which when analysed gave in three Cl determinations 42·13 per cent, 42·07 per cent, and 42·09 per cent Cl, showing them

to be simple $IrCl_4(KCl)_2$, of which the percentage of Cl is 42·08 per cent.

I next got a crystallisation of fine sharply-formed monoclinic crystals of a reddish-brown colour, which I think the analyses, although not perfectly conclusive, still go to show to be a new compound. Several different crystallisations of it were analysed. It could not always be entirely separated from the slight crust of decomposed KCl which separated out along with and among the crystals.

Preparation No. 1.—Large well-formed crystals, with but very little foreign matter adhering to the sides.

0·1567 grm. dried over H_2SO_4 lost by heating to 100° 0·0170 grm. = 10·85 per cent:
gave 0·0525 grm. metallic iridium = 33·50 per cent:
gave also 0·2275 grm. AgCl = 0·0563 grm. Cl = 35·92 per cent.

0·1610 grm. dried over H_2SO_4 lost by heating to 100° 0·0172 grm. = 10·68 per cent:
gave – Ir determination accidentally spoiled:
gave also 0·2320 grm. AgCl = 0.0574 grm. Cl = 35·65 per cent.

This we see at once cannot be any chloride of iridium and potassium. Its luminous flame, too, when burned, shows the same. Nor do the percentages agree with the simple potassic-ethylen iridium protochloride—

$$IrCl_2C_2H_4KCl+2H_2O,$$

where the Ir = 48·45 per cent and Cl = 26·19 per cent.

If we reckon out the ratio of iridium to chlorine, we find it as 1 : 6, showing it to be an iridium chloride compound. The large per cent of loss on heating, the small Ir. and Cl per cents, when compared with double iridium and potassic chloride, and the luminous flame when burned, all go to show that an organic constituent must make the additional per cent. If we suppose now ethylen to enter here into the union with iridium chloride, hanging itself on, we can expect from the consideration of analogous compounds that 2 atoms of the bivalent radical C_2H_4 would join the atom $PtCl_4$.

We would have on this supposition the formula

$$IrCl_4(C_2H_4)_2(KCl)_2+\chi H_2O.$$

Now this formula with 3 atoms H_2O gives Ir = 32·93 per cent, Cl = 35·61 per cent, and with 2 atoms H_2O, Ir = 33·95 per cent, Cl = 36·71 per cent; anhydrous it gives Ir = 36·20 per cent and Cl = 39·14 per cent.

The large per cent of loss at 100° is not accounted for by $3H_2O$, which give only 9·03 per cent; but it is possible that in a compound where the organic constituent is so loosely connected with the rest, as must be the case here, a partial decomposition of the salt enters at 100° already.

In another preparation, also well crystallised, 0·1822 grm. dried at 100°:
gave 0·0678 grm. metallic iridium = 37·21 per cent;
gave also 0·3063 grm. AgCl = 0·0758 grm. Cl = 41·59 per cent.

In another preparation, indistinctly crystallised, 0·0502 grm. dried at 100°:
gave 0·0172 grm. metallic iridium = 34·26 per cent.
(Probably low from HCl mechanically admixed.)

In another preparation, also indistinctly crystallised, 0·3207 grm. dried at 100°:
gave 0·2125 grm. AgCl = 0·1268 grm. Cl = 39·53 per cent.

It will thus be seen the determinations, all things considered, agree close enough with the theoretical per cents of the formula to make it very probable. The want of enough sufficiently-well crystallised material prevented me from making an organic combustion which might settle it definitely.

Several individual crystals of the first crystallisation were very sharply and clearly formed, and I subjected them to examination under the microscope with a power of about 50 diameters. The faces were clearly to be made out. They belong to the monoclinic system, and their prevailing habitus in crystallisation is a combination of the two lateral pinacoids with positive and negative pyramids accompanied by one macrodome on the ends. The faces observed in an examination of five distinct crystals were (according to Naumann)—

$$\infty P\infty.\infty P\bar{\infty}+P.-P.+\tfrac{1}{2}P.-\tfrac{1}{2}P.+P_\infty.-P_\infty.$$

In considering the compounds of the iridium base with NH_4Cl, we find again a mixture of crystallised salts.

Preparation No. 1 consisted of sharply crystallised needles that looked almost black, and only by transmitted light showed a brownish-green colour. They were also monoclinic.

On analysis they prove, I think, to be the sought-for ethylen-iridium compound.

0·0713 grm. dried over H_2SO_4 lost on heating to 100° 0·0029 = 4·07 per cent:
gave 0·0850 grm. AgCl = 0·0210 grm. Cl = 29·49 per cent or 30·74 per cent of salt dried at 100°.

The iridium determination was made with magnesium, and was inaccurate as before.

The formula $IrCl_2C_2H_4NH_4Cl+H_2O=367·5$ demands Cl = 28·98 per cent, H_2O=4·89, or anhydrous 30·47 per cent Cl.

Preparation No. 2 was of much smaller needles and of lighter colour.

Analyses show it to be of very similar composition to the potassium salt described above.

0·1207 grm. dried at 100° C:
gave 0·049 5 grm. metallic Ir.=41·97 per cent:
gave also 0·2068 grm. AgCl=0·0512 grm. Cl=43·37 per cent.

$IrCl_4(C_2H_4)_2(NH_4Cl)_2$ = 0·502 gives Ir = 39·25 per cent and Cl = 42·43 per cent, and supposing it to lose some of the C_2H_4 at 100°, as stated above,

$$IrCl_4(C_2H_4)(NH_4Cl)_2$$

would give Ir = 41·50 per cent and Cl = 44·94 per cent.

The other two preparations of the ammonium salt analysed appeared under the lens to be mixtures of the iridium protochloride-ethylen salt and the iridium chloride-ethylen salt given above.

The results were—

0·1322 grm. dried at 100°:
gave 0·0609 grm. metallic iridium = 46·07 per cent.

0·1715 grm. dried at 100°:
gave 0·0784 grm. metallic iridium = 46·95 per cent.

$IrCl_2(C_2H_4)(NH_4Cl)+H_2O$ gives Ir = 39·25 per cent.

$IrCl_4\ (Cl_2H_4)_2\ (NH_4Cl)_2$ gives Ir = 23·61 per cent.

The existence of the base $IrCl_4(C_2H_4)_2$ I hope to settle definitely by renewed analyses of larger quantities.

While engaged with the preparation of the ethylen and iridium compound, the thought of the possibility of acetylen (C_2H_2) uniting with $PtCl_2$ or $IrCl_2$ led me to make some experiments in that direction. After a number of endeavours to form a platinum salt and analyses of the products (a detailed account of which is given in the original paper), I obtained negative results only. The existence of such a salt is highly improbable.—*American Journal of Science.*

ON A NEW FORM OF GAS APPARATUS.

By JOHN PARRY.

Having occasion to make daily analyses of the gases from the blast-furnace, finding the method of Bunsen very slow and tedious, and that Frankland and Ward's apparatus —though giving correct results — was unsuitable for daily use in the laboratory, I have designed the apparatus of which I enclose a sketch.

The measuring or gas tube, A, is enclosed in a glass cylinder filled with water, and dips into the mercury trough, B. The absorbing and eudiometer-tube, C, is connected with A by well-fitting elastic tubing of double thickness, firmly wired to the capillary glass tubing shown in the sketch.

The use of this apparatus hardly requires to be described. By alternately raising and lowering the mercury reservoir, R, both A and C are filled. The gas for analysis being then bubbled up into A, and measured with the usual precaution.

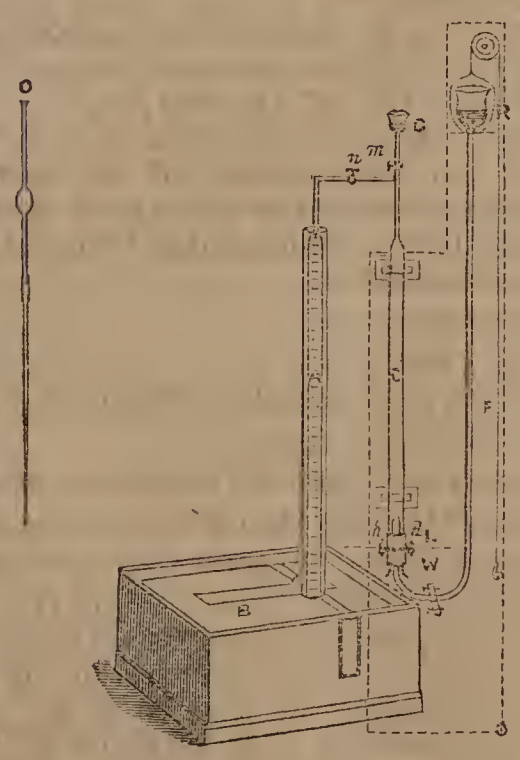
The liquid absorbent required is poured into the cup, G; R is lowered, M opened, thus drawing the test into C, a little being left in the cup to prevent admission of air.

The trap, N, is now opened, and the gas drawn into C; both M and N are to be kept closed while the gas is being subjected to the action of the absorbent. The latter must always be run into C as described, or it is drawn into the measuring-tube.

To clean C the gas is passed back into A, N is closed, and M opened, B lowered, and the mercury and absorbent allowed to flow out to about the level of L (see dotted line).

Unscrewing the nuts H and D, the lower part, W, is taken out, the test, &c., falling into a large basin placed under. While the mercury, &c., is falling down the tube C; water must be poured into the cup, G, for washing out traces of the absorbent.

The eudiometer-tube, C, is well washed with pure water, with the pipette, O (which consists only of an ordinary pipette joined to a long glass tube by a short piece of elastic tubing); it is evident the long tube may thus be conveniently passed up C, and the water blown through and up C, flowing down the sides of the tube into the basin.



The part W is made of iron or steel of the form shown, a plug of caoutchouc is firmly cemented into the short iron tube; the platina wires for explosions insulated in glass tubing, also the glass tube (wired to the elastic tubing, F, by which the reservoir, R, is raised and lowered) are passed air-tight through the caoutchouc plug.

The flanges, &c., W and L, should be well made with smooth true surfaces; a washer of caoutchouc is placed between the flanges, also the end of C presses down on the plug when the nuts H and D are screwed down.

The writer has used this apparatus for some time with very satisfactory results.

Analyses are rapidly and conveniently done; explosions are accomplished without difficulty, with far less trouble and risk than with the ordinary eudiometer; the gas for explosion may be expanded to any required extent by lowering R, and any risk of bursting C is thus entirely obviated.

Water may be substituted for mercury in the trough, B, but, of course, with less accurate results.

The eudiometer, C, may be supported by clamps attached to a long iron rod, and R raised or lowered by a pulley.

The writer attaches the eudiometer to a board to which a pulley is fixed, as shown by the dotted lines.

I am also much indebted to my assistant, Mr. James Needham, for his aid in arranging the details of the apparatus.

ANCIENT JEWISH GLASS.

By DUGALD CAMPBELL, F.C.S.

Having recently analysed some ancient glass which I obtained from Mr. Bessant, secretary to the "Palestine Exploration Fund," and which, that gentleman writes, "Is all from shafts *round the Temple*, and found at depths varying from 20 to 80 feet," and as its history is truly interesting and its composition is somewhat curious, an analysis, I trust, may not be considered out of place in your valuable journal.

The sample of glass furnished me weighed altogether about 3 ounces, and consisted of a number of small pieces, many of which in parts had undergone a change both in structure and colour by time and exposure.

The portion selected for analysis was from pieces which appeared to me to have undergone the least if any change, and the results were as follows, in 100 parts:—

Silica	69·30
Lime	8·50
Magnesia	0·55
Soda	13·79
Potash	1·49
Alumina	3·20
Oxide of iron (FeO_3)	2·00
Oxide of antimony	0·29
Oxide of lead	trace
Phosphoric acid	0·80
Loss in analysis	0·08

The specific gravity of the glass is 2·430.

7, Quality Court, Chancery Lane, London,
December 11, 1871.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 7th, 1871.

Professor Frankland, F.R.S., President, in the Chair.

When the minutes of the Society had been read and confirmed, Mr. James L. Shuter was formally admitted a member, and the President announced that Mr. Gassiot had presented to the Society a greatly enlarged photograph of Daniell and Faraday.

The names of the following gentlemen were read for the first time:—Julian Louis Vanderstraaten, John Millar Thompson, Charles W. Vincent, Robert Barton, David Watson, William Thompson, William Forster, Henry James Helm, Thomas W. Fletcher, George Thomas Glover, and Thomas Eltoft.

For the third time—Charles Thomas, Benjamin Tanner, Hugh Paterson, Frederick Hicks, George Joseph Warner, Samuel William Moore, William John Wilson, William Gray, Robert Irvine, Reginald C. Woodcock, and Donald Munroe. After a ballot had been taken, these gentlemen were declared by the President to be duly elected.

Dr. J. H. Gladstone, F.R.S., then read a paper "*On Essential Oils*," Part II. The following is a short

abstract of this valuable and laborious communication, which is the continuation of one laid before the Society eight years ago. The first group of oils described includes —(1). That of citrin from the leaves of the lemon tree, which consists principally of a liquid boiling at 166° to 168°, sp. gr. 0·8459; refractive index for the line A 1·4680, and dispersion 0·273. (2). Lign aloes: a colourless oil having a pleasant odour, the greater part of which comes over at about 200°. (3). Pimento, from the seeds of *Myrtus pimento*, the greater portion of which distils at 243°, and is found to be entirely soluble in potash solution. It has a sp. gr. of 1·0436, refractive index for A 1·5281; dispersion about 0·416; and in other respects agrees with eugenic acid, so that the oil of pimento seems to differ from oil of cloves only in the hydrocarbon that is mixed with the eugenic acid. (4). Oil of Villvert, which is composed chiefly of an oil boiling at 280° to 283°; the action of sodium, however, showed that this was not homogeneous, but a mixture of two bodies.

The hydrocarbons from essential oils may be divided into three polymeric groups having the general formulæ $C_{10}H_{16}$, $C_{15}H_{24}$, and $C_{20}H_{32}$. The first group, $C_{10}H_{16}$, represents the greater number of these hydrocarbons, turpentine, orange, carraway, and more than twenty others. The second, $C_{15}H_{24}$, those from cloves, rosewood, cubebs, calamus, cascarilla, and patchouli, whilst the third is represented by colophene. That there is a broad line of demarcation between these three groups may be seen by comparing their physical properties set down in the following table, which also shows that the middle group is intermediate in its properties between the C_{10} and the C_{20} groups:—

	I.	II.	III.
Formula	$C_{10}H_{16}$	$C_{15}H_{24}$	$C_{20}H_{32}$
Vapour density.. ..	4·7	7·1	—
Specific gravity ..	0·846—0·880	0·904—0·927	0·939
Refractive index for A	1·457—1·467	1·488—1·497	1·5084
Dispersion..	about 0·027	about 0·029	0·031
Sensitiveness	about 48	about 43	41
Boiling-point	160°—176°	249°—260°	315°

Many of the essential oils are mixtures of a hydrocarbon with a compound containing oxygen, of which but few have hitherto been carefully examined. Those obtained from citronella and from wormwood the author calls citronellole and absinthole respectively: they both have the composition $C_{10}H_{16}O$, the most remarkable point of difference between them being in their refraction equivalents; that of absinthole being 74·5, which agrees closely with the theoretical for $C_{10}H_{16}O$, while citronellole has 79·3 or 79·8 for its equivalent, a discrepancy almost the same as that found throughout the great phenyl group. Besides these he has examined cajeputole from oil of cajeput, and also the two carvoles from oil of carraway and oil of dill. These appear to be identical and not merely isomeric, and are remarkable for forming a crystalline compound with sulphuretted hydrogen having the composition $(C_{10}H_{14}O)_2H_2S$. The physical properties of menthole from spear mint, myristicole from nutmeg, and hydride of cumanyl from cassia, have likewise been examined; the latter has the enormous refraction of 1·6045 for the line A, and its refraction equivalent is also very abnormal.

The President said that the paper which Dr. Gladstone had communicated to the Society was one of great importance, since these physical qualities were facts which would remain unalterable however much our views as to the theory of their constitution might change, and although no one admired this class of investigation more than he did, he might also be allowed to speak a word in favour of certain chemical reactions which might, perhaps, enable us to relegate these hydrocarbons to their proper families, such as the action of chlorine or bromine on them. He should like to elicit from the author if he had tried any such reaction, so as to distinguish, for example, whether they were hydrides or radicals.

Dr. Gladstone said that bromine and chloride derivatives had been prepared, but that, in the cases he had tried, the result had been unsatisfactory.

Dr. Wright asked whether his researches had led the author to consider the hydrocarbons as isomeric in the same way that the butylic hydrides are, or was it possible that many of these hydrocarbons might be identical, the difference in their properties being due to accidental impurities.

Dr. Gladstone replied that these oils were distinguished in some cases chiefly by their optical properties, and in others by their odour; citronellole was distinguished from absinthole by the former, having a considerably higher refractive equivalent than the theoretical, like that found in compounds throughout the great phenyl group; and again, the carvol from dill and the carvol from carraway were considered to be identical and not isomeric, from having the same odour; the same might be said of the eugenic acid from pimento and from cloves; identity of odour alone, however, is not sufficient to establish the identity of the hydrocarbons.

Dr. Wright suggested that the odour might be due to a chemical change which the substance undergoes in the presence of oxygen and in contact with the mucous membrane of the nose. It was well-known that hydrocarbons which had been recently distilled over sodium had a less powerful odour than they had after being exposed for some time to the air.

Professor A. H. Church would like to refer to the very interesting sulphur compound, $(C_{10}H_{14}O)_2H_2S$, in which an oxidised oil was united with sulphuretted hydrogen. Some eight or nine years ago he had described tasmanite, a resin found in a shale from Tasmania, which contained oxygen and sulphur in the same relative proportions as the above-mentioned compound. This resin, when treated with sulphuric acid, evolved sulphuretted hydrogen, so that the sulphur was in organic union with it, and not like the sulphur found in coal. In another fossil resin, dysodile, which he had examined the sulphur and oxygen only approximated to that ratio, but then it was not pure.

Dr. H. E. Armstrong then read a paper entitled "*Observations on Nitrochlorophenols*," No. III. This communication comprises the experiments made to discover the relation between the dinitrochlorophenol melting at 110° to 111° and its isomers and the nitrodichlorophenols. For this purpose the author first converted dinitrophenol into dinitrochlorophenol by treating it with chlorine in the presence of antimony pentachloride. The compound melts at 110° to 111°, and is identical in every respect with that obtained by the nitration of dichlorophenolparasulphonic acid. The nitro-componnd was converted into the amidonitrochlorophenol in the usual way; this crystallises in long slender brass-yellow needles, which lose their water of crystallisation at 100° and melt at 140°. The chlorination of the orthonitrophenol was effected by the direct action of chlorine, but the product was somewhat difficult to purify. When this is done, however, the chloronitrophenol crystallises in white silky needles, which melt at 109° to 110°, and would seem to be identical with that obtained by Faust from dinitrochlorophenol. By the action of fuming sulphuric acid on dichlorophenol an acid was obtained, the potassium salt of which, when treated with nitric acid, gave a dinitrochlorophenol melting at 103°, apparently identical with that obtained by Stenhouse, by the action of chloride of iodine on picric acid; in most of its properties it bears a very strong resemblance to the isomeric phenol melting at 110°, the great difference being that all the salts of the former are orange-red, whilst those of the latter are yellow.

In reply to an observation of the President, Dr. Armstrong illustrated the possible constitution of some of the nitrochlorophenols according to Kekulé's view of the structure of benzol.

The meeting was then adjourned until Thursday, December 21.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 28th, 1871.

J. P. Joule, D.C.L., LL.D., F.R.S., Vice-President, in the Chair.

Mr. Richard Samuel Dale, B.A., was elected an Ordinary Member of the Society.

"*Encke's Comet, and the Supposed Resisting Medium*," by Professor W. Stanley Jevons, M.A.

The observed regular diminution of period of Encke's comet is still, I believe, an unexplained phenomenon for which it is necessary to invent a special hypothesis, a *Deus ex machina*, in the shape of an imaginary resisting medium. I cannot be sure that the suggestion I am about to make has not already been made, but I have never happened to meet with it; and therefore I venture to point out how it seems likely that the retardation of the comet may be reconciled with known physical laws.

It is asserted by Mr. R. A. Proctor, Professor Osborne Reynolds, and possibly others, that comets owe many of their peculiar phenomena to electric action. I need not enter upon any conjectures as to the exact nature of the electric disturbance, and I do not adopt any one theory of cometary constitution more than another. I merely point out that if the approach of a comet to the sun causes the development of electricity arising from the comet's motion, a certain resistance is at once accounted for. Wherever there is an electric current some heat will be produced and sooner or later radiated into space, so that the comet in each revolution will lose a small portion of its total energy. In the experiments of Arago, Joule, and Foucault the conversion of mechanical energy into heat by the motion of a metallic body in the neighbourhood of a magnet was made perfectly manifest. If then there is any magnetic relation whatever between the sun and comet, the latter will certainly experience resistance.

The question is thus resolved into one concerning the probability that a comet would experience electric disturbance in approaching the sun. On this point we have the evidence now existing that there is a close magnetic relation between the sun and planets. If, as is generally believed, the sun-spot periods depend on the motions of the planets, a small fraction of the planetary energy must be expended. I find, indeed, that a very brief remark to this effect was given in the memoir of the original discoverers of the relation, namely—Messrs. Warren de la Rue, Balfour Stewart, and B. Loewy. At p. 45 of their "Researches on Solar Physics" they add a small note to the following effect:—It is, however, a possible enquiry whether these phenomena do not imply a certain loss of motion in the influencing planets." As I conceive, no doubt can exist that periodic disturbances depending upon the motions of bodies must cause a certain dissipation of their energy, for if stationary the constant radiation of the sun could not produce any periodic changes, unless the sun were itself variable. Is there not, then, a reasonable probability that the light of the aurora represents an almost infinitesimal fraction of the earth's energy, and that in like manner the light of Encke's comet represents a far larger fraction of its energy? It is also worthy of notice that the tail of a comet is usually developed most largely at those parts of its orbit where the rate of approach or recess is most rapid, and where the electric disturbance would be correspondingly intense.

I do not, of course, deny that the resisting medium may nevertheless exist, or may by other observations or experiments be made manifest. But I hold that so long as other physical causes can be pointed out which might produce the same effect, it is quite unphilosophical to resort to a special hypothesis. Encke's comet ought not to be quoted as evidence of the existence of such a medium until electric disturbance is shown by calculation to be insufficient to account for the observed diminution of period.

"*On Cometary Phenomena*," by Professor Osborne Reynolds, M.A.

In all comets which have been observed through powerful telescopes there is an action going on which appears to be the result of evaporation. Jets of something like vapour are seen to issue from what is supposed to be a solid nucleus on that side which is towards the sun.

No such signs of evaporation are observed on the planets, nor is there any phenomenon that we are aware of which can be compared with this taking place on our earth. At first sight it seems strange that the sun should act to more effect on such small bodies as comets than it does on the larger bodies, even when the latter are nearer to it than the former. When, however, we come to look closer, I think good reason may be given for this; and I think that the difference of evaporation on the earth and on a comet may probably be the cause of electrical phenomena existing on the latter which certainly do not exist on the earth, and that the relation between the motion of the comet and the evaporation which might be expected to take place is precisely that which is observed between the motion and those appearances which I would explain on an electrical hypothesis.

The first thing to be done is to take notice of the following facts:—

(1.) Comets move in very eccentric orbits, whereas the planets move in orbits nearly circular.

(2.) Comets are supposed to be much smaller than the planets.

(3.) All the heat received by a body from the sun must be expended in one or other of the following ways:—

I. By radiation from the body.

II. By evaporating the materials.

III. Producing chemical change in these materials, or in electrical separation, &c.

That spent in the third method may be considered small. Thus the heat which a body receives = heat radiated + heat spent in evaporation (1).

and

$$\frac{\text{heat radiated}}{\text{heat received}} = (\text{some constant}) \times \frac{\text{temperature of body}}{(\text{distance of sun})^2} \quad (2).$$

Now, the temperature at which any given material, say water, would evaporate would be much lower on a comet than on a planet, on account of the comet being so much smaller. For we may assume that there is a limit to the pressure which an atmosphere of vapour of unlimited extent can exert on the materials of the body it envelopes; then the limit of the temperature of the body will be that which will evaporate the material of the body under this pressure. It is clear that if there be such a limit it must increase very rapidly with the mass of the solid body, and hence that it would be much higher in the case of a planet than in that of a comet. This temperature may be called that of permanent evaporation, for as long as it was maintained the body would continue to evaporate; therefore the temperature of permanent evaporation of the planet would be much greater than that of the comet. That is, from equation (2.) the ratio of the heat radiated away to that received would be much less in the case of the comet than in the case of the planet, leaving, by equation (1,) a greater ratio for evaporation in the former than in the latter.

Now it is clear that our earth is well out of reach of this permanent evaporation; for the temperature at the equator is much less than 212° F., which is the boiling-point of water, its most volatile substance; and we may assume that the same is the case with all the other planets. If, however, the earth's atmosphere were removed, then evaporation would go on until there was another atmosphere formed which would hold the liquid in check. If, however, the earth had no attraction for vapour, or only a very slight one, then it would go on evaporating, in the

first place, until all the water was ice, and then it would spend all the heat it got from the sun in vapour. This, according to Sir J. Herschel's rate, is sufficient to melt ice just enough to reduce the diameter of the earth by an inch in about 4½ hours, and if it had to evaporate the water as well as melt the ice it would evaporate about 1 inch in 130 hours. Now, although this is a purely imaginary condition with regard to the earth, yet it must exist in the case of a small body like a comet, that is to say, there would be no liquid on the comet even when evaporation was going on, and, when the comet was near enough the sun, permanent evaporation would go on, which would only be ended by the comet removing itself, or by the exhaustion of the volatile material. This latter would take place supposing a comet should change its orbit, when near the sun, into a circular orbit, like a planet or meteorite. Even in the case of a periodic comet, there must be some exhaustion of the volatile materials. During the two hours in which the comet of 1843 was within close approximation to the sun, if the comet had been made of ice covered with lamp-black it would have received the heat of 47,000 suns according to Sir J. Herschel's computation. This would have evaporated the ice at the rate of 55 feet per hour on that side next the sun, or 13 feet over the whole comet. But in fact, owing to the protection of its atmosphere and imperfect absorbing power, it would have been much less than this, that is to say, the diameter of the comet would not have been reduced 10 feet. However, it may be that all the material evaporated is not lost. For, from the way in which comets approach and recede from the sun, it is probable that part of their orbit lies without, and part within, the range of permanent evaporation. Hence during part of their motion, when they are distant from the sun, condensation will be going on if there is anything to condense. This agrees well with the observed fact that a periodic comet makes less and less display each revolution. There the heat acts on the surface of the comet so that the less volatile substances would form a skin over the softer ones, through which the heat would have to pass, and through which the steam would have to force its way in jets.

Now such jets as these would act the same part as the jets in Armstrong's hydro-electrical machine, and the vapour which emerged would be charged with either positive or negative electricity, as the case might be, the solid being charged with electricity of the opposite kind.

The vapour, as it formed an atmosphere round the nucleus, would then discharge some of the electricity back. This would cause those portions which were nearest the nucleus to be bright (self-luminous), brighter than the more distant. Although the variations in temperature would be slight, yet as the atmosphere moved outwards from the nucleus there would be expansion, and consequently condensation; hence the outside of the coma might be illuminated by the direct rays of the sun, or we might have several bands of condensed vapour so illuminated, as suggested by Sir J. Herschel. On the other hand, I think this illumination may be due, at least in part, to the electric action between the matter of the comet and matter previously in space. This point will probably be settled by Mr. Huggins when the next large comet makes its appearance.

The period of greatest display is not reached till after the comet has passed its perihelion, and the tail is visible for much longer after this than it was before it. Now, if we suppose the comet to be made up of hard and volatile substances, owing to the heat absorbed by the hard substances the evaporation would lag somewhat behind the position of the comet, and consequently be greatest after it had passed its perihelion distance, just as a thick retort will continue to boil after the lamp has been removed. Hence we see that, if the evaporation causes electrical separation in the comet, this will be at its maximum just when the display is observed to be at a maximum.

This communication is not intended as an alteration of the views which I expressed in a former communication, but as an extension of those views, for I formerly advanced no hypothesis as to the possible cause of the electricity. Also, with regard to the formation of tails, I wish to add somewhat to my former remarks. Professor Norton has shown that the primary tail of Donati's comet might have been formed by matter emitted by the comet, and repelled by the sun with a force equal to from 0·75 to 0·55, the attraction of the sun for ordinary matter; the matter repelled with 0·55 forming the following edge, that with 0·75 the leading edge of this tail. Professor Norton suggests that these forces may be electrical or magnetic.

Accepting Professor Norton's calculations as correct, it is certain that if, for some cause or other, the sun repelled negative electricity, and there were two streams of electrified matter leaving the comet, charged in the ratio of 0.75 to 0·55, these would be repelled in the ratio he wants; at the same time I do not think he has sufficiently taken into account the repulsion one stream would have on the other.

Professor Norton does not suggest an explanation of the straight tails seen with most comets as primary or secondary tails. These I maintain can only be explained on the supposition that there is matter in space in the form of gas, and that the comet causes it to be electrically illuminated by a brush, as I stated in my former communication.

Again, if the tail of the comet be electricity of one kind (say negative), leaving the comet never to return, then the comet must leave the neighbourhood of the sun with a charge of positive electricity, which, as it gets further from the sun and evaporation becomes feeble, will in time overpower the negative electricity in the atmosphere, which will then be attracted by the sun instead of repelled, and if the comet has any tail it will now turn away from the sun; in which condition it will probably remain until its approach to our sun, or some other star, again cause it to become negative and turn round. In this case a periodic comet would turn its tail round at definite points in its orbit, and, owing to the lagging of the symmetry of the comet's appearance in its orbit, the point of turning will be nearer to the sun on its return than on its departure. Now it seems, from a remark of Professor Airy, that comets, when first seen, often have their tails before them, and that such is the case with Encke's comet now visible.

GLASGOW PHILOSOPHICAL SOCIETY.
(Chemical Section).

Ordinary Meeting, December 4th, 1871.

Dr. Wallace, F.R.S.E., in the Chair.

Dr. John Clark read a paper on "*The Analysis of Chrome Ores, and a New Method of Estimating the Oxide of Chromium.*" He first referred to the discrepancies which Dr. Genth, in 1862, had noticed between his own analyses of such ores and those of English chemists. Discordant results still exist, and the consumers of chrome ore complain that in the manufacture of bichromate of potash there is a loss of oxide of chromium which they can only account for on the supposition that the chemist reports too high a result. Such complaints are not altogether unfounded, and the author considered that, while some discrepancies may be due to differences in the samples, the greater number must be due to the inexperience of the analysts and to the difficulty of obtaining correct results by the ordinary methods of analysis. Dr. Genth recognised the impossibility of obtaining, by washing alone, an oxide of chromium precipitate perfectly free from alkali after fusing the ore with bisulphate of potash, and he recommended that, before weighing, the ignited precipitate should be boiled with water containing

sulphurous acid to reduce the chromate which had been formed, and that the resulting oxide should be precipitated with ammonia. By this means the weight of the precipitate of oxide of chromium is greatly reduced.

Dr. Clark said he had never obtained a perfectly pure oxide by this method, and instead of boiling with water containing sulphurous acid, he had been in the habit of using dilute acetic acid, and estimating chromic acid thus removed with the diluted solution of the double sulphate of ammonium and iron of known strength. The oxide of chromium, in the form of chromate, usually amounts, even in the most carefully washed precipitates, to 0·76 per cent. The author referred to the process of M. Clouet, manufacturer of bichromate of potash, Havre, as one which gives very good results. This consists in fusing pulverised chrome ore with from five to six times its weight of pure carbonate of soda in a platinum crucible for five or six hours at a bright red heat, without the addition of any oxidising agent, reducing the purified chromic acid formed with alcohol in presence of hydrochloric acid, and precipitating the oxide of chromium with ammonia. But although this process yields the correct amount of oxide of chromium, it is not well adapted for the laboratory on account of the length of time required for the complete oxidation of the oxide of chromium in the ore.

Dr. Clark stated that perfectly accurate results might be obtained by the following process, which is both simple and expeditious :—25 grains of the finely-pulverised ore are intimately mixed with 5 parts of hydrate of sodium and 3 parts of calcined magnesia, and the mixture is exposed in a platinum crucible in a Bunsen flame for ¾ of an hour, with the lid on. Oxidation at once takes place under the influence of the hydrate of sodium and magnesia, and it is practically complete in less than an hour. The crucible with its contents is then placed in a basin containing water, the contents being washed out with water as far as possible, and the operation completed by using dilute sulphuric acid quite free from nitric acid. An additional quantity of dilute sulphuric acid is added and then the whole is heated. Everything will dissolve, except, perhaps, a few flakes of silica. To the clear yellow solution is added a weighed quantity of double sulphate of iron and ammonium of known strength, and more than is sufficient for the reduction of the chromic acid. The excess of unoxidised iron is then estimated with a weak standard solution of bichromate of potash, and the amount of oxide of chromium in the ore calculated from the quantity of iron oxidised. The results obtained by Dr. Clark by the process now described seldom vary 0·2 per cent. The process has been submitted to a number of chemists, including the Director of the School of Mines in St. Petersburg, who has not only expressed a very favourable opinion of it, but who has also adopted it in the testing of the Russian ores.

Dr. Clark gave a brief digest of M. Clouet's paper (*Annales de Chim. et Phys.*), and stated that he had never been able by Clouet's process to remove the alumina completely soluble in water by fusion with carbonate of sodium, and that he had always found a considerable proportion of the alumina in the precipitate, which M. Clouet regards as pure oxide of iron. He also stated that in the many analyses which he had made of chrome ores he had never found the composition to agree with any of the formulæ given by M. Clouet; still he did not say that the protoxide of iron and the sesquioxide of chromium did not exist in definite proportions. However, if they did exist in definite proportions, it must be necessary to frame other formulæ to represent the relationship of the two compounds in addition to those mentioned by M. Clouet.

A short discussion followed in which Dr. Wallace and Dr. Thorpe took part, the former referring to the isomorphous character of magnesia and protoxide of iron, and the sesquioxides of chromium and iron, as a circumstance which might not have been observed by Clouet in his analyses and in framing his formulæ.

Dr. T. E. Thorpe, F.R.S.E. made a short oral communication on "*A Method of Taking Specific Gravities.*" He exhibited and described an exceedingly neat and ingenious apparatus which he had devised for taking the specific gravities of certain volatile compounds, more especially the oxychlorides, such as—

$$POCl_3,\ VOCl_3,\ PSCl_3,\ CrO_2Cl_2,\ SO_2Cl_2.$$

By means of the apparatus Dr. Thorpe stated that he had been able to obtain the following results in respect of oxychloride of phosphorus, taking three operations :—7·47062, 7·47014, and 7·47019; while oxychloride of vanadium gave the following results :—8·06408, 8·06381, and 8·06450. He explained that the instrument might, with more or less structural modification, be applied to other uses, such, for instance, as determining expansion coefficients; as a pipette for brominating hydrocarbons, and as a specific gravity where volatile hydrocarbons are concerned.

The apparatus excited much interest among the members, and was greatly admired on account of its ingenious arrangements.

CORRESPONDENCE.

SMOKE DRAINAGE.

To the Editor of the Chemical News.

Sir,—I have to thank you for naming the fact that the suggestion of the Rev. B. W. Gibsone is merely a repetition of that of which I gave a detailed statement with all the data needful for proving its practicability in the paper read before Manchester Literary and Philosophical Society, and published by me in 1857. A copy of this pamphlet I shall be most happy to transmit to Mr. Gibsone on his furnishing me with his address. I am sorry I missed seeing his letter in the *Times*, else I should have referred to it sooner. I beg, however, to demur most decidedly to your statement that I had found difficulty in obtaining sufficient draught, &c, to effect the object.

Where the matter has been at all attempted, I believe there has been no difficulty of the sort found to exist, and, had Mr. Waterhouse's design for the new Law Courts been adopted, as I believe it ought, you would have had the scheme in its integrity carried out in that building with 1000 fires and ventilating flues turned into the sewerage below, and carried up in one shaft 300 feet high. Anyone who will go over the calculations in my pamphlet will see that the only practical difficulty is the expense of re-constructing our flues and sewerage. I may say that the strong language I used in 1857 against the London sewage scheme then only contemplated, I fully endorse now it is completed.—I am, &c.,

Peter Spence.

Pendleton Alum Works, Manchester,
December 11, 1871.

MISCELLANEOUS.

The Rupture of Iron Wire by a Blow.—At the last meeting of the Manchester Literary and Philosophical Society, Mr. John Hopkinson, B.A., D.Sc.. detailed some experiments on this subject, the results of which are—1st. That if any physical cause increase the tenacity of wire, but increase the product of its elasticity and linear density in a more than duplicate ratio, it will render it more liable to break under a blow. 2nd. That the breaking of wire under a blow depends intimately on the length of the wire, its support, and the method of applying the blow. 3rd. That in cases such as surges on chains, &c., the effect depends more on the velocity than on the momentum or *vis viva* of the surge. 4th. That it is very rash to generalise from observations on the breaking of structures by a blow in one case to others even nearly allied, without carefully considering all the details.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, November 13, 1871.

This number opens with a brief but well deserved eulogium on the late illustrious Sir Roderick Impey Murchison, who was one of the Foreign Associates of this eminent scientific institution. Due honour is done to the memory of the celebrated deceased *savant* by his eminent *confrère*, the eloquent M. Dumas.

This number contains, in addition to several papers relating strictly to other departments of science, the following papers relating to chemistry:—

Thermal Researches Relating to Crystalline Dissociation.—P. A. Favre and C. A. Valson.—The contents of this very lengthy essay are not suited for useful reproduction, owing to the fact that it would require the reproduction of a very lengthy series of tabulated forms exhibiting results of experiments.

Salant.—E. P. Bérard.—Under the name of salant, also *salan* and *salobré*, is understood, in those Departments of France which border on the Mediterranean, a light saline crust found on the soil of certain portions of the localities alluded to, which soil is almost entirely sterile and unfit for any plants to grow on. The author has made some researches on this matter, and paid more particular attention to the alluvial deposit met with near Agde (Département de l'Hérault). It appears that this *salan* is chiefly composed of chloride of sodium and the sulphates of lime and magnesia. The contents of this paper are, however, chiefly of local interest only.

Formation of Precipitates.—Dr. Berthelot.—The continuation of the exhaustive essay on this subject, this portion treating on the separation between the acid and the base of the salts.

Most Economical Arrangement to be Given to Galvanic Elements in Reference to their Polar Electrodes.—Th. du Moncel.

November 20, 1871.

This number contains the following papers more especially relating to chemistry:—

Thermal Researches on Electrolysis.—P. A. Favre.—The continuation of this very lengthy and exhaustive essay.

Velocity of Sound in Sonorous Pipes.—J. Bourget.—An algebraico-physical essay; an observation also applicable to the following paper:—

Transversal Vibrations of Strings and Thin Laminæ.—E. Gripon.

New Phenomenon of Phosphorescence Produced by Frictional Electricity.—Dr. Alvergniat.—A vacuum is first made into glass tubes about 45 centimetres in length. After the introduction into these tubes of a small quantity of either chloride or bromide of silicium, the pressure inside these tubes having been reduced to 12 or 15 millims., the same are sealed by means of the glass-blower's lamp. When such tubes are next rubbed with a piece of silk, there appears inside the tubes a bright luminous flash, which exhibits a rose colour with the chloride, and a yellowish green colour with the bromide, of silicium. Only when a more perfect vacuum is made in these tubes the induction spark produces a luminous phenomenon in them when the spark passes through, but then the phosphorescence by friction entirely disappears.

Continuation of the Essay on the Formation of Precipitates.—Dr. Berthelot.—This portion treats on the change which occurs in the state of aggregation.

Conversion of Albuminoid Matters into Urea by the Action of Permanganate of Potassa.—E. Ritter.—The contents of this paper contain the record of a series of experiments made by the author simply with the view to ascertain whether the researches of Dr. Béchamp on this subject, which have been repeatedly (even very recently by Dr. O. Loew) contradicted and declared to be wrong, are or are not correct. The author of this paper states that, by correctly following the directions given by Dr. Béchamp, he (Dr. Ritter) has perfectly succeeded in converting albumen, fibrin, and gluten into urea, by the action of the salt alluded to, but the quantities of urea so obtained are very small, as may be inferred from the following data:—30 grms. of albumen yielded 0·09 grm. of urea; fibrin, 0·07 grm.; gluten, from 0·21 to 0·31 grm.

This number also contains several original papers relating to physical geography, geology, astronomy, meteorology, and natural history.

The American Journal of Science and Arts, November, 1871.

This number contains the following original papers relating to chemistry and collateral sciences:—

On Some Phenomena of Binocular Vision.—J. Leconte.—The sixth portion of this lengthy essay, illustrated by several woodcuts.

Variations of the Temperature of the Human Body.—Dr. B. F. Craig.—An important physiological paper, recording a series of experiments.

Precise Geographical Position of the Large Masses of Meteoric Iron in North Mexico, with the Description of a New Mass—the San Gregorio Meteorite.—J. Lawrence Smith.—In the introduction to this paper, the author relates what has become known about the meteorites of North Mexico by the labours of the Boundary Commission. The immense mass of meteoric iron—the San Gregorio meteorite—is situated on the western border of the Mexican desert. Its shape (illustrated by a woodcut in the original) bears some likeness to that of a blacksmith's anvil. Its greatest length is 6 feet 6 inches; it is 5 feet 6 inches high, and 4 feet thick at its base. On one part of its surface "1821" is cut with a chisel, and above this date is the following inscription:—"Solo dios con un poder este fierro destruerá, por que el en mondo non habra quien lo puedo deschacer" (Only gods can have the power to break up this mass of iron, for there is no body on earth who can break it to pieces). The weight of this mass is nearly 5 tons; it lies near to the spot where it hss fallen, but nothing is further known of its history. The author has examined a small detached specimen of this stone, which is of the softer meteoric iron (sp. gr. = 7·84). Chemical composition percentically:—Iron, 95·01; nickel, 4·22; cobalt, 0·51; copper, minute traces; phosphorus, 0·08. The Mexican desert has an extension of 400 miles from east to west, and 500 miles from north to south = an area of 200,000 square miles. The United Kingdom has an area of 121,518 square miles.

Iridium Compounds Analogous to Ethylen and Protochloride of Platinum Salts.—S. P. Sadtler.—Reproduced in present number.

The Paragenesis and Derivation of Copper and its Associates on Lake Superior.—R. Rumpelly.—The continuation of a lengthy essay on this subject.

Observations on the Colour of Fluorescent Solutions.—Dr. H. Morton.

As is usual, this number contains some excellent original papers relating to natural history, astronomy, geology, and botany.

Zeitschrift für Chemie von Beilstein, No. 12, 1871.

This number only contains the following original paper:—

On Dibromo-Benzol-Sulpho Acid.—A. Wölz.—In the introduction to this paper, the author briefly refers to the researches of Dr. R. D. Williams on this same subject (see Chemical News, vol. xxiv., p. 193), stating that the last-named author's results of experiments do not materially differ from those obtained by himself. The dibromo-benzol-sulpho acid fuses at between 97° and 98°. The following salts of this acid are briefly described:—Barium salt, $(C_6H_3Br_2SO_2O)_2Ba$, a beautiful crystalline substance, difficultly soluble in cold, readily so in hot, water; potassium salt—

$$C_6H_3Br_2SO_2OK+H_2O,$$

obtained by double decomposition from the baryta salt, is soluble in water and in alcohol; calcium salt, $(C_6H_3Br_2SO_2O)_2Ca+9H_2O$, a crystalline efflorescent salt, readily soluble in water and alcohol; lead salt, not very soluble in water; copper salt, a very rapidly efflorescing green-coloured salt, very soluble in water; ammonium salt—

$$C_6H_3Br_2SO_2ONH_4,$$

a needle-shaped crystalline salt, very soluble in water. The acid alluded to is isomeric, not identical, with that obtained many years ago by Schmitt.

Le Moniteur Scientifique Quesneville, Nos. 357 and 358 (double number), November 1 and 15, 1871.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Historical Notice on the Labours which have Led to the Synthesis of Indigotine.—A. Rosenstiehl.—We regret that the contents of this very excellent essay do not admit of any useful abstraction.

Constitution of Milk and of Blood.—Dr. J. Dumas.—This paper was read last summer at Genève, but it is impossible to give an abstract without detracting from the merits of the essay.

Observations on the Alteration of Well-Water by the Proximity of Burial-Grounds.—J. Lefort.—The contents of this paper bear more especially upon the effect of a decree, dated March 7, 1808, whereby it has been enjoined that no wells shall be bored or dug out at a less distance than 100 metres in all directions from any burial-ground. The author, having found that not only in many country villages but also in several towns this regulation has not been observed, has made some experiments on the water of a well at Saint Didier (Département de l'Allier). This locality is situated on an alluvial soil; this water is used for drinking purposes by the parish priest and a portion of the inhabitants, and, on examination, the author found it to contain not only a large proportion of ammoniacal salts but also, on evaporation, to leave a very large quantity of a dark-coloured organic matter mixed with carbonated salts, which, on being mixed with some hydrochloric acid, gave off an offensive carbonic acid gas, the smell being somewhat akin to a mixture of a concentrated solution of glue and butyric acid. The well is very deep, and the water is quite clear and bright, but exhibits, especially in summer time, a very vapid taste, while, in the warm season of the year, it rapidly becomes putrid. The author comes to the conclusion that, in any soil, a well dug at the

distance of 100 metres from either burial-grounds or battle-fields is quite useless to protect the water of even deep wells from becoming so contaminated with organic and other injurious matter as to make it imperatively necessary to make new and sound regulations on this subject, so as to avoid wells (for obtaining potable water for domestic use) being sunk without a stringent inquiry as to where the water comes from, and through what strata of soil it may have to pass.

Remarks on Dr. A. Taylor's Process for Detecting Blood Stains.—J. Lefort.—A medico-forensic essay of value.

Practical Instruction in Beet-Root Sugar Preparation.—Dr. Vivien.—An excellent and clearly written paper on the so-called boiling (really evaporation of water from a saccharine juice) of sugar.

Boiling of Food at a Temperature below 100°.—Dr. Jeannel.—The contents of this lengthy essay record the results of a series of experiments, from which it appears that food (meat as well as vegetables) boiled at 95° is more nutritious and of better flavour than when boiled at or above 100°. The author illustrates this point by what takes place in mountain localities (every 100 metres' rise above sea level make a difference of $\frac{1}{3}$° C. less in the boiling-point of water); as, for instance, at Potosi (Bolivia), at 4061 metres above sea level, and an average barometer reading of 454 m.m., the water boils at 86·2°; at Mexico, 2277 metres above sea level, 569 m.m. barometer, water boils at 92·1°; at Briançon (France), 1321 metres above sea level, 643 m.m. barometer, at 95·4°, as by the action of the so-called Norwegian cooking apparatus.

Les Mondes, December 7, 1871.

Mineral Riches of Japan.—M. Sévoz.—In the shape of a letter addressed to the excellent editor of this periodical, the author communicates some interesting facts on the metallurgical industry of the country just named, wherein coals are found, and gold and silver, copper, lead, and iron are extracted from their ores or from the rocks wherein they are imbedded. The Japanese work iron by an imperfect method called the Catalan method. After smelting, the slag still contains 40 per cent of metallic iron; a small blast-furnace will, however, be built by the author at the locality where this iron ore is found. The natives are excellent miners, but were until lately unacquainted with the use of gunpowder in mining operations.

Experiments made by Thermo-Dynamics.—F. Tommassi.—For the purpose of proving the possibility of converting into dynamical work the dilatation produced in liquids by heat; the facility to utilise this motive force for the purpose of working hydraulic presses. Illustrated by a series of woodcuts.

La Revue des Scientifique de la France et de l'Etranger, November 4, 1871.

This number does not contain any original papers relating to chemistry.

December 2, 1871.

Although the titles of the following original papers do not strictly belong to the subject-matter usually treated in our columns, we call attention to them for their general scientific interest:—

International Congress of Anthropology and Pre-Historic Archæology; Meeting at Bologna, Italy.—A highly valuable record of well observed and digested facts.

Origin of the Sedimentary Terrains (Rocks, Coal, &c.)—Ch. Contrejeau.—A very clear *exposé* of geological facts.

December 9, 1871.

In this number we meet with the—

Compte Rendu of the Daily Meetings of the Last Session (September) of the International Congress of Anthropology and Pre-Historic Archæology at Bologna.—M. Cazalis de Fondouce.

Present State of Aërial Navigation and the Attempts made to Steer Air-Balloons.—W. de Fonvielle.

Polytechnisches Journal von Dingler, first number for November, 1871.

Continuation and End of Essay on Blast-Furnaces for Making Pig-Iron.—C. Schinz.

Contribution to the History of the Recovery of Sulphur from Alkali Waste.—L. Mond.—The real gist of this paper turns upon a question of priority of invention. It appears that the author has been very unjustly accused in papers published abroad of purloining and patenting inventions not his own, but the property and invention of others. The author, in this paper, proves not only that there is not the remotest ground for such base assertions, but that he was the first who devised a practicable and advantageous method for extracting sulphur from alkali waste on the large scale now some twelve years ago.

Water contained in some of the Double Sulphates.—H. Rheineck.—Protosulphate of iron and ammonia, $NH_4FeS_2O_8+5HO$—equivalent, 187·4; water, 24·72 per cent. Protosulphate of iron and potassa, $KFeS_2O_8+5HO$—equivalent, 208; water, 21·63 per cent. Ammonio-sulphate of magnesia, $MgNH_4S_2O_8+6HO$—water, 33·33 per cent. Ammonio-sulphate of copper, $CuNH_4S_2O_8+6HO$—water, 27·04 per cent.; and $CuSO_4$, 39·56 per cent. The author has analysed these salts volumetrically, care being taken to obtain the substances in a pure and perfectly crystalline state.

Suggestion for the Means of Preventing as much as possible Explosions occurring with Detonating and Explosive Substances, more especially Fulminate of Mercury, when prepared for the purpose of Filling Percussion Caps.—Dr. Ph. Neumann.—This paper bears entirely upon the making of percussion caps. The author proves, by a series of facts elucidated by experiments, that the operations of granulation and mixing of the fulminate are best and most safely conducted in vacuum.

Phenomena of Fermentation.—H. Rheineck.—However valuable in a scientific sense, the contents of this paper are not well suited for any useful abstraction.

Brewing Industry of the Austro-Hungarian Empire.—G. Yoback.—A lengthy statistical essay on the beer production of the country alluded to.

NOTES AND QUERIES.

Comparative Tables of Hydrometers.—(Reply to L. C.).—You will find the latest comparative tables of hydrometers in *Zeitschrift für Analytische Chemie*, von R. Fresenius, 1870, p. 437.—V. C.

Comparative Tables of Hydrometers.—(Reply to L. C.).—You will very likely find what you desire in "Sammlung Physikalischer Tabellen," von Dr. E. L. Schubarth: Berlin, 1849 or later, 8vo., 200 pages.

Naphthalic Acid.—(Reply to "Naphthaline").—By prolonged boiling of naphthaline with nitric acid, the former body is converted into a mixture of oxalic and naphthalic acids. Consult, further, Miller's "Elements of Organic Chemistry," part iii., p. 707, 4th edition.

Apparatus for the Liquefaction of Gases.—(Reply to S. T.).—Consult Müller-Pouillet's "Lehrbuch der Physik," Gehler's "Physikalisches Lexikon," or Prechtl's "Technologische Encyclopedie," all of which books you may inspect at the Patent Office Library.

Gas-Proof Fabric.—(Reply to "L.R.C.P. Ed.").—The Xylonite Company (Limited), 7, Great Winchester Street Buildings, London, E.C., are supplying hospitals, &c., with a cheap kind of collodion, which is also made into the finest of tissues both with and without a fibrous material; in some respects it is superior to either gutta-percha or india-rubber.—S. E. P.

Adulterations in Food and Drink.—In answer to "An Amateur Chemist," I would repeat that hackneyed saying "there is no royal road to chemistry," and especially to the detection of adulterations in food and drink. Very few illicit admixtures are capable of detection by chemical means; the majority require considerable acquaintance with the microscope, and many are determined by mechanical means—*i.e.*, such as density, &c. Hassall's book is one of the best, and "An Amateur Chemist" will find no shorter way to the subject than by a careful perusal of such a one.—S. W. MOORE.

Heat and Electricity.—No doubt Mr. Wilson is right as to what ought to be done for a full determination of the laws of this subject. I hope soon to have time to carry out experiments more fully; meanwhile I only wished to call the attention of experimentalists to the matter. Till it is more fully investigated it is scarcely worth while to say anything more about it. But, perhaps, I may add that I found, quite contrary to what might be expected, that a zinc and sulphate of copper battery giving a current of 75° on the tangent galvanometer would keep hot three or four times the length of wire which a zinc and platinum element would, though, from the electro-motive power of the elements respectively, one would have expected just the contrary result. However, after a short time I hope to experiment fully and ascertain whether the laws derived from elements of the same kind apply to elements of different kinds.—H. HIGHTON.

MEETINGS FOR THE WEEK.

MONDAY, Dec. 18th.—London Institution, 4. Prof. Huxley, LL.D. F.R.S., on "Elementary Physiology."
—— Medical, 8.
—— Anthropological, 8.
TUESDAY, 19th.—Civil Engineers, 8.
WEDNESDAY, 20th.—Society of Arts, 8.
—— Geological, 8.
THURSDAY, 21st.—Royal, 8.30.
—— Zoological, 4.
—— Chemical, 8. Mr. H. Bassett, "On Eulyte and Dyslyte."
—— Philosophical Club, 6.
FRIDAY, 22nd.—Quekett Microscopical Club, 8.

TO CORRESPONDENTS.

F.R.C.S.—(1). You will find all the information you require in Brande's "Manual of Chemistry," 6th edition, vol. i., pp. 457 to 464. (2). There are several kinds of apparatus in use for condensing carbonic acid gas; Natterer's is readily worked.

L. Mond.—Your communication has received attention.

C. T. Kingzett, C. Crump, V. Cruse, W. Valentin, and J. Parry, are thanked for their communications.

Now ready, price 4s., with Coloured Frontispiece of the more important of the Spectra,

INORGANIC CHEMISTRY,

By the late PROFESSOR GEORGE WILSON, of Edinburgh University.

Thoroughly revised and brought up to the latest state of the Science by H. G. Madan, M.A., Fellow of Queen's College, Oxford, and Natural Science Master in Eton College.

W. and R. Chambers, London and Edinburgh.

TEXT-BOOKS OF SCIENCE.

On Tuesday, December 19th, in small 8vo., price 3s. 6d.,

The Theory of Heat. B. J. Clerk Maxwell, M.A., F.R.SS. L. & E., Professor of Experimental Physics in the University of Cambridge.

Being the Sixth of the New Series of Elementary Works on Mechanical and Physical Science in course of publication, edited by Professor T. M. Goodeve, M.A.

Text-Books previously published, price 3s. 6d. each:—

1. GOODEVE'S MECHANISM.
2. BLOXAM'S METALS.
3. MILLER'S INORGANIC CHEMISTRY.
4. GRIFFIN'S ALGEBRA AND TRIGONOMETRY.
5. WATSON'S PLANE AND SOLID GEOMETRY.

London: Longmans, Green, and Co., Paternoster Row.

Chemical Technology, or Chemistry in its Applications to the Arts and Manufactures. By Thomas Richardson and Henry Watts. Second Edition, illustrated with numerous Wood Engravings.

Vol. I., Parts 1 and 2, price 36s., with more than 400 Illustrations.

Nature and Properties of Fuel: Secondary Products obtained from Fuel: Production of Light: Secondary Products of the Gas Manufacture.

Vol. I., Part 3, price 33s., with more than 300 Illustrations.

Sulphur and its Compounds: Acidimetry: Chlorine and its Bleaching Compounds: Soda, Potash: Alkalimetry: Grease.

Vol. I., Part 4, price 21s., 300 Illustrations.

Aluminium and Sodium: Stannates, Tungstates, Chromates, and Silicates of Potash and Soda: Phosphorus, Borax: Nitre: Gun-Powder: Gun Cotton.

Vol. I., Part 5, price 36s.

Prussiate of Potash: Oxalic, Tartaric, and Citric Acids, and Appendices containing the latest information and specifications relating to the materials described in Parts 3 and 4.

Bailliere and Co., 20, King William Street, Strand.

PRACTICAL CHEMISTRY.

Laboratory, 60, Gower Street, Bedford Square, W.C.

Mr. Henry Matthews, F.C.S., is prepared to give Instruction in all branches of PRACTICAL CHEMISTRY, particularly in its application to MEDICINE, AGRICULTURE, and COMMERCE.

The Laboratory is open daily, except Saturday, from ten to five o'clock; on Saturday, from ten till one o'clock.

Mr. Matthews is also prepared to undertake ANALYSES of every description.

For Particulars and Prospectuses, apply to Mr. Henry Matthews, the Laboratory, 60, Gower Street, Bedford Square, W.C.

BERNERS COLLEGE of CHEMISTRY.—EXPERIMENTAL MILITARY and NAVAL SCIENCES, under the direction of Professor E. V. GARDNER, F.E.S., &c.: of the late Royal Polytechnic Institution and the Royal Naval College.

The Laboratory and Class Rooms are open daily.

Especial facilities for persons preparing for Government and other examinations.

Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

For particulars, &c., apply to Prof. E. V. G., 44, Berners-street, W.

Methylated Spirits.—David Smith Kidd, Licensed Maker, Commercial Street, Shoreditch, N.E. Also FINISH, FUSEL OIL, and RECT. NAPHTHA.

Silicates of Soda and Potash in the state of Soluble glass, or in CONCENTRATED SOLUTION of first quality, suited for the manufacture of Soap and other purposes, supplied on best terms by W. GOSSAGE and Sons, Widnes Soapery, Warrington.

London Agents, CLARKE and COSTE, 19 and 20, Water Lane, Tower Street, E.C. who hold stock ready for delivery.

ANALYTICAL LABORATORY AND SCHOOL OF TECHNICAL CHEMISTRY.

7 and 9, HACKIN'S HEY, LIVERPOOL.

Conducted by A. NORMAN TATE, Analytical and Consulting Chemist, and Chemical Engineer.

Established for Educational Purposes connected with Chemistry in its practical Applications to Manufactures, Commerce, &c.; for the performance of Analyses, Assays, and Chemical Investigations; and for affording information respecting the construction, &c., of Chemical Manufactories, and the conduct of Chemical Manufacturing Processes.

The Course of Instruction, in addition to the ordinary Chemical studies, comprises, as far as possible, all such other subjects as are necessary to give the scientific and practical information required in the Arrangement, Construction, and Management of Chemical Manufactories, and in the Application of Chemistry to Industrial Pursuits.

Students' Fees may be known on Application.

Plans, &c., for Chemical Apparatus and Manufactories are supplied and the erection of Plant and Buildings is superintended when required.

AMSTERDAM EXHIBITION, 1869.

The GRAND DIPLOMA of HONOUR, being the First Prize, and superior to the Gold Medal.

Liebig Company's Extract of Meat.—Paris EXHIBITION, 1867, TWO GOLD MEDALS; HAVRE EXHIBITION, 1868, THE GOLD MEDAL.—Only sort warranted perfect and genuine by Baron Liebig, the Inventor. "A success and a boon."—Medical Press and Circular. One pint of delicious beef-tea for 2½d., which costs 1s. if made fresh from meat. Cheapest and finest-flavoured "stock" for soups, &c.

CAUTION.—Require Baron Liebig's signature upon every jar Sold by all Italian Warehousemen, Grocers, Chemists, and Ships. Store Dealers; all Wholesale Houses; and of LIEBIG'S EXTRACT of MEAT COMPANY (LIMITED), 43, Mark Lane, E.C.

NOTICE.—Various chemical analyses have been published purporting to show a fraction more of moisture to exist in the Company's Extract than in some imitation sorts. It is extremely easy to evaporate the water almost to any extent, but it is quite as certain that the fine meaty flavour which distinguishes the Company's Extract from all others would be destroyed if the concentration of the Extract were carried beyond a certain degree. Beef-tea made from Liebig Company's Extract with *boiling-hot water* will be found to be greatly superior in flavour, strength, clearness, to any other sort. This explains the universal preference it obtains in the market.

This Extract is supplied to the British French, Prussian, Russian, and other Governments.

Established 1798.

ROBERT DAGLISH & CO.,

BOILER MAKERS, ENGINEERS, AND MILL-WRIGHTS,

BRASS AND IRONFOUNDERS,

St. Helen's Foundry, Lancashire.

Makers of every description of Chemical, Colliery, Copper Ore Mining, and Glass Machinery, including Crown, German Sheet, and Plate Glass Plant, as supplied to some of the largest Firms in England, Ireland, Scotland, and Wales.

Makers of the latest Improved Revolving Black Ash Furnace, with Siemens's Patent Gas Arrangement, and as used in the Manufacture of Soda.

Improved Vertical Blowing Engines (which have given a much higher Blast than any others have yet obtained), and as supplied to the entire satisfaction of most of the largest Bleaching Powder Manufacturers who have adopted "Weldon's Patent Process."

Authorised by Patentee to supply the Ironwork and Plant required in the Manufacture of Bleaching Powder by "Deacon's Patent."

Plans and Estimates of the Plant required for working these Patents in accordance with the Patentee's instructions.

Photographs, Prices, and other information, supplied on receipt of Order.

PHOTOGRAPHIC AND OPTICAL WAREHOUSE.

J. SOLOMON,

22, RED LION SQUARE, LONDON, W.C.,

PATENTEE OF MAGNESIUM LAMP FOR ENLARGING PHOTOGRAPHS.

Photographs vitrified on Enamel or Porcelain for the trade

Catalogues on Application.

THE CHEMICAL NEWS.

Vol. XXIV. No. 630.

NOTES ON FLUORESCENCE.

By HENRY MORTON, Ph.D.

(Correction).

Through a series of accidents, I was prevented from obtaining access to Professor Stokes's papers on fluorescence in the *Philosophical Transactions* until the present time. I thus failed to be aware that two observations casually mentioned in my previous "Notes" or "Observations" on this subject had been previously made and discussed by this eminent physicist.

The points to which I allude are the effect of hydrochloric acid on quinine sulphate and the increase of fluorescence in solutions of the latter substance by dilution.

ON FLUORIDE OF SILVER.*

By G. GORE, F.R.S.

Part III.

In this communication the author has finally shown that the action of iodine, under the influence of heat (including the process described by Kammerer, *Phil. Mag.*, 1863, vol. xxv., p. 213, for the isolation of fluorine), does not liberate uncombined fluorine, but produces fluoride of iodine and iodide of silver, a double salt, composed of iodide of silver and fluoride of platinum, being produced at the same time by corrosion of the platinum vessels, if the temperature approaches a red heat.

The fluoride of iodine produced is a highly volatile and colourless liquid, does not corrode mercury or red-hot platinum, corrodes glass at 60° F., and crystals of silicon at a red heat, also platinum in contact with argentic fluoride in a state of fusion; it instantly turns a deal splint black, fumes powerfully in the air, and is decomposed with violence by water into hydrofluoric and iodic acids, in accordance with the following equation,

$$IF_5+3H_2O=5HF+HIO_3.$$

It dissolves iodine, and is absorbed by that substance; it is also absorbed either by argentic fluoride or iodide when those substances are cooled in its vapour, and may be expelled from them at a red heat. Its vapour quickly darkens the colour of a deal splint, and very gradually turns paraffine brown.

The platinum vessels in which the reaction with iodine was effected were considerably corroded (but less so than when bromine or chlorine were employed), and many expensive vessels were rendered useless by this cause during the experiments.

No chemical change occurred on heating argentic fluoride to redness with pure carbon.

By heating this fluoride to redness in a current of dried coal-gas, it was wholly reduced to metallic silver, hydrofluoric acid and tetrafluoride of carbon being evolved.

In liquid cyanogen, argentic fluoride neither dissolved nor suffered chemical change, but at a low red heat, in a current of dry cyanogen gas, it was entirely reduced to metal, either nitrogen and tetrafluoride of carbon, or fluoride of cyanogen being liberated. An aqueous solution of silver fluoride was precipitated by passing a prolonged current of cyanogen gas through it. Fluoride of silver was also decomposed by fusion with paracyanogen.

Argentic fluoride was not dissolved or chemically changed by immersion in anhydrous liquefied hydrocyanic acid, but by passing the dry acid in vapour over the red-hot salt, the latter was decomposed and metallic silver liberated. Aqueous hydrocyanic acid readily precipitated a solution of argentic fluoride.

Fluoride of silver was not decomposed by heating it to redness in an atmosphere of carbonic oxide or carbonic acid gases.

By fusing the fluoride in a current of vaporous terchloride of carbon, it was wholly converted into argentic chloride, the vessels being much corroded, and an insoluble double salt of platinum and silver formed. Similar results took place on using tetrachloride of carbon. Silver fluoride was insoluble, and remained unchanged in liquid tetrachloride of carbon at 60° F.; and terchloride or tetrachloride of carbon had no chemical effect upon an aqueous solution of the silver-salt. A solution of bromine or iodine in tetrachloride of carbon was quickly decolourised by agitation with small particles of argentic fluoride.

Crystals of boron did not decompose fluoride of silver at a low red heat, nor chemically change at 60° F., an aqueous solution of the salt containing either free hydrofluoric or nitric acids.

Vitrified boracic acid violently decomposed fluoride of silver in a state of fusion, emitting copious white acid fumes, but it had no chemical effect upon an aqueous solution of the salt at 60° F.

By placing crystals of silicon upon argentic fluoride in a state of fusion, they become at once red-hot, undergoing rapid combustion, and evolving fluoride of silicon. A lump of fused silicon slowly decomposed an aqueous solution of fluoride of silver, setting free metallic silver in crystals. Crystals of silver behaved similarly, but much more rapidly, and evolved abundance of gas if the solution contained free hydrofluoric acid; on adding nitric acid to this mixture, bubbles of spontaneously inflammable silicide of hydrogen gas were evolved and ignited.

Pure and dry precipitated silica added to fluoride of silver, at a temperature of low redness, evolved much heat, with violent action, and set free metallic silver.

No chemical change took place on passing fluoride of silicon over red-hot fluoride of silver.

Argentic fluoride in a state of fusion is rapidly decomposed by sulphur with evolution of heat; fluoride of sulphur is at the same time produced, and argentic sulphide formed. To ascertain whether fluoride of sulphur is a gas or a volatile liquid, an apparatus called a "gas collector" was devised and employed, and a full description of its construction is given. By using this apparatus, substances may be heated without contact with the external air, and without subjecting the joints of the apparatus in which they are heated to leakage by expansion or contraction of the gaseous contents.

Fluoride of sulphur was found to be a heavy colourless vapour, uncondensable at the temperature of melting ice and at the ordinary atmospheric pressure. It corrodes glass, fumes strongly in the air, and has a characteristic and very powerful dusty odour, not very unlike that of a mixture of chloride of sulphur and sulphurous anhydride. Sulphur rapidly decomposed an aqueous solution of argentic fluoride.

Sulphurous anhydride passed over fluoride of silver at an incipient red heat, produced little or no decomposition of the silver-salt. Vaporous fluoride of sulphur also produced no visible effect.

By passing the vapour of liquid chloride of sulphur over the fluoride in a state of fusion, chemical action occurred, a vapour was evolved which corroded glass, and possessed a dusty odour, but did not condense to a liquid; it was probably fluoride of sulphur. The saline residue consisted of argentic chloride and sulphide. A solution of argentic fluoride was decomposed by agitation with liquid chloride of sulphur, hydrofluoric acid being evolved, and argentic chloride and sulphide produced.

Argentic fluoride did not dissolve in bisulphide of carbon. By passing the vapour of the latter substance over the silver-salt at a red heat, a chemical change took

* Abstract of a Paper read before the Royal Society.

place, and a fuming acid vapour was evolved, in accordance with the following equation:—$4AgF + CS_2 = Ag_2S + CF_4$. A solution of bromine or iodine in bisulphide of carbon was rapidly decolourised by agitation with particles of argentic fluoride, and the liquid acquired the odour of tetrafluoride of carbon.

NOTES OF

DEMONSTRATIONS ON PHYSIOLOGICAL CHEMISTRY AT ST. GEORGE'S HOSPITAL.

By S. W. MOORE.

VII.

Blood, seen by the unaided eye, is a red fluid; when observed through a microscope of tolerably good magnifying power, appears to consist of a yellow fluid, in which may be seen floating corpuscles; these are red and white. In human blood the red corpuscle is about 1-3400th of an inch in diameter, the white about three times this size, and in proportion of 2 or 3 white to 1000 red.

The constituents of blood are albumin, fibrin (?), hematin, and globulin; oleic, stearic, lactic, phosphoric, sulphuric, and hydrochloric acids, in combination with Na, K, Ca, Mg, &c; cholesterine and phosphorised fat. The blood is so intimately connected with every change going on in the system that its composition is not the same at any two periods; the constant changes also generate heat, the degree of which may be estimated with a thermometer either at the mouth or rectum, the latter giving the better results.

Blood under certain conditions coagulates, becomes solid; the clot formed contracts, and serum separates, forming the condition known to the ancients as the "buffy coat;" this phenomenon is due to the formation of a substance called fibrin. There are several speculative theories regarding this body: the one most credited at present being that it is formed from two different elements uniting, a "fibrinoplastic" and fibrinogenous; one existing in the corpuscles, the other in the serum.

Fibrin, which has the same composition as albumin, is considered by some to be a waste product: this is very doubtful; the subject, however, is too lengthy for discussion here.

Fresh fibrin decomposes H_2O_2 with evolution of O.

Freshly drawn blood, when whipt with twigs or shaken up in a bottle with fragments of zinc, yields fibrin in a coagulated form. This coagulation may be accelerated by a temperature of more than 50° C., the electrical current, contact with air, and agitation; it may be retarded by cold, contact with living membranes, diluting with water, or mixing with such salts as Na_2SO_4, NaCl, the alkaline carbonates, and KNO_3. Fresh blood freezes at 0° C., and can be melted without perceptible change.

During respiration, the blood undergoes very important changes, the appreciable alteration being in the corpuscles, due evidently to the oxidation of their hematin.

On entering the lungs, the blood is exposed to a vast surface of air by its distribution in the capillaries; O is absorbed, and the blood assumes a bright-red colour, losing CO_2. The exhalation of CO_2 from the lungs occurs to so great an extent that it is calculated that about 8 ozs. of C are given off in twenty-four hours: we may thus look on the corpuscles as carriers of O to the various tissues for the purpose of the interchange necessary to burn up effete matters. These changes may be observed to perfection by the aid of the spectroscope.

Many gases may be respired without ill effect; others, such as CO_2 and N, cause death from the absence of O, whilst others, as H_2S, AsH_3, PH_3, HCN, CO, &c., are poisons of a very active nature.

There are several gases contained in the blood; these may be separated by the aid of the air-pump.

EXAMPLES FOR PRACTICE IN QUANTITATIVE ANALYSIS.

By ALEXIS A. JULIEN,

Assistant in Charge of the Quantitative Laboratory of the School of Mines, Columbia College.

(Concluded from p. 9).

Example No. 9.—*Determination of the Alkalies in Silicates.*

Pulverise very finely, weigh out 2 grammes, mix with 2 grms. of dry NH_4Cl, add 16 grms. of $CaCO_3$, mix intimately, transfer completely to a platinum crucible, warm gradually until fumes of ammonia salts no longer appear, and heat to full redness, but not too intensely, for 30 to 40 minutes. Cool, boil with 100 c.c. of H_2O until no lumps remain, filter, and wash thoroughly. To the filtrate add $(NH_4)_2CO_3$ in slight excess, concentrate to about 30 c.c., add a little more $(NH_4)_2CO_3$, and some $(NH_4)_2O$, filter and wash. Evaporate the filtrate in a weighed dish on the water-bath to dryness, then heat in an air-bath, and finally heat carefully almost to redness, to expel ammonia salts, cool, and weigh. Result, NaCl+KCl. If, on re-dissolving in a little water, an insoluble residue appears, separate and determine it on a very small filter.

To the solution of the alkaline chlorides add an excess of a concentrated neutral solution of $PtCl_4$, evaporate nearly to dryness on a water-bath below the boiling-point, treat the residue with alcohol (sp. gr. 0·86—0·87), cover, and allow to stand a few hours with occasional stirring, and decant upon a small filter. If the fluid is of a deep yellow colour, and no white saline particles are to be seen mixed with the yellow crystalline precipitate, a sufficient quantity of the precipitant has been added. Transfer to the filter, wash thoroughly with alcohol, dry, wrap up the filter, place in a small weighed porcelain crucible, cover, heat until the paper is completely charred, remove the cover, burn off the carbon, cool, throw in a very minute portion of pure oxalic acid, cover, and ignite, gently at first, finally to a strong red-heat, and cool. Treat with water, and wash the residuary platinum by decantation, until the last rinsings remain clear upon addition of argentic nitrate. Dry, ignite, and weigh. One equivalent of platinum represents one equivalent of potassium; and the amount of KCL is thus readily calculated.

Example No. 10.—*Analysis of Iron Ores.*

General Scheme.—Prepare an average sample for analysis (Note 1). Make a qualitative examination for Cr_2O_3, Cu, As, and Ti.

The ore generally contains Ca, Mg, Al, Fe, Mn, S, P, H_2O, SiO_2, and may contain Na_2O, K_2O, Cr_2O_3, Zn, Ni, Co, Cu, As, SO_3, TiO_2, V_2O_5, WO_3, CO_2, Cl, Fl, organic matter.

I. *Special Determinations.*—A. In 1 grm. determine H_2O by direct weight. B. In 1 grm. determine CO_2 by direct weight, as in example 7, B. C. For special determinations of K_2O, Na_2O, Cr_2O_3, FeO, As, S, SO_3, TiO_2, V_2O_5, WO_3, Cl, Fl, organic matter, see Appendix.

II. *Main Analysis.*—Pulverise 5 grammes to impalpable powder, and fuse thoroughly in platinum crucible (Note 2) with 20 grms. Na_2CO_3 (increasing to 30 grms. as the ore contains more SiO_2 and silicates) and 2 grms. $NaNO_3$ (increasing to 5 grms. as the ore contains more FeO, sulphides, or organic matter). After cooling, treat crucible and fused mass in a small beaker with boiling water, until the mass is thoroughly disintegrated (Note 3). If the solution has a *decided* green colour, digest with a little alcohol, filter, and wash with hot water (Note 4).

1. Water Solution.—It must be perfectly clear, but may be coloured. It may contain Al_2O_3, ZnO, SiO_2, SO_3, P_2O_5, CrO_3, As_2O_5.

Add excess of HCl, evaporate to dryness (Note 5), moisten residue thoroughly with HCl, digest with hot water, filter, and wash with hot water.

Residue (a).	*Filtrate (a).* Dilute to 500 c.c., and divide into three portions.		
SiO_2, &c., to be added to and re-fused with Residue (*b*).	*Solution (a1)*, 300 c.c. (If the ore contains As, see Note 6). Put into a large flask (to be afterward combined with solution *d1*) after determining Cr_2O_3, if present (Note 7).	*Solution (a2)*, 100 c.c. Add $BaCl_2$ and determine SO_3 as $BaSO_4$ (Note 8).	*Solution (a3)*, 100 c.c. Add to solution (*d2*), as a little Fe often enters the water solution.

2. Insoluble Residue.—It may contain CaO, MgO, Al_2O_3, MnO, ZnO, NiO, CoO, Fe, As, CuO, P_2O_5, SiO_2. TiO_2 (and Pt from the crucible).

Dry the residue, transfer it to casserole, dry and burn the filter and add its ashes, moisten with H_2O, treat with HCl, evaporate to dryness, and add HCl (Note 9). Warm and digest with hot water, with occasional stirring. When dissolved to a clear solution, filter and wash.

Residue (b).	*Filtrate (b), or Hydrochloric Solution.* Combine with Filtrate (*c*). Saturate thoroughly with H_2S gas.								
It may contain SiO_2, TiO_2, and other insoluble substances. Combine it with Residue (*a*), fuse with 5 parts Na_2CO_3, and proceed as in example No. 7, A, *a*.	*Precipitate (d)* May contain Cu, As, Pt, and separated S. Boil with aqua regia, add NH_4Cl, evaporate to dryness, treat with H_2O and alcohol, filter, and wash. The precipitate contains Pt from crucible, as $2NH_4, Cl, Pt, Cl_4$. Saturate filtrate with H_2S gas, filter, dry, burn filter, and put in crucible, add conc. HNO_3, dry, ignite, and weigh CuO.	*Filtrate (d).* Boil with HNO_3, dilute to 500 c.c., and divide into 3 portions.							
		Solution (d1), 300 c.c. Combine with Solution (*a1*) in large flask, add $(NH_4)_2CO_3$ almost to neutralisation and sodic acetate in excess, dilute very largely (Note 11), and boil.				*Solution (d2).* 100 c.c. (when the ore contains TiO_2 see Note 10). Determine the Fe volumetrically (Note 18).	*Sol. (d3)* 100 c.c. to be reserved for accidents.		
		Precipitate (e) May contain Fe_2O_3 and Al_2O_3 (as basic acetates) and perhaps P_2O_5 and TiO_2. Dissolve in HCl, and divide into 2 portions.		*Filtrate (e)* May contain Mn, Zn, Co, Ni, Ca, Mg. Concentrate to small bulk, transfer to flask, add $NH_4Cl+(NH_4)_2O$ to alkaline reaction and $(NH_4)_2S$ until odour is decided. Fill flask with water, and set aside over night (Note 14).					
Resid. (c). Dry, ignite, and weigh in platinum crucible. Weight= SiO_2+TiO_2. Expel SiO_2 with dilute H_2SO_4 & NH_4Fl. If residue is soluble, dissolve and add to Filt. (*b*). If not, determine the TiO_2 Note 10).	*Filt. (c).* Add this filtrate and washings to Filt. (*b*).	*Sol. (e1).* $\frac{2}{3}$ Remove all HCl, add HNO_2 in large excess, and determine P_2O_5 as in example No. 7, C, *b*, (Note 12).	*Solution (e2).* $\frac{1}{3}$ Boil with a little $KClO_3$, and add $(NH_4)O$ in excess, and $(NH_4)_2CO_3$, to precipitate $Fe_2O_3+Al_2O_3+P_2O_5(+TiO_2)$. Boil till all free NH_3 is expelled, filter and wash thoroughly, &c. (Note 13). From this weight deduct P_2O_5 found in *e1* and Fe_2O_3 calculated from *d2*, and difference = $Al_2O_3(+TiO_2)$. If TiO_2 is present, determine this part and the Fe as in Note 10.	*Precipitate (f)* May contain Mn, Zn, Co, and Ni (as sulphides). Dissolve on the filter with very dilute HCl, and wash.		*Filtrate (f)* May contain CaO and MgO. Acidulate with acetic acid, boil and filter. (Note 17).		
				Residue (g) May contain Ni and Co as sulphides. Combine with Precipitate (*h*). Transfer to crucible, add conc. HNO_3 and H_2SO_4, digest. evaporate, dry, ignite, and weigh as sulphates. (Note 15).	*Solution (g)* May contain Zn and Mn. Boil, add Na_2CO_3 in excess. filter, and wash (Note 16). Dry precipitate, and ignite strongly to constant weight. Then dissolve in HCl, add sodic acetate, and saturate with H_2S gas. Filter, wash. dry, ignite in platinum crucible, at first gently, then intensely, adding a little $(NH_4)_2CO_3$. Deduct this weight from the former, and difference = Mn as Mn_3O_4.		*Precipitate (h).* Combine with Residue (*g*).	*Filtrate (h).* Precipitate CaO as CaC_2O_4 and MgO as $MgNH_4PO_4.6H_2O$.	

NOTES.

NOTE 1. *Sampling the Ore.*—Break up in an iron mortar 40 or 50 lbs. into pieces that will pass through a tin sieve with ½-inch holes. Thoroughly mix the fine and coarse. Break up about 10 lbs. of average quality, so that it will pass through a tin sieve with ¼-inch holes. Mix well, take 1 lb., and pulverise in iron mortar until it will pass through brass sieve of 60 meshes to the linear inch. Mix well, take out about 30 grammes, pulverise in iron mortar, pass through muslin bolting-cloth, and put into a small bottle, tightly corked, for analysis and special determinations. It is yet necessary that every portion of this, required for the main analysis or a special determination, should be further pulverised, as needed, in the agate mortar, to an *impalpable powder*.

NOTE 2. *Preliminary Fusion.*—Thoroughly mix the ore and its fluxes on glazed paper, put about a third of the mixture in a 2-oz. platinum crucible, the lower portion of whose interior surface has been previously lined with a thin layer of Na_2CO_3, and heat over a common Bunsen burner, with a strong flame, until the greatest violence of the effervescence has ceased. Then add and treat the two-thirds remaining successively, and with the same precaution. Finally, heat strongly over the blast-lamp until the mass is in complete and quiet fusion, adding a little more Na_2CO_3, should it not readily fuse.

NOTE 3. *Removal of the Fused Mass.*—Let the crucible cool until just below red-heat, and place it on a clean and dry iron plate, whose lower part is immersed in cold water. When the crucible is cool enough to hold in the hand, put it into the smallest beaker in which it can lie upon its side, and digest with boiling water. The fused mass will generally soon become detached from the crucible, and come out in a cake. Then remove the crucible, wash it, treat in a small beaker with a little conc. HCl, to remove any adhering particles of the mass, and add this solution to that of the Insoluble Residue (2). Should any portion of the fused mass, thicker than a film, obstinately resist solution in the hot water, it must be removed only by patience and long boiling; and no attempt should be made either to *dig* it out or to dissolve it in HCl, lest by the formation of aqua regia or free Cl (in presence of the $NaNO_3$ or Mn_2O_3) the crucible may be attacked and injured.

NOTE 4. *Reduction of* H_2MnO_4.—If alcohol is added to the solution, heat on the water-bath, to avoid any risk of breaking the beaker by the bumping of the residue in the boiling solution. If there was no bluish-green tint in the fused mass, nor decided green colour in its solution, it is unnecessary to add alcohol.

NOTE 5. *Separation of* SiO_2.—In order to render the SiO_2 entirely insoluble, the evaporation should be carried to perfect dryness, until no odours of HCl can any longer be detected, and the mass is hard and crumbly. As the residue is to be re-fused with Residue (*b*), the drying may be completed at a temperature somewhat higher than 100° C.

NOTE 6. *Removal of* As.—The As has already been mostly or completely volatilised in the foregoing evaporation. If a trace is still suspected to remain, either repeat the evaporation with HCl or else employ the following method:—Saturate with H_2S gas, filter, wash, add a little $KClO_2$ to the filtrate, and boil until the S is completely oxidised.

Note 7. *Determination of* Cr_2O_3.—In order to oxidise all the Cr_2O_3 in the solution, either of the following methods may be employed :—

(*j*). Add Na_2CO_3 almost to neutralisation, and then sodic acetate in excess. Pass Cl or add Br. to saturation. Boil gently, keeping solution almost neutral by occasional additions of Na_2CO_3, until all excess of Cl or Br is expelled.

(*k*). Add pure KHO in excess, and boil with sufficient Br. Cool, add HNO_3 almost to neutralisation, acidulate with acetic acid, add sodic acetate in excess, and boil.

Filter out hot the basic aluminic acetate precipitated as above, and wash with hot H_2O containing a little sodic acetate. To filtrate add baric acetate in slight excess, filter, and wash. This last filtrate and the precipitate of aluminic acetate contain all the P_2O_5 and Al_2O_3 in the Water Solution. The latter is to be dissolved in HCl, the former to be freed from the excess of baric acetate with dilute H_2SO_4, and both to be added to Solution (d^1).

Digest the precipitate of $BaCrO_4$ and $BaSO_4$ with conc. H_2SO_4, boil, filter, and wash. Then adopt either of the following methods :—

(*l*). Boil the filtrate with conc. HCl and alcohol, to reduce CrH_2O_4 to Cr_2O_3, and precipitate the latter with $(NH_4)_2O$.

(*m*). Add $(NH_4)_2O$ in excess, pass H_2S gas until saturation, keeping the liquid near the boiling-point. When Cr_2O_3 is completely precipitated, filter, wash thoroughly with hot water, dry, &c.

Note 8. *Precipitation of* $BaSO_4$.—Avoid the addition of a large excess of $BaCl_2$ solution. Add only 5 c.c. at first, and then, after complete subsidence of precipitate, add a few drops to determine if any H_2SO_4 remains unprecipitated, &c. Then proceed as in Example No. 2, B.

Note 9. *Separation of* SiO_2.—Evaporate as in Note 5. Then add HCl pretty freely, and warm for some time before adding any water, as the high heat may have produced anhydrous Fe_2O_3, forming an oxychloride which is very slow to dissolve, especially in dilute acid. Should the acid already added be too dilute, concentrate by evaporation, add conc. HCl, and digest at a moderate heat.

Note 10. *Determination of* TiO_2.—After weighing the precipitate, ignite it *strongly* in H gas to reduce the Fe_2O_3, cool, dissolve out all the metallic Fe by boiling with dilute H_2SO_4, filter, wash, dry, ignite, and weigh in platinum crucible ($TiO_2+Al_2O_3$). In the filtrate determine the Fe volumetrically (Note 18). Fuse the residue with about six parts of $KHSO_4$, in which it will readily dissolve. Cool, take up the fused cake in *cold* water, filter if necessary, add one or two drops of dilute HNO_3, and precipitate the TiO_2 in the very dilute solution by long boiling (usually six to eight hours). Filter, wash with acidulated water, dry, and ignite. Should the ignited TiO_2 be coloured by FeO_2, repeat the process. When there is much TiO_2 in the ore, a special determination should be made (see Appendix) ; or the percentage found as above should be added to that of the part found in (e^2) by treating that precipitate in exactly the same way.

Note 11. *Precipitation of the Basic Acetates.*—Dilute the solution to about 1 litre for each gramme of the sesquioxides present. It is sufficient to boil from 10 to 15 minutes for the complete precipitation of the acetates. The filtering should be done rapidly on a ribbed filter, keeping the fluid hot, and disturbing the settled precipitate as little as possible. After the supernatant fluid has been poured through the filter, throw on the precipitate, and wash it with boiling water containing a little sodic acetate. Should any basic acetate separate upon concentrating the filtrate, add some sodic acetate, boil, filter, dissolve the precipitate in HCl, and unite to the solution of the main body.

Note 12. *Determination of* P_2O_5.—The removal of HCl may be effected by evaporating the solution with a large excess of HNO_3, until a glass rod, moistened with $AgNO_3$ and held over the surface of the liquid, is no longer clouded by the escaping vapours. Or still better, in some hands, add $(NH_4)_2O$ suddenly in large excess, filter, wash once, and re-dissolve in boiling HNO_3.

Note 13. *Determination of* Al_2O_3.—It is generally more accurate to determine the Al_2O_3 directly in this precipitate, as follows :—Dissolve by long boiling in a flask with conc. HCl, remove from the flame, reduce the Fe_2O_3 by Na_2SO_3. Boil some time, neutralise with Na_2CO_3, add solution of *pure* KHO or NaHO in excess, boil some time, allow to settle, decant the clear liquid through a filter, boil again with KHO, decant, and wash, first by decantation, afterwards on the filter with hot water. Acidify the filtrate with HCl, boil with a little $KClO_3$, concentrate, and precipitate the Al_2O_3 ($+TiO_2$, if present) with $(NH_4)_2O$. Other methods are given by A. Frönde. (*Zeits. für An. Chem.*, 1866, 395).

Note 14. *Precipitation of the Sulphides.*—Add no more of the yellow sulphide of ammonium than is required, as an excess will re-dissolve a portion of the precipitate unless much NH_4Cl be present. But an excess of the latter reagent will interfere with the concentration necessary to precipitate the MgO in Filtrate (*h*). Cork the flask tightly before setting it aside.

Note 15. *Separation of* Co *and* Ni.—Should these constituents be present in considerable quantity, which very rarely happens, it is better, as the nickelic sulphate is likely to be partially converted into NiO strong ignition, to dissolve the sulphides in aqua regia, neutralise with KHO, precipitate and determine the CoO by Genth and Gibbs's process, and in the filtrate determine the Ni as oxide.

Note 16. *Determination of* Mn.—(Gibbs's process. *Am. Journ. Sci.*, xliv., p. 216). To the HCl solution, free from H_2S, add $(NH_4)_2O$ in excess, and solution of Na_2HPO_4 in large excess. Then add dilute H_2SO_4 or HCl until the white precipitate re-dissolves, heat to boiling, and add $(NH_4)_2O$ in excess. Digest near the boiling-point about an hour, when the precipitate, at first white and gelatinous, becomes crystalline in rose-coloured scales. Filter, and wash with hot water. If tinged red, re-dissolve the precipitate in dilute HCl, and repeat the process. On ignition the precipitate is converted into $Mn_2P_2O_7$, a nearly white powder. If Zn is present, it must first be separated as ZnS, as in the scheme.

Note 17. *Precipitation of Dissolved* NiS.—A trace of NiS, which is somewhat soluble in sulphide of ammonium, is often carried through into this filtrate, but is completely thrown down, along with the excess of S, by this acidulation.

Note 18. *Volumetric Determination of* Fe.—Put Solution (d^2) directly into a flask holding 200 c.c., cool, dilute with cold water exactly up to the mark, mix by pouring back and forth several times from the flask to a beaker, draw out 100 c.c. with a pipette known to *deliver* that quantity, empty it into one reduction bottle, and into another empty the flask, and rinse out the flask, beaker, and pipette. The reduction bottle consists of a wide-mouthed bottle, holding about 250 c.c., with its lip ground down perfectly smooth, and covered by a ground-glass plate loosely held to its place by wires. Carefully let down in each bottle a lump of amalgamated zinc, free from Fe, and a strip of platinum foil resting upon it, add about 10 c.c. of conc. H_2SO_4, cover, and set aside overnight. When the reduction is complete the solution will be colourless.

Then in each of two flasks, holding about 75 c.c., introduce exactly 0·2 gramme of fine iron wire, add an excess of dilute H_2SO_4, and immediately adjust corks (having bent tubes attached, with their ends immersed in small beakers of warm water), and heat until the complete solution of the wire. By this water-valve arrangement the entrance of air and oxidation of the $FeSO_4$ solution are avoided, and when the water begins to run back, after the evolution of H has ceased, its warmth prevents the too sudden reduction of the temperature, and condensation of the vapours in the flasks. After cooling, pour and wash out the contents of each flask, with the beaker of

water attached, into a large beaker, add dilute H_2SO_4 in excess, dilute to about 1 litre, and titrate successively and rapidly with the solution of $KMnO_4$, to determine its strength.

Now pour and wash the contents of each reduction bottle into a large beaker, add dilute H_2SO_4, dilute to about a litre, and titrate successively as before. In a HCl solution all possible excess of that acid must be avoided, and the solution must be diluted to about 2 litres. When greater accuracy is desired the HCl may be replaced, previously to the reduction, by evaporating the solution with excess of H_2SO_4.

When the ore contains TiO_2 the process given in Note 10 must precede this determination, because any TiO_2 present in the solutions put in the reduction bottles would be reduced (yielding a pink tinge), as well as the Fe_2O_3, and consume a portion of the $KMnO_4$ in its reoxidation.

Another method has been recently published (*American Chemist*, July, 1870, p. 23), by which the previous reduction of the iron is not required, and a solution of $CuCl_4$ is employed for titration, but its accuracy has not yet been confirmed.

Appendix.—Special Determinations.

Alkalies.—Weigh out 5 grms., and determine as in Example No. 9.

Chromium.—Fuse, &c., as in Main Analysis, obtain Filtrate (*a*) of the Water Solution, and determine the Cr as in Note 7. But if the ore be chromic iron, either of the four following methods may be employed for its decomposition, after it has been pulverised to an impalpable powder. Little is known in regard to their comparative accuracy and convenience, especially of the last two.

(*a*). Hunt's Method.—Mix 0·5 grm. of ore with 6 grms. $KHSO_4$ in a large platinum crucible, fuse for 15 minutes at a temperature scarcely above the fusing-point of the salt, and then raise the heat somewhat, so that the bottom of the crucible may just appear red, and keep it so for 15 to 20 minutes. The fusing mass should not rise higher than half-way up the crucible. Then heat until the fumes of H_2SO_4 no longer escape. Now add 3 grms. Na_2CO_3, heat to fusion for an hour at a gentle red-heat, adding 3 grms. KNO_3 in small portions from time to time, and then heat for 15 minutes to bright redness, and cool. Treat with boiling water, filter hot, wash with hot water, digest the residue with HCl, and, if anything then remains undissolved, subject it again to the above operation. To the alkaline filtrate add an excess of $(NH_4)_2NO_3$ in excess, evaporate on a water-bath nearly to dryness, and until all free ammonia is expelled, filter, and wash. The CrO_3 is determined in this solution.

(*b*). Gibbs's Method (*Am. Journ. Sci.*, II., xxxix., p. 59).—Fuse over blast-lamp with 10 to 15 parts KF, HF, digest with H_2SO_4 until F is expelled, add hot water, and filter.

(*c*). Britton's Method (*Journ. Frank. Inst.*, March, 1870).—Weigh 0·5 grm., mix with 4 grms. of the flux (1 part KCl_3O + 3 parts soda-lime), ignite in a platinum crucible at a bright red-heat for over 1½ hours, cool, triturate the sintered mass in a porcelain mortar, digest in a 4 oz. beaker with 18 c.c. of hot water, boil for 2 or 3 minutes, cool, add 15 c.c. of HCl, and stir for a few minutes until solution. Pour into a known quantity of solution of $FeSO_4$, and determine volumetrically the amount of iron which remains unoxidised by the CrO_3.

(*d*). Pearson's Method (*Am. Journ. Sci.*, Sept., 1870).—Place 0·5 grm. of ore in an evaporating dish, add sufficient conc. HNO_3 to cover it, add a little $KClO_3$, cover with an inverted funnel, and digest, adding small quantities of $KClO_3$ from time to time, until the ore is thoroughly decomposed. Dilute, filter, and wash. Dry the residue, fuse it with a mixture of Na_2CO_3 and KNO_3, cool, dissolve in hot water, and test the solution for Cr. If none is found, the entire amount will be found in the above filtrate.

Ferrous Oxide.—Digest 1 grm. of ore, finely pulverised, in a flask with conc. HCl, passing a current of carbonic anhydride. After complete decomposition, cool in carbonic anhydride, and immediately titrate the solution of $FeCl_2$, without removing the insoluble residue, with $KMnO_4$ (Note 18). The presence of organic matter and of the higher oxides of Mn will interfere with the accuracy of the process.

For a special determination of the entire amount of Fe in an ore, either this method may be employed, omitting the use of carbonic anhydride, and reducing by Zn, as in Note 18; or the ore may be decomposed by fusion, as in the Main Analysis, without the use of Na_2NO_3; or, in the case of chromic iron, either of the above-mentioned four methods may be used; or Clarke's method may be employed, as follows (*Am. Journ. Sci.*, xlv., 178):—Thoroughly mix 1 grm. of ore with 3 grms. of NaF or pure powdered cryolite, put in a large platinum crucible, and cover with 12 grms. of coarsely powdered $KHSO_4$. Fuse about 20 minutes, cool, add conc. H_2SO_4, fuse to homogeneous paste, cool, and dissolve in cold water. When cryolite is used, a bulky white residue of $CaSO_4$ generally remains. Reduce the solution obtained by either of these methods, and titrate in usual way. But if the ore contains TiO_2, see Notes 10 and 18.

Arsenic.—Fuse 5 grms. of ore as in Main Analysis, and obtain the Water Solution, in which the As will be present as sodic arseniate. Add a little Na_2SO_4 and HCl to slight acid reaction, boil a few minutes until all the As_2O_5 has been reduced to As_2O_3, saturate the warm solution with H_2S gas, filter, and wash with H_2S water. Dry filter and contents, and oxidise them in a beaker with fuming HNO_3. Dilute, warm gently with a little $KClO_3$, to oxidise organic matter.

Sulphuric Acid.—Boil 5 grms. ore with 50 c.c. HCl + 50 c.c. H_2O + 10 c.c. alcohol. Filter and precipitate with $BaCl_2$ in the filtrate. The difference between the sulphuric anhydride thus found and the total found in the Main Analysis will give the amount equivalent to the S actually existing in the ore as metallic sulphide.

Titanic Acid.—The ore must be decomposed, and the TiO_2 brought into solution in cold water by Clarke's method, described under "Ferrous Oxide." Then proceed as in Note 10.

Vanadic and Tungstic Acids.—These acids, which occur in very small quantities in some European ores, may be separated and detected as follows:—Treat Residue (*a*), obtained from 10 to 20 grms. of ore, like Residue (*c*) in the Scheme, until all SiO_2 is expelled. Any residue which remains may contain Al_2O_3, TiO_2, V_2O_5, and WO_3. Ignite and weigh, fuse it with Na_2CO_3, dissolve in HCl, boil, add $(NH_4)_2O$ in excess, and saturate with H_2S gas. A red colour will denote the presence of V_2O_5, and a brown precipitate that of WO_3 (*Pogg. Annal.*, 21, 47. *H. Rose's Handb. d. Anal. Chem.*, ii., 764).

Chlorine.—This occurs in ores containing apatite. Mix with Na_2CO_3 and K_2CO_3, moisten with water, dry in the platinum crucible, fuse, boil with water, remove the dissolved SiO_2 by means of $(NH_4)_2CO_3$, and then precipitate, after addition of HNO_3, with $AgNO_3$.

Fluorine.—This occurs in ores containing apatite and fluor-spar. Decompose the ore by Berzelius's method, separate the SiO_2, and expel the excess of $(NH_4)_2CO_3$. If P_2O_5 is present, precipitate with $CaCl_2$, together with CO_2 and HFl, and separate the $CaCO_3$ by acetic acid. In the remaining precipitate of $Ca_3P_2O_8 + CaFl_2$, determine the Fl directly by Wöhler's method, as $SiFl_2$.

Organic Matter.—Roast 1 grm. in an open crucible, at a red-heat, and (when the protoxide of iron, the higher oxides of manganese, sulphur, and arsenic, are absent) the *loss* diminished by the amounts of carbonic anhydride and H_2O present will be approximately equivalent to the amount of organic matter.

ON THE

CHEMICAL CONSTITUTION OF GLYCOLIC ALCOHOL AND ITS HETEROLOGUES,

AS VIEWED IN THE NEW LIGHT OF THE "TYPO-NUCLEUS" THEORY.*

By OTTO RICHTER, Ph.D.

(Continued from p. 280).

The chemical constitution of glycolic alcohol and its heterologues may be adequately expressed by means of the following table of rational formulæ, where the non-essential constituents are separated from the essential constituents by a horizontal line. You will also understand that the various marks of punctuation used in these formulæ are typical symbols of molecular grouping. Thus, a dot connects the base with its acid; a semicolon connects the hydrocarbon adjunct with its principal; an inverted semicolon connects the halogen† adjunct with its principal, and a concave curve connects two principal bases with one another. I must further say that for want of a proper nomenclature, it has here and there been found necessary to introduce new names.

Table of Chemical Formulæ Representing the Chemical Constitution of Glycolic Alcohol and its Heterologues.

$H_{12}C_8O_8$	$H_2O_2 \cdot$	$H_2O_2 \cdot$
Glycolic alcohol	$2C_2 ; H_2O_2$	$2H_2C_2 ; H_2O_2$
$H_8C_8O_8$	$H_2O_2 \cdot$	$H_2O_2 \cdot$
Deglycolic alcohol..	$2C_2 ; H_2O_2$	$2C_2 ; H_2O_2$
$H_8C_8O_8$	$H_2O_2 \cdot$	$H_2O_2 \cdot$
Glycolite of water	$2C_2 ; H_2O_2$	$2H ; 2C_2O$
$H_8C_8O_{12}$	$H_2O_2 \cdot$	$H_2O_2 \cdot$
Glycolate of water..	$2C_2 ; H_2O_2$	$2H ; 2C_2O_3$
$H_8C_8O_{16}$	$H_2O_2 \cdot$	$H_2O_2 \cdot$
Oxyglycolate of water	$2C_2 ; H_2O_2$	$2H ; 2C_2O_5$

So far as I am aware, the glycolic alcohol, which is the parent molecule of this family group, has not yet been obtained in a state of isolation. The well-known ethylen-glycol might at first sight be taken for the missing alcohol, more particularly when we couple the decidedly biatomic character of their respective molecules with the other and even more significant fact that the whole of the glycolic heterologues may be produced by the simple oxidation of the ethylen-glycol. Nevertheless, and notwithstanding these striking points of resemblance, I am inclined to believe that these two alcohols are not alcohol, but only isomeric, and I ground my belief upon the occurrence of a certain class of chemical compounds among which the so-called diethyl-acetal is the most conspicuous and best investigated member. This diethyl-acetal, you will recollect, is strictly isomeric with the diethyl-ether of the ethylen-glycol, and I feel convinced that it is the missing glycolic alcohol to which we are indebted for this curious and instructive case of isomerism. A cursory examination and comparison of the subjoined rational formulæ will suffice in order to prove that my belief is well founded.

$H_{12}C_8O_8$	$H_2O_2 \cdot$	$H_2O_2 \cdot$
Ethylen-glycol	$2H_2C_2 ; H_2O_2$	$2C_2 ; H_2O_2$
$H_{12}C_8O_8$	$H_2O_2 \cdot$	$H_2O_2 \cdot$
Glycolic alcohol	$2C_2 ; H_2O_2$	$2H_2C_2 ; H_2O_2$
$H_{28}C_{24}O_8$ Diethyl ether of ethylen-glycol	$2H_4C_4 ; H_2O_2 \cdot$	$2H_4C_4 ; H_2O_2 \cdot$
	$2H_2C_2 ; H_2O_2$	$2C_2 ; H_2O_2$
$H_{28}C_{24}O_8$	$2H_4C_4 ; H_2O_2 \cdot$	$2H_4C_4 ; H_2O_2 \cdot$
Diethylacetal	$2C_2 ; H_2O_2$	$2H_2C_2 ; H_2O_2$

You will observe that ethylen-glycol differs from glycolic alcohol in two essential points; *first*, in the former compound, the two alcoholic constituents are represented as playing the co-ordinate part of principal alcoholic bases, while in the latter compound one of these alcoholic bases is represented as playing the subordinate part of adjunct to the other base. *Secondly*, the relative positions which the two alcoholic constituents occupy in ethylen-glycol are exactly reversed in the glycolic alcohol. A mere glance at the two formulæ which express the chemical constitution of the isomeric ether derivatives will, I trust, enable the reader to complete the analysis of these hitherto obscure and unintelligible cases of isomerism. The second member in the family of glycolic heterologues is likewise very little known. I have applied to it the term "deglycolic alcohol," in order to record the fact that it is produced from the primary alcohol by the simple abstraction of two molecules of hydrogen from the methylen adjunct of the principal water base. This secondary alcohol, like the majority of the alcohols which occupy the second place in the family group of the heterologues of the fatty alcohols, seems, from its want of stability, very prone to merge into the isomeric and far more permanent modification of the glycolite of water. In this remarkable metamorphosis, the double carbon adjunct of the principal water base becomes first of all converted into an acid twin carbon nucleus, which reunites under this new form with the old water base, whereupon, under the combined influence of base and acid, the remaining water molecule becomes decomposed so as to surrender its oxygen to the envelope of the acid twin carbon nucleus, while the hydrogen connects itself with the same nucleus under the typical form of a hydrocarbon adjunct. It is worthy of note that in this singular and characteristic re-arrangement of the constituent elements, the organic molecule has, without loss of substance and without loss of saturating capacity, passed at one bound from the category of a true and genuine alcohol into the category of a true and genuine water salt. As regards the two remaining heterologues of glycolate of water and oxyglycolate of water, you cannot but see that their formation is due to the successive absorption of two molecules of oxygen by the envelope of the glycolous acid constituent, and that they differ from each other in this respect only, that the former contains for its principal constituent formate of water, while the latter contains instead of it oxyformate of water. Some of my readers may here be supposed to ask, what is oxyformate of water: Why, it is simply a highly interesting isomeric modification of the neutral carbonate of water. You are aware that on account of its excessive want of stability none of the carbonates of water can be obtained in a state of isolation. The compound before us differs from the isomeric neutral carbonate in being decidedly monobasic, while the latter is as decidedly bibasic. The cause of this apparent anomaly becomes now fully revealed, for it is plain that one of the two hydrogen molecules which, in the ordinary carbonate of water are both of them readily displaceable by metals, has assumed the hydrocarbon form of grouping, in consequence of which it will cease to play the part of a basic nucleus, and although it may become eliminated or exchanged in obedience to other modes of substitution, it is certain that the ordinary process of double decomposition has no control over it. In speaking of the deglycolic alcohol, I forgot to mention that a substance has recently been obtained by Boutlerow, and re-examined by Hofmann, who mistook it at first for the missing formic aldehyde. This curious compound, if we take the density of its vapour for our guide, ought to be represented by the same empirical formula as the deglycolic alcohol, but from its chemical deportment it will probably become identified with the glycolite of water, which I regard as the true aldehyde of the glycolic family group.

Let us now pass on to consider those interesting and singularly close chemical relations which are found to obtain between the heterologues of the glycolic alcohol on

* Abstract of a Paper read before the British Association, Edinburgh Meeting, 1871.

† You will bear in mind that in my system the term "halogen" includes every species of mono- or polynormal acids, bases, or salts; and that the empirical formulæ used in my system are exactly the double of the ordinary formulæ. $H_2=2$; $C_2=12$; $O_2=16$.

the one hand and the heterologues of the ethylic alcohol on the other hand. These two kindred family groups are in the subjoined table brought face to face with one another.

Heterologues of Glycolic Alcohol.

$H_{12}C_8O_8$	$\frac{H_2O_2\cdot}{2C_2\,;\,H_2O_2}\,:\,\frac{H_2O_2\cdot}{2H_2C_2\,;\,H_2O_2}$
Glycolic alcohol	
$H_8C_8O_8$	$\frac{H_2O_2\cdot}{2C_2\,;\,H_2O_2}\,:\,\frac{H_2O_2\cdot}{2C\,;\,H_2O_2}$
Deglycolic alcohol	
$H_8C_8O_8$	$\frac{H_2O_2\cdot}{{}_2C_2\,;\,H_2O_2}\,:\,\frac{H_2O_2\cdot}{2H\,;\,2C_2O}$
Glycolite of water	
$H_8C_8O_{12}$	$\frac{H_2O_2\cdot}{2C_2\,;\,H_2O_2}\,:\,\frac{H_2O_2\cdot}{2H\,;\,2C_2O_3}$
Glycolate of water	
$H_8C_8O_{16}$	$\frac{H_2O_2\cdot}{2C_2\,;\,H_2O_2}\,:\,\frac{H_2O_2\cdot}{2H\,;\,2C_2O_5}$
Oxyglycolate of water	

Heterologues of Ethylic Alcohol.

$H_{12}C_8O_4$	$\frac{H_2O_2\cdot}{2H_4C_4\,;\,H_2O_2}$
Ethylic alcohol	
$H_8C_8O_4$	$\frac{H_2O_2\cdot}{2H_2C_4\,;\,H_2O_2}$
De-ethylic alcohol	
$H_8C_8O_4$	$\frac{H_2O_2\cdot}{2H_3C_2\,;\,2C_2O}$
Acetite of water..	
$H_8C_8O_8$	$\frac{H_2O_2\cdot}{2H_3C_2\,;\,2C_2O_3}$
Acetate of water	
$H_8C_8O_{12}$	$\frac{H_2O_2\cdot}{2H_3C_2\,;\,2C_2O_5}$
Oxyacetate of water	

You will observe, firstly, that the members thus placed opposite each other differ throughout by the constant quantity of two molecules of oxygen. You will find, moreover, that the acetate of water is isomeric with the glycolite of water and the oxyacetate of water isomeric with the glycolate of water. Now, it is an established fact, that ethylic alcohol may, under favourable conditions, become oxidised into the ethylen-glycol, or possibly, in the first instance, into the glycolic alcohol; but whichever way we take it, the fact remains, and the explanation is easy. In ordinary circumstances, namely, when by the removal of two hydrogen molecules from the ethylen adjunct, the ethylic-alcohol becomes converted into the de-ethylic alcohol, the two molecules of water, which are generated in this process will simply be eliminated from the system, whereas, in extraordinary circumstances, these two molecules of water, instead of being eliminated, will appropriate to themselves two carbon molecules from the residual acetylen adjunct, whereupon the resulting methylic and formylic alcohols will instantly combine under the one or the other form of biatomic grouping. As regards the isomeric relations of acetate and glycolite of water, on the one hand, and of oxyacetate and glycolate of water on the other hand, there cannot be the slightest doubt that these isomeric cympounds are mutually convertible, and it is clear, that when the acetate merges into the glycolate, two oxygen molecules of the oxalic acid constituent will unite, in the first instance, with two hydrogen molecules of the methyl adjunct so as to produce two molecules of water; these latter will then combine with the two molecules of carbon which are ceded to them by the residual formyl adjunct, and lastly, the generated formyl alcohol will connect itself as halogen adjunct with the acid twin nucleus of the residual formite of water. This explanation applies with equal facility to the conversion of oxyacetate of water into glycolate of water. The details of this process, as well as of the reverse process, whereby the glycolic heterologues remerge into the corresponding acetic heterologues, I shall leave the hearer to work out for himself. Let us now direct our attention to another highly instructive variety of isomeric changes which the acetic water salts are apt to experience after one or two of the methylic hydrogen molecules have been displaced by chlorine, bromine, or iodine. I shall illustrate these analogous cases by means of the bromo- and bibromo-acetates of water. The bromo-acetate has the rational formula $\frac{H_2O_2\cdot}{2H_2C_2Br\,;\,2C_2O_3}$ and it is plain that the successive phases of the process will be as follows:—One hydrogen molecule will disengage itself from the brom-methyl adjunct, become converted into an acid nucleus, and brominised; the newly formed bromide of hydrogen will then unite with the two carbon molecules which it has acquired from the residual formyl adjunct, and in the last phase of the process the resulting bromide of formyl will unite as halogen adjunct with the acid twin nucleus of the residual formate of water. Accordingly, the end product of the reaction will be bromo-glycolite of water with the rational formula—

$$\frac{H_2O_2\cdot}{2B_2\,;\,H_2Br_2\,:\,2H\,;\,2C_2O_3}$$

This compound is, therefore, isomeric with its parent bromo-acetate of water.

The bibromo-acetate of water has the rational formula $\frac{H_2O_2\cdot}{2HC_2Br_2\,;\,2C_2O_3}$ and the reaction takes the same course precisely. Hence we ought to obtain as final product, the bibromo-glycolite of water with the rational formula $\frac{H_2O_2\cdot}{2C_2\,;\,H_2Br_2\,:\,2Br\,;\,2C_2O_3}$ This compound is, therefore, isomeric with its parent bibromo-acetate of water. From its want of stability it becomes, however, readily decomposed into bromide of hydrogen and bromo-glycolid with the rational formula $\frac{}{2C_2\,;\,H_2Br_2\,:\,2C_2O_4}$. When this bromo-glycolid is in its turn subjected to successive treatment with strong bases and acids, it will give rise in the first instance to the bromoglycolate of water with the rational formula $\frac{H_2O_2\cdot}{2C_2\,;\,H_2Br_2\,:\,2H\,;\,2C_2O_5}$. and in the second instance to the oxyglycolate of water with the rational formula $\frac{H_2O_2\cdot\quad H_2O_2\cdot}{2C_2\,;\,H_2O_2\,:\,2H\,;\,2C_2O_5}$.

DECAY OF STONE AND BRICK.

By JOHN C. DRAPER,
Professor of Chemistry, University Medical College, New York.

The rapid disintegration or decay of the brown stone, so generally employed in the construction of New York houses, leads naturally to the consideration of the causes producing this decay, and also to the examination of other building materials, and the discussion of their merits or demerits as compared with brown stone.

The chief causes of disintegration of stone and brick are:—

(1). Roughness of surface, favouring the deposition of dust.

(2). Vegetable growths, favoured by dust and moisture.

(3). Percolation of water through interstices and fissures.

(4). Action of frost.

(5). Action of acid vapours in the air.

In the experiments we propose to relate, the materials employed were the same as those mentioned in a previous paper, namely, brown stone, Nova Scotia stone, red brick, and white brick. Submitting these to a microscopic examination under a power of 25 or 30 diameters, a very instructive lesson regarding the structure of these materials is obtained. The stone is seen to be composed of various sized particles loosely aggregated together, and presenting a very rough surface; the red brick is smooth,

the fracture showing interstices of considerable size, while the white brick is not only smooth, but also dense, the interstices being very small; and every here and there minute spheres of molten glassy material are discoverable, showing the intense heat to which the brick has been subjected. Such a microscopic examination affords, to the architect and engineer, indications regarding the probable weathering power, which should never be overlooked in the selection of building material to be used in exposed locations, for the rough imperfectly cemented material not only favours the deposition of dust, which, being chiefly organic, furnishes a suitable nidus for vegetable growths, but it is also, by virtue of its structure, more friable, and, therefore, easily disintegrated by the forces to be considered hereafter.

The vegetable growth, of which we have spoken above, is a minute lichen, known as *Lepra antiquitatis*, and it grows with remarkable freedom on such hygroscopic rocks as the sandstones, as any one may satisfy himself on examining the houses on the cross, or east and west, streets of New York.

The percolation or passage of water takes place even in the densest rocks, as trap and basalt, for, in the interior of even the most compact specimens of these rocks, spots of moisture are often found on breaking them, and Bischoff states that these are always connected with minute fissures, the edges of which often show effervescence when they are touched with acid, thereby demonstrating that water may convey into, or produce carbonates, even in these dense rocks, and thereby alter their structure. This being the case with compact rock, we can form some idea of the manner in which percolating water acts on such loosely cemented material as the different kinds of sandstone.

Of the agents engaged in the disintegration of rock, one of the most efficient is frost. In its action, two elements are involved, namely the friability of the material and its hygroscopic power. The difficulty attending the direct application of cold in the examination of the action of frost, has led to the use of other and similar means. Among these none is better adopted for the purpose in view than that of dipping the material to be examined in a saturated solution of sulphate of soda, and allowing the salt to crystallise when the specimen has been thoroughly saturated with the saline solution. The crystallisation of the sulphate of soda, on and in that substance, brings to bear upon its particles the same kind of force as that produced in the crystallisation or freezing of water, and particles are torn off or separated exactly as in the latter operation. In employing this test I soaked the rock in the solution for about four hours, and let it dry and crystallise for twenty hours. The loosened material was washed off by a fine jet of water from a washing bottle, the sample re-dipped for four hours, and again set to crystallise. This was repeated eight times, the experiment extending over a period of eight days, with the following results:—

Table I.

Brown stone	10,000 parts	lost	191	of substance.
Nova Scotia stone ..	,,	,,	441	,,
Red brick	,,	,,	74	,,
White brick	,,	,,	24	,,

The disintegration is very nearly in the ratio of 1 for the white brick, 3 for the red, 8 for the brown stone, and 18 for the Nova Scotia stone, a result which furnishes information of the greatest value from an economic point of view, and which cannot be too strongly insisted upon in a country where so little attention is paid to the durability of public and private edifices.

The long periods of time required for the performance of the crystallisation test, led me to make a series of experiments to find a quicker method of arriving at a reliable determination of the friability of these substances. The plan I endeavoured to apply was to heat the specimens to a temperature of about 600° F., and then quench them while hot in cold water. The sudden chill and formation of steam on the surface of the masses caused them to disintegrate superficially, the amount of material removed after the repetitions of the chill being—

Table II.

Brown stone	10,000 parts	lost	202	of substance.
Nova Scotia stone..	,,	,,	597	,,
Red brick	,,	,,	82	,,
White brick	,,	,,	43	,,

Which gives a ratio of 1 for the white brick, 2 for the red, 5 for the brown stone, and 14 for the Nova Scotia. These results do not agree exactly with those given by the sulphate of soda test, but they approach them more closely than could have been expected considering the different character of the force applied.

Though the chilling test described above may be objected to as not meeting the conditions prevailing during the action of frost, but being rather the opposite, on account of the employment of heat in place of cold, it gives results which are very significant when viewed in relation to the power of brick and stone to resist the destroying action of great conflagrations. The conditions of the experiment are almost identical with those presented by a building on fire, for in each case the substance is alternately heated by the flames and chilled by the water thrown to quench them. The table, therefore, gives a very fair estimate of the relative powers of the materials in question to resist such destructive action.

The chemical ingredients of the air that act on building materials are carbonic, nitric, sulphuric, and sulphurous acids. The first of these is always present as the product of combustion, and, when dissolved in rain-water, forms a solution which readily dissolves marble and other limestones, and even acts on dense granite and other rocks. Sulphuric and sulphurous acids are both found in appreciable quantity in the air of all localities where coal is used as fuel. Nitric acid is, in its turn, at times an ingredient of the air, especially after great displays of lightning; it also is produced, under certain conditions, during the decomposition of organic matter containing nitrogen. To determine the action of these acids on the materials with which I was experimenting, I placed portions of them in dilute nitric acid, and left them in contact with the liquid for two weeks. I then kept them in water for ten days, changing the water every day to ensure the removal of all soluble material; they were then dried, and being weighed, gave the following results:—

Table III.

Brown stone	10,000 parts	lost	214	of substance
Nova Scotia stone ..	,,	,,	66	,,
Red brick..	,,	,,	33	,,
White brick	,,	,,	7	,,

In which the ratio of disintegration is 1 for the white brick, 5 for the red, 9 for the Nova Scotia stone, and 30 for the brown stone. From this it would appear that the reason the brown stone disintegrates so rapidly in New York is its greater susceptibility to the action of the acid products of organic decomposition and combustion, where the cementing material is dissolved or weakened, and pores and fissures in the rock being opened, it is less able to resist the attack of frost. The Nova Scotia stone, on the contrary, is a more friable material than the brown stone; yet being less acted upon by the acid waters, it resists the process of decay better. The superiority of the white over the red brick, in this respect, is even more marked than under the other tests, and, taken with them, gives unquestionable evidence of the weather-resisting power of this hard-burned compact brick.—*Scientific American.*

A REACTION OF PHENOL.

By C. CRUMP.

If a current of ordinary coal-gas be passed into a flask containing a mixture of equal parts of phenol and strong sulphuric acid, the liquid soon becomes coloured and thick, so that unless the flask be gently heated, the passage of the gas is interrupted. After a few hours, if the contents of the flask be poured into water, a red colouring matter is obtained insoluble in water, soluble in alcohol and in alkaline solutions, its colour being changed by the latter to blue or green. The formation of the colour is not prevented by previously passing the gas through dilute sulphuric acid, solution of caustic potash, or of cupreous chloride either in hydrochloric acid or ammonia, nor does the colour seem to be produced by passing any of the ordinary constituents of coal-gas into the mixture. A similar substance, however, seems to be formed by digesting the mixture of phenol and sulphuric acid for some time at a gentle heat with two or three times its volume of commercial benzol.

PROCEEDINGS OF SOCIETIES.

ROYAL DUBLIN SOCIETY.

At the evening Scientific Meeting of the Society, held on the 18th, Professor R. Ball delivered a discourse on the "*Conservation of Energy*," illustrated by experiments. These discourses, to which ladies have been admitted, have proved most successful. The lecturer treated his extensive and difficult subject in an able, and at the same time popular, form. He divided his discourse into five parts. 1. The different forms of energy and their mutual convertibility. 2. The indestructibility of energy. 3. The conservation of energy. 4. The distribution of energy throughout the universe. 5. The dissipitation of energy.

At the conclusion of the lecture Professor Ball spoke in eulogistic terms of Sir Wm. Thomson's finite theories of the universe. In mentioning the names of those connected with his subject, the lecturer omitted, evidently by an oversight, the names of Grove and Mayer. To these illustrious names are due the first speculations as regards the connection of the various forms of energy.

The experiments were frequently novel, and were in every case perfectly successful.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, November 27, 1871.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Optical and Crystallographical Observations on the Montebrasite and the Amblygonite of Montebras (Creuse).—Dr. Des Cloizeaux.—An exhaustive essay, illustrated by engravings.

Thermal Researches on Electrolysis.—P. A. Favre.—The continuation of the author's experiments.

Three Enormously Large Meteorites.—M. le Ministre de l'Instruction Publique.—The author states that he has received from the French Consul at Elseneur (Danemark) a letter communicating the arrival at Copenhagen of the two Swedish men-of-war sent to Groenland, there to take on board three very large meteorites discovered in that country by the Swedish *savant* Nordenskiold last year. By arrangement with the Danish Government, the Government of Sweden equipped the vessels to convey the meteorites to Europe. Two of these masses, weighing respectively 49,600 and 10,000 lbs., have been sent to Stockholm, while the third, weighing 20,000 lbs., has been presented to the museum at Copenhagen. The ponderous masses surpass in weight and size any meteorites yet found, excepting that the San Gregorio meteorite of the Mexican desert exceeds in weight and, in all probability, in size, the least weighty of the masses alluded to.

Separation of Potassa from Soda.—Th. Schlœsing.—The contents of this paper will be translated in our columns.

New Observations on the Alternating Predominance of Nitrous and Nitric Acid in Rain-Water.—Dr. Chabrier.—The main gist of this paper is that, during calm weather and a cloudy sky, rain-water usually contains nitrous acid, while, during storms and violent commotions of the atmosphere, nitric acid prevails.

Experimental Researches on the Properties of the So-Called Drying Oils.—Dr. Sacc.—The contents of this paper agree mainly with the exhaustive researches made several years ago by G. J. Mulder, and published in a separate volume in the Dutch language. An excellent abstract of these researches is published in *Jahresbericht über die Fortschritte der Reinen, Pharmaceutischen, und Technischen Chemie* for 1865, pp. 323 to 326.

Some Facts Relating to the History of the Phenols.—Drs. Dusart and Ch. Bardy.—The authors communicate the results of a series of experiments made with the view to prove that the class of bodies termed phenols and their compounds resemble in their chemical character some of the hydrocarbons they are derived from, and also, though with less strong affinity, the character of alcohols with which, if they are mixed, they form, under the influence of acids for instance, double ethers, which appear to be identical with those formed by the distillation of salycilates, and discovered by Professor Cahours.

Musical Sounds Produced by the Opening of the Safety-Valve Fitted to Air-Balloons while Ascending in the Atmosphere.—W. de Fonvielle.

Journal für Gasbeleuchtung und Wasserversorgung, No. 21, 1871.

In addition to a series of original papers relating to gas- and water-works' engineering and management, this number contains—

The Description of an Apparatus for So-Called Cold Gas Manufacture.—Dr. N. H. Schilling.—The author illustrates by a woodcut an apparatus essentially contrived for the preparation of hydrogen by the aid of iron and sulphuric acid, the gas being next forced through gasoline, and thus rendered luminous. It appears that in America, viz., the United States and the Brazilian Empire, this mode of obtaining gaslight is used in some localities, but is, after all, an expensive and by no means complete substitute for coal-gas. Dr. Philipp's carboxygen illumination is found superior and also less costly.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 17, 1871.

This number contains the following original papers and memoirs:—

Silico-Heptyl Series.—A. Ladenburg.—The silico-heptyl ether, $Si(C_2H_5)_3OC_2H_5$, is a substance not acted upon by contact with air, not decomposed when treated at 250° with alcoholic ammonia solution, and decomposed by water at a temperature of 200°. Among the products of decomposition is the body $SiC_6H_{15}(OH)$, mixed with other substances having a higher boiling-point, and from which it was impossible to separate this substance. When the silico-heptyl ether is treated at 180° with chloracetyl (equal number of molecules of each of these bodies) in a sealed tube, and the resulting product fractionally distilled, two substances are obtained, one of which, boiling at between 70° and 80°, was proved to be acetic ether; the other, boiling at between 142° and 145°, was, on analysis, found to consist of $SiC_6H_{15}Cl$, silico-heptyl chloride; exact boiling-point when pure, 143·5°; smells like camphor; sp. gr., at 0°, 0·9249; is not decomposed by alcohol alone, but is instantaneously decomposed by aqueous and alcoholic solutions of ammonia, and by aqueous solution of nitrate of silver. By the action of liquid ammonia, the silico-heptyl chloride yields a compound, $SiC_6H_{16}O$, a fluid boiling at 153·5°; vapour density = 124·3; constitutional formula, $Si(C_2H_5)_3(OH)$. The author proposes for this new class of compounds the name of silicols. This substance is a carbohydrate. Triethyl-silicol is insoluble in water, miscible with ether and alcohol, and burns with a bright flame, leaving silica; smells like camphor; sp. gr., at 0° = 0·8709.

New Locality in the Ural (Russia) where Diamonds Occur.—G. Rose.—After first briefly alluding to the finding of a diamond in Bohemia about two years ago, the celebrated *savant* communicates the finding of very small-sized diamonds, not as usual among the detritus of disintegrated rocks, but imbedded in xanthophyllite, a mineral occurring in the talcose schist of Achmatowsk, near Statoust, in the Southern Ural. The researches of Drs. Jeremejew and Lissenko, at St. Petersburg, leave no doubt of the correctness of this important discovery, which is of great interest in reference to the origin and formation of diamonds, which, in the locality alluded to, as also in the Bresil, occur in so-called metamorphic rocks. The author considers that diamonds may be remnants of organic material, the great mass of which has been destroyed by the metamorphosis the

rocks, originally of so-called Neptunic origin, have undergone; but no reply can be given to the question, why in the itacolumite of the Bresil the diamond should have been formed, and in that of Silesia (Strehlen) only graphite.

Pyrocatechin Met with as a Constituent of a Living Plant.—Dr. E. von Gorup-Besanez.—While engaged with a chemical research of the leaves of *Ampelopsis hederacea* (so-called wild vine), the author found that the filtrate of a precipitate caused by acetate of lead on being neutralised with milk of lime turned first bright green, then brownish green, becoming at last nearly black, reactions exhibited by pyrocatechin. On entering more particularly into this matter, the author succeeded in extracting from 2½ kilos. of the fresh green leaves of the plant, a small quantity of a body, which in all its reactions, agreed with those of pyrocatechin, viz., solubility in water, alcohol, and ether; precipitation of aqueous solution by acetate of lead; reduction of solutions of copper and silver when gently heated; olive-green colouration with somewhat oxidised solution of sulphate of iron, and emerald-green colouration with chloride of iron, turning violet by the addition of a drop of a dilute solution of bicarbonate of soda; lastly, microscopical research exhibited perfectly defined crystals of pyrocatechin. Although this body has been discovered by Eisfeldt in Malabar kino, but not in Butea kino, it does not follow that pyrocatechin should be present in the living plant *(Pterocarpus marsupium)* from which the former kind of kino is obtained. Moreover, the preparation of the drug alluded to is by no means well known; according to Hoppe-Seyler's researches, pyrocatechin is formed from carbohydrates when heated along with water under pressure, as well as by treating the carbohydrates with alkalies. In addition to pyrocatechin, the author of this memoir found, in the leaves alluded to, bitartrate of potassa, tartrate of lime, free tartaric acid, gum, and a mixture of dextrose and levulose, the former predominating.

Lecture Experiment—The Sounds (Das Tönen) of Reciprocal Flames.—M. Ballo.—The contents of this paper cannot be well understood without the reproduction of the annexed woodcut.

Anilides of the So-Called Carbohydrates.—H. Schiff.—After first briefly referring to the researches of R. Sachsse (see Chemical News, vol. xxiv., p. 263), and next to his own researches on the action of aniline upon glycose (*Ann. d. Chem. u. Pharm.*, cxl., p. 123; cliv., p. 30), the author further states that when equal parts by weight of anhydrous glucose and aniline are mixed and heated there is obtained, with elimination of water, a deep yellow-coloured mass, which is decomposed by water and dilute acids; in its constituents any excess of aniline can, therefore, only be removed by benzine. The composition of this glucosanilide is $C_{12}H_{17}NO_5 = C_6H_{12}O_6 + C_6H_7N - H_2O$. The action of aniline upon cane sugar is far more difficult, and, since it requires a temperature of from 200° to 220°, the greater part of the sugar is converted into caramel, and an impure compound is obtained. The author, therefore, caused aniline to react upon pure caramel, prepared at a temperature of from 220° to 230°; formula, $C_6H_8O_4$. At 200°, this substance dissolves readily in aniline, the excess of which having been first removed by distillation, the residue is treated with ether, yielding a brown-coloured flocculent substance readily soluble in hot alcohol. After having been purified by being treated with animal charcoal, the composition of this combination was found to be $C_{30}H_{31}N_3O_5 = C_{12}H_{16}O_8 + 3C_6H_7N - 3H_2O$. This body is a fusible substance, glass-like on solidifying; combines with acids, the hydrochlorate forming with platinic chloride an amorphous cinnamon-brown coloured double salt, $2C_{30}H_{31}N_3O_5,H_2PtCl_6$. The combination between aniline and the glucose remnants *(Glycose rückständen)* may be expressed by the following formula:—

$$\left\{\begin{array}{l} CH.N.C_6H_5 \\ CH- \\ CH- \\ CH- \\ CH- \\ CH_2- \\ CH_2- \\ CH- \\ CH- \\ CH.OH \\ CH.OH \\ CH.N.C_6H_5 \end{array}\right. \begin{array}{l} \\ >O \\ \\ >O \\ \\ >N.C_6H_5 \\ \\ >O \\ \\ \\ \\ \\ \end{array}$$

Starch is converted into dextrine when boiled with aniline, and gum, as well as dextrine, does not yield, it appears, any definite compound with aniline, which, at 200°, does not also act upon glycerine.

Oil Contained in the Pips of Grapes and Raisins.—A. Fitz.—This very lengthy memoir is divided into the following sections:—Description of the physical properties of this oil and of its products of saponification by means of caustic potassa; investigation of the fatty acids and the derivatives thereof; crucasic and brassidic acids; action of fusing caustic potassa upon erucasic acid.

So-Called Glycerin-Ether.—H. von Gegerfelt.—After referring to the researches of Linnemann and Zotta on a compound resulting from the action of chloride of calcium upon glycerine, which the chemists just named state to be identical with Tollens's monallylin = $C_6H_{10}O_3$ or glycerin-ether, the author states that he discovered a substance of the same composition, by the distillation of glycerine left in a retort after the preparation of allyl alcohol. The purified substance boils at between 170° and 172°; is colourless, somewhat thick, and miscible with water, alcohol, and ether in every proportion; sp. gr., at 17° = 1·0907. Tollens's monallylin boils at 240°; sp. gr., at 0° = 1·116. Linnemann's and Zotta's compound boils between 169° and 173°. The author winds up his paper with a discussion on the rational formula to be given to these compounds, but states that, owing to not having a sufficient quantity of material, he could not finish his experiments at present, intending, however, to return to this subject.

Observation on a Paper on Bryonicin.—L. de Koninck and P. Marquart.—The authors mainly state that all they have stated in a formerly published paper on bryonicin (see Chemical News, vol. xxi., p. 227) is to be transferred to nitro-naphthaline and its derivatives. Researches now instituted with the root of the *Bryonis dioica* led to a negative result, and, by what the authors relate, it would appear that the chemist then (viz., at the time of communication of the first experiments) attached to the manufactory of the last-named author either made a mistake, or played them a trick, when he asserted that the material the authors experimented with and published their researches on was obtained from the root alluded to.

Some Mistakes Published in the Memoir "Mesure des Propriétés Explosives du Chlorure d'Azote," by Drs. H. Sainte-Claire Deville and P. Hautefeuille.—J. Thomsen.

Action of Hydrobromic Acid upon Mononitro-Naphthaline.—H. Baumhauer.—After first referring to his former researches on the action of hydrobromic and hydrochloric acids upon mononitro-benzol, the author proceeds to relate the results of his experiments on the action of hydrobromic acid at 195° upon mononitro-naphthaline, the substances being heated in sealed tubes. One of the two new bodies formed by this reaction did not possess basic properties, but was found to be, after having been purified, a crystalline white-coloured substance, fusing at 110°, and exhibiting a distinct reaction of bromine. The other body, a fluid, boiled at between 275° and 295°, and was also free from nitrogen, but contained bromine. The reaction differs in this instance from that which obtains with nitro-benzol. Since, in this instance, the nitro-group is eliminated, and not converted into NH_2, the process may be illustrated by the following formula:—

$$C_{10}H_7.NO_2 + 2HBr = C_{10}H_7Br + Br + H_2O + NO.$$

If, in this manner, 2 molecules of nitro-naphthaline have been decomposed, the 2 atoms of bromine set free are sufficient to convert 1 molecule of monobrom-naphthaline into bibrom-naphthaline—

$$C_{10}H_7Br + 2Br = C_{10}H_6Br_2 + 4Br.$$

Freezing-Point of Bromine.—H. Baumhauer.—Beginning with the observation that great difference of statements exist on this point, and quoting as instances that Dr. Roscoe, in his excellent book on chemistry (German edition, 1871), states that bromine is solidified at −22°, while Dr. von Gorup-Besanez (1871) mentions −7·3° as the freezing-point of bromine, the author has verified this matter with perfectly pure and anhydrous bromine. As result of his experiments, he finds that this haloid freezes at −24·5, forming, not as generally stated, a lead-grey coloured, but a reddish-brown coloured, solid crystalline mass. Since, in the presence of water, bromine forms a hydrate which has a far higher freezing-point, the author thinks that the quotation −7·3° for the freezing-point of bromine has arisen from the fact that a hydrate of that element has been experimented with.

On Phenaconic and Fumaric Acids.—L. Carius.—The contents of this paper are to be considered as a preliminary notice; as yet the author only calls attention to the fact elicited by his researches that phenaconic acid is identical with fumaric acid. The complete results of the researches on this subject will be published later.

Chemistry at the Meeting of the Russian Savants and Philosophers at Kiew.—V. von Richter.—During the meeting of the British Association at the modern Athens, the capital of Scotland, the *savants* and philosophers of the Russian empire assembled in large numbers at Kiew for a similar purpose. From the contents of this lengthy memoir, it appears that chemistry was fully and creditably represented by men who are, in all respects, an honour to their country. As the brief quotations made here are to be published in more complete form at a future day, we do not enter into the details of the contents of this memoir, but we may yet mention that Kiew has been selected on account of being the centre of the highly developed beet-root sugar industry of south-eastern European Russia, as well as on account of its excellent situation and celebrated university.

Zeitschrift für Chemie von Beilstein, No. 13, 1871.

This number contains the following original papers and memoirs:—

Quantitative Estimation of Sulphuretted Hydrogen mixed with Carbonic Acid.—R. Fresenius.—A strong solution of sulphate of copper is first intimately mixed with and absorbed by pea-sized lumps of pumice-stone, and this mass dried at first gently, and afterwards heated to about 150°—160°; the dried lumps are next placed in U-shaped tubes, that placed next to the gas-evolving apparatus being partly filled with fused chloride of calcium; 14 grms. of the pumice-stone, prepared as mentioned, may absorb 0·2 grm. of sulphuretted hydrogen; the material alluded to is very useful for determining sulphuretted hydrogen and carbonic acid, the latter being, of course, absorbed by soda-lime, and the gases dried previous to reaching the absorbents in ball-soda.

Quantitative Estimation of the Tannin contained in Oak Bark.—C. Neubauer.—The author describes at length a very complicated process for the estimation of the substance alluded to, the process being based upon the fact that when a solution (infusion) of oak bark is mixed with indigo-carmine, and permanganate of potassa added, the blue colour of the indigo is destroyed simultaneously with the tannin. The process described requires several titrated liquids, viz., a solution of indigo-carmine, a standard solution of tannin, a standard solution of permanganate, and a decimal normal solution of oxalic acid. Although the process here detailed may yield very correct results in the hands of an experienced analytical and volumetrical chemist, it is not well suited for technical use in tan-yards.

More Important Gravimetrical Methods for the Quantitative Estimation of Arsenic.—R. E. O. Puller.—The author

compares together the process of estimation as arsenicum-trisulphide, as ammonium-magnesium-arseniate, and as uranium oxide-arseniate. As regards the first-named, it may be used for the quantitative estimation of arsenic by removing any free sulphur it contains by the aid of sulphide of carbon; the precipitate (tersulphide of arsenic) may be heated without loss even to 160°. As regards the second, the author quotes its degree of solubility in various fluids: 1 part of the anhydrous salt is soluble in 2784 parts of water; 15,904 parts of a mixture of 1 part of ammonia and 3 parts of water; in 1386 parts of a solution of 1 part NH_4Cl in 60 parts of water; in 886·7 parts of a solution consisting of 1 part of NH_4Cl in 7 parts of water; in 2879 parts of a mixture of 1 part of NH_4Cl in 10 parts of ammonia (sp. gr., 0·96) and 60 parts of water; in 32,827 parts of Fresenius's magnesium mixture. Dried at 100° the composition of the ammonium-magnesium-arseniate is $2(NH_4MgAsO_4)+H_2O$; carefully ignited in a current of oxygen gas the salt leaves $Mg_2As_2O_7$; the third-mentioned compound, produced by acetate of uranium in a solution of arsenic acid, is insoluble in water and acetic acid: boiling of the liquid aids the precipitation greatly, and the settling of the precipitate is greatly promoted by the addition of a few drops of chloroform; the washed and dried precipitate should be ignited in a current of oxygen, or, before ignition, moistened with some nitrate of ammonium solution; the ignited precipitate consists of $(UrO_4)As_2O_7$; results very correct.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, October, 1871.

This number contains the following original papers and memoirs:—

Progress of the Cultivation of the Cinchona Bark.—Dr. F. A. Flückiger.—A botanico-pharmacognostical essay, exhibiting, in a clearly written style, the real value of this important subject.

Chemical Investigation of the Fruit of the Vaccinium Vitis-Idæa (the Cowberry, or Red Whortleberry).—Dr. Grüger.—The berries alluded to belong to the cranberry family, and grow wild in many parts of Europe. The berries contain in 100 parts:—Water, 85·611; soluble matter, 10·185; insoluble, viz., cellulose, pectose, &c., 4·204. The juice consists, in 100 parts, of:—(*a*) Organic matter, viz., free acid, hydrate of malic, 1.9750; grape sugar, 5·1850; tannic acid, 0·4760; albuminous matter, pectine compounds, and suspended fatty matter, 2·3330; (*b*) Inorganic matter, viz., potassa, 0·0580; lime, 0·1280; magnesia, 0·0114; peroxide of iron, 0·0186; water, 89·8150; total, 100·000. This paper contains, further, a very complete and detailed account of the method of analysis pursued by the author in this research.

Methods for the Preparation of Tartar Emetic free from Arsenic.—S. Lovén.—This paper describes a series of pharmaceutical experiments made with the view to ascertain under what conditions the salt alluded to may be obtained free from arsenic, the antimonial preparation which forms the starting-point of the preparation being the black commercial sulphuret of antimony. The author found that when this compound is treated with hydrochloric acid (sp. gr., 1·17), and the mixture at first slowly heated and brought to the boiling-point, and kept boiling as long as sulphuretted hydrogen is evolved, and afterwards slowly cooled, the sulphuretted hydrogen present in the liquid causes the complete precipitation of the arsenic originally present in the crude sulphuret of antimony.

NOTES AND QUERIES.

Dehydrating Oxalic Acid.—I should feel obliged if any of your correspondents would inform me of the best mode of dehydrating oxalic acid; and also if a mixture of hehydrated oxalic acid and ether would form oxalic ether.—Q. R.

Gas-Proof Fabric.—(Reply to "L.R.C.P. Ed.").—You will find mentioned in Cooley's "Cyclopædia of Practical Receipts," under the head of "Varnish," several mixtures which will answer your purpose; well-boiled linseed oil, or a solution of caoutchouc in that fluid, are generally applied.

The Solubility of Black Silk.—I enclose two patterns of black silk, and according to one of your contributors silk is soluble in hydrochloric acid. I failed in half an hour to dissolve the black portion of both samples. The orange spot of one and green stripe of the other dissolved immediately. The black colour impedes my microscopical observations. Will the black dye impede or prevent the action of the hydrochloric acid? The determination of the composition of woven and dyed fabrics is certainly a work of great difficulty, and in the present dishonest state of trade instant detection is a desideratum. All I know about the patterns is that the dresses are said to have worn badly. Strong caustic soda breaks up the fibres transversely, and discharges much of the colour. I fail to obtain the usual appearances of silk under such treatment.—W. T. S.

TO CORRESPONDENTS.

ERRATUM.—Vol. xxiv., p. 283, line 34 from top, *for* "(FeO_3)" *read* "(Fe_2O_3)."

A. H. A.—(1.) The CHEMICAL NEWS will contain reports. (2.) Messrs. Hopkin and Williams, New Cavendish Street, W.C.

B. W. Gibsone, M.A.—Thanks for your letter, but the subject has been discussed so fully in the *Times* that it will not interest our readers.

L. P.—You had better apply to an analytical chemist.

TEXT-BOOKS OF SCIENCE.

Now ready, in small 8vo., price 3s. 6d.,

The Theory of Heat. By J. Clerk Maxwell, M.A., F.R.SS. L. & E., Professor of Experimental Physics in the University of Cambridge.

Being the Sixth of the New Series of Elementary Works on Mechanical and Physical Science in course of publication, edited by Professor T. M. GOODEVE, M.A.

Text-Books previously published, price 3s. 6d. each:—

1. GOODEVE'S MECHANISM.
2. BLOXAM'S METALS.
3. MILLER'S INORGANIC CHEMISTRY.
4. GRIFFIN'S ALGEBRA AND TRIGONOMETRY.
5. WATSON'S PLANE AND SOLID GEOMETRY.

London: Longmans, Green, and Co., Paternoster Row.

PRACTICAL CHEMISTRY.

Laboratory, 60, Gower Street, Bedford Square, W.C.

Mr. Henry Matthews, F.C.S., is prepared to give Instruction in all branches of PRACTICAL CHEMISTRY, particularly in its application to MEDICINE, AGRICULTURE, and COMMERCE.

The Laboratory is open daily, except Saturday, from ten to five o'clock; on Saturday, from ten till one o'clock.

Mr. Matthews is also prepared to undertake ANALYSES of every description.

For Particulars and Prospectuses, apply to Mr. Henry Matthews, the Laboratory, 60, Gower Street, Bedford Square, W.C.

BERNERS COLLEGE of CHEMISTRY.—EXPERIMENTAL MILITARY and NAVAL SCIENCES, under the direction of Professor E. V. GARDNER, F.E.S., &c.: of the late Royal Polytechnic Institution and the Royal Naval College.

The Laboratory and Class Rooms are open daily.

Especial facilities for persons preparing for Government and other examinations.

Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

For particulars, &c., apply to Prof. E. V. G., 44, Berners-street, W.

ANALYTICAL LABORATORY AND SCHOOL OF TECHNICAL CHEMISTRY.

7 and 9, HACKIN'S HEY, LIVERPOOL.

Conducted by A. NORMAN TATE, Analytical and Consulting Chemist, and Chemical Engineer.

Established for Educational Purposes connected with Chemistry in its practical Applications to Manufactures, Commerce, &c.; for the performance of Analyses, Assays, and Chemical Investigations; and for affording information respecting the construction, &c., of Chemical Manufactories, and the conduct of Chemical Manufacturing Processes.

The Course of Instruction, in addition to the ordinary Chemical studies, comprises, as far as possible, all such other subjects as are necessary to give the scientific and practical information required in the Arrangement, Construction, and Management of Chemical Manufactories, and in the Application of Chemistry to Industrial Pursuits.

Students' Fees may be known on Application.

Plans, &c., for Chemical Apparatus and Manufactories are supplied and the erection of Plant and Buildings is superintended when required.

AMSTERDAM EXHIBITION, 1869.

The GRAND DIPLOMA of HONOUR, being the First Prize, and SUPERIOR to the Gold Medal.

Liebig Company's Extract of Meat.—Paris EXHIBITION, 1867, TWO GOLD MEDALS; HAVRE EXHIBITION, 1868, THE GOLD MEDAL.—Only sort warranted perfect and genuine by BARON LIEBIG, the Inventor. "A success and a boon."—Medical Press and Circular. One pint of delicious beef-tea for 2½d., which costs 1s. if made fresh from meat. Cheapest and finest-flavoured "stock" for soups, &c.

CAUTION.—Require BARON LIEBIG'S signature upon every jar Sold by all Italian Warehousemen, Grocers, Chemists, and Ships. Store Dealers; all Wholesale Houses; and of LIEBIG'S EXTRACT of MEAT COMPANY (LIMITED), 43, Mark Lane, E.C.

NOTICE.—Various chemical analyses have been published purporting to show a fraction more of moisture to exist in the Company's Extract than in some imitation sorts. It is extremely easy to evaporate the water almost to any extent, but it is quite as certain that the fine meaty flavour which distinguishes the Company's Extract from all others would be destroyed if the concentration of the Extract were carried beyond a certain degree. Beef-tea made from Liebig Company's Extract with *boiling-hot water* will be found to be greatly superior in flavour, strength, clearness, to any other sort. This explains the universal preference it obtains in the market.

This Extract is supplied to the British French, Prussian, Russian and other Governments.

THE

MANUFACTURE OF CHLORINE.

ALTHOUGH the development of the process for the Manufacture of Chlorine by means of oxides of manganese regenerated by means of magnesia, to which reference was made on this page some months ago, has been sorely delayed by serious ill-health on my part, I am nevertheless in a position to announce that that process, in a certain modified form which it has now assumed, has proved capable of yielding even more advantageous results than I formerly claimed for it. It will necessarily be yet some time before I can be able or free to supply working details. Meanwhile, I beg to report as follows :—

I. That the new form of process yields, in the free state, practically *all* the chlorine contained in the salt decomposed, being at about the rate of *a ton of bleaching-powder per fourteen hundredweights of salt.*

II. That, of the chlorine which it thus yields, a sufficient proportion to give a ton of bleaching-powder for about each thirty hundredweights of salt is ENTIRELY UNDILUTED, and therefore available for the manufacture of bleaching-powder in the chambers at present in use. This portion of the chlorine is generated in the ordinary (Weldon) stills, and is in precisely the same condition as that produced in my process as at present practised, or as that generated by means of native manganese.

III. That, while the remainder of the chlorine is *dilute*, it is not more so than that produced in any process yielding dilute chlorine only, and is free from carbonic acid, the sole diluent being nitrogen.

IV. That the process, in its new shape, is performed without blowing engines, and *without machinery of any kind*, by appliances already in use in every alkali-work, the only thing employed in it which has any "moving parts" being an ordinary liquor-pump.

The new form of process thus yields more *strong* chlorine, per given quantity of salt, than has ever hitherto been produced by any process whatever, and, in addition, yields the remainder of the chlorine in as good a state as the richest chlorine producible by any process which yields dilute chlorine only. While permitting the present production of bleaching-powder, per given quantity of salt, to be nearly *quadrupled*, it enables one-half of the quadrupled production to be made from undiluted chlorine, in such chambers as have been employed hitherto, and one-half of the chlorine to be generated in the present stills. Putting the whole cost of the process on the *strong* chlorine only, the cost of the latter, per ton of bleaching-powder, promises to be lower than it has ever been yet, the other half of the chlorine counting as not costing at all. Lastly, the special plant required for the new form of process is so simple and inexpensive, that the cost of a plant for any considerable production will probably not exceed £20 for each ton of bleaching-powder to be made by it per week.

WALTER WELDON.

OFFICES OF WELDON'S CHLORINE PROCESSES COMPANY, (LIMITED),
59, LINCOLN'S INN FIELDS, LONDON, W.C.

December 12th, 1871.

THE CHEMICAL NEWS.

Vol. XXIV. No. 631.

NOTE ON FUCUSOL.*

By JOHN STENHOUSE, LL.D., F.R.S.

In a paper which I communicated to the Royal Society of London in 1850,† "On the Oils produced by the Action of Sulphuric Acid upon various Classes of Vegetables," after describing the sources, method of preparation, and characteristic properties of furfurol, and its educts, I described another isomeric substance closely resembling furfurol, both in its physical and chemical properties, and which I named fucusol from the source whence it had been obtained, namely, *Fucus nodosus*, *F. vesiculosus*, and *F. serratus*, &c.

The nature of the substance which yielded furfurol was involved in considerable obscurity until the publication of Gutzkow's paper "On the Furfurol-yielding Substance in Bran,"‡ which he found to be present in it to the amount of 15 to 20 per cent, and which, when boiled with dilute sulphuric acid, was converted into a brownish sweet syrup. This is the substance from which furfurol is obtained by distillation with sulphuric acid or hydrochloric acid.

Fucusol.

I have found that when sea-weeds were boiled with very dilute sulphuric acid, containing about 3 per cent of acid, that a substance corresponding to that described by Gutzkow was obtained, which, when distilled with sulphuric or hydrochloric acid, yielded fucusol. In my paper of the year 1850 I have described the difference in the physical properties of furfurol and fucusol, and also the difference between the products obtained by the action of ammonia upon them and the bases derived from these. I have again repeated the examination of these substances with great care, and find my former statements to be correct. In addition to these, I have recently prepared the aniline compound analogous to furfuraniline.‖ *Fucusaniline* hydrochlorate crystallises in needles of a magnificent purple colour, and closely resembles the corresponding furfurol compound.

As is well known,§ when furfurol is boiled with water and silver oxide, metallic silver is deposited and silver pyromucate formed, which remains in solution. In a similar manner I found that when fucusol was digested at 100° C. for five or six hours with an excess of recently precipitated silver oxide and a considerable quantity of water, its odour gradually disappeared, and at the completion of the reaction a silver-salt was found in solution, whilst metallic silver was deposited, partly in a granular state, and partly as a mirror, on the bottom of the flask. Sufficient hydrochloric acid was then added to the hot filtered solution to precipitate the silver. After the removal of the argentic chloride it was carefully evaporated at a temperature below 100°; and the brown semi-crystalline mass thus obtained boiled with light petroleum oil, which dissolved the acid and left the colouring matter. One or two crystallisations from boiling water rendered it quite pure.

Analysis.—0·188 grm. substance gave 0·370 grm. carbonic anhydride and 0·080 grm. water.

		Theory.	Found.
C_5	60	53·56	53·68
H_4	4	3·57	4·25
O_3	48	42·87	—
	112	100·00	

* A Paper read before the Royal Society.
† *Phil. Trans.*, 1850, p. 467.
‡ *Zeits. Chem.*, 1870, p. 360.
‖ *Proc. Roy. Soc.*, vol. xviii., p. 537.
§ *Ann. Chem. Pharm.*, vol. cxvi., p. 259.

From this analysis, it will be seen that this acid, which I propose to call *β pyromucic acid*, is isomeric with ordinary pyromucic acid, from which, however, it slightly differs in its physical properties. The melting-point of pure β pyromucic acid is 130°, being nearly the same as that of the acid obtained from furfurol, which I found to be 133°, and which Schwanert* gives as 134·3°. The β pyromucic acid from fucusol crystallises from its aqueous solution in small rhomboidal plates, whilst the acid which I had prepared from furfurol crystallised in flat needles.

Silver β pyromucate.—This compound was prepared from the pure β acid by boiling it for a short time with silver oxide and a sufficient quantity of water, filtering, and setting aside to crystallise. A single re-crystallisation from boiling water, in which it is only moderately soluble, rendered it quite pure. On cooling the hot aqueous solution, the silver β pyromucate is obtained in long flat needles, whilst the corresponding salt of the ordinary acid forms small crystalline scales; 0·505 grm. of silver-salt gave 0·330 grm. argentic chloride, which corresponds to 49·18 per cent of metallic silver. The formula $C_5H_3AgO_3$ requires 49·32 per cent.

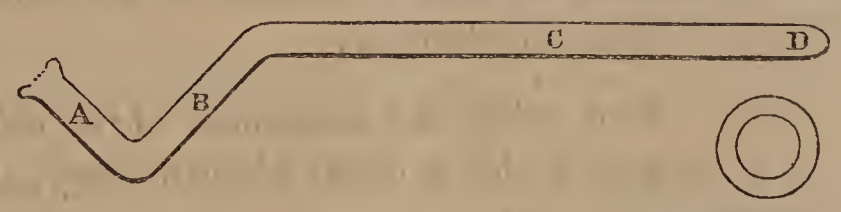
From this silver determination it will be seen that this compound is isomeric with the ordinary silver α pyromucate, $C_5H_3AgO_3$.

ON THE SOLVENT POWER OF LIQUID CYANOGEN.†

By G. GORE, F.R.S.

In the following experiments a number of stout tubes of refractory glass of the annexed shape were employed

Scale ¼.



Full sized section of glass tube.

Each tube was closed at one end, and had a flanged mouth at the other. The limb A was 1½ inches long, the limb B 2 inches, and C 7 inches.

In making the experiments, each tube was first filled to an extent of 5½ inches of its length, with highly dried crystals of mercuric cyanide: a small fragment of asbestos‡ was then pushed tightly against the end of the cyanide by means of a thin rod of gutta-percha, and the bend of the tube cleaned by means of a slender brush. A number of taper plugs of gutta-percha were previously made, by softening the end of a rod of that substance in boiling water, and then chilling it; and loops of thin copper wire were also prepared for the purpose of securing the plugs.

Having placed in the bend of the tube the substance to be operated on, a plug was wetted with chloroform, and at once firmly inserted in the mouth of the tube and secured by means of the wire. A wet rag was wrapped round the limb B, and the portion of the limb C containing the cyanide was inserted in a loosely-fitting tube of copper-foil within a tube of wrought-iron about 2 feet long, supported in a nearly horizontal position with the end D the lowest.

A vessel having been previously arranged to drop cold water continually upon the wet rag, a glass screen was placed by the side of the exposed part of the glass tube, and heat was gradually applied, by means of a row of Bunsen's burners, to the part of the iron tube containing the limb C. In about four minutes liquid cyanogen began

* *Ann. Chem. Pharm.*, vol. cxvi., p. 257.
† Read before the Royal Society.
‡ This may be dispensed with if the mercuric cyanide is perfectly dry.

to form, and in about five minutes longer about 2 inches in length of the bend was filled with that liquid, and the heat was then discontinued. The temperature of the iron tube was below that of visible redness: if the heat applied was not too great the glass tube retained its original form, and might afterwards be easily removed from its casing and set aside for future examination. A white fog, and signs of a heavy vapour in the bend of the tube, always immediately preceded the formation of the liquid. In many instances some of the cyanogen retained the liquid state for several days, and even weeks, especially if the bend of the tube was kept cool by means of a wet sponge.

The cyanide employed in the experiments should be crushed to a coarse powder, and highly heated a long time, with constant stirring, until it is of a slightly brown colour, otherwise, immediately previous to the appearance of the liquid cyanogen, a small quantity of a brownish treacly liquid distils over and affects the results.

More than 130 substances, including solids and liquids, and a great variety of simple and compound bodies, were subjected to the action of the liquid; the substances were in nearly all cases as free from moisture as it was possible to obtain them. The following are the results obtained:—

Substances Soluble in Liquid Cyanogen at 60° *F.*—Camphor dissolved rapidly and copiously. Hydrate of chloral quickly and freely. Solid C_2Cl_6 was freely soluble. Iodine was moderately soluble, and formed a deep red liquid. Picric acid moderately soluble; the solution was yellow. White phosphorus dissolved very slowly, and to but a small extent.* Gum benzoin, also white cane sugar, dissolved slowly and sparingly. Gum assafœtida and gamboge dissolved slightly, and formed yellowish liquids. Bisulphide of carbon, C_2Cl_2 and C_2Cl_4 mixed perfectly with the liquid; CCl_4 mixed less perfectly. Water was only slightly absorbed.

Substances Insoluble in Liquid Cyanogen at 60° *F.*—Water (nearly insoluble) would not mix with the liquid,† and produced no chemical change. Iodic acid. Fine lamp-black. Well-burned wood-charcoal (two kinds). Crystals of boron. Boracic acid. Crystals of silicon. Precipitated silica. Titanic acid. A fragment of sulphur. Selenium. Selenious acid. Tellurium. Arsenic. Arsenious and arsenic acids. Realgar. Orpiment. Antimony. Antimonic oxide. Antimonic acid. Fused fluoride of antimony. Red sesquisulphide of antimony. Bismuth. Fluoride of bismuth. The oxides of iridium and silver. Argentic nitrate, fluoride, chloride, iodide, and iodate. Mercury. Mercuric chloride. Copper. Cuprous iodide. Chloride of nickel. Iron. Mundic. Peroxide of manganese. Fluoride of manganese. Chromic oxide. Violet chloride of chromium. Oxide and fluoride of uranium. Red oxide and peroxide of lead. Plumbic chromate. Tin. Cadmium. Sulphide of cadmium. Zinc. Tungstic and niobic acids. Oxide of cerium. Carbonate of glucinum. Aluminium. Magnesium. Magnesia. Dry lime. Anhydrous carbonate of sodium. Potassic nitrate, bromide, iodate, and fluo-zirconate. Bichromate and bitartrate of rubidium. Bitartrate of cæsium. Chloride and carbonate of ammonium. Oxalate of cerium. Paracyanogen. Cyanide of mercury. Nitrocyanide of titanium. Pyrogallic, gallic, tannic, and succinic acids. Sulphate of quinine. Alloxan. Starch. Milk-sugar. Egg-albumen. Gun-cotton. The gums ammoniac, animi, copal, dammar, elemi, galbanum, guaiacum, juniper, kowrie, mastic, myrrha, olibanum, opoponax, sagapenum, seed-lac, shellac, thus, and tragacanth. Yellow resin. Egyptian asphalte. Gutta-percha. India-rubber. Paraffine. Anthracene. Stearine. Bees'-wax. Spermaceti. Aloes—Barbadoes, Cape, hepatic, and socotrine. Brazil-wood. Red santal-wood. Cuba yellow fustic. Terra japonica.

The following substances produced some changes, but did not dissolve:—Perfectly white and dry iodic acid made the liquid of a pink colour. Dry selenious acid and iodate of potassium became slightly pink. Yellow chloride of nickel (nearly anhydrous) became at once green.* Cuprous iodide acquired the colour of vermillion. Sesquicarbonate of ammonium became brown. The gums myrrha and guaiacum coloured the liquid yellowish. Bisulphide of carbon, saturated with sulphur, rapidly set free its sulphur in the form of crystals, the bisulphide being absorbed and dissolved by the cyanogen. A saturated solution of phosphorus in bisulphide of carbon quickly liberated its phosphorus in a similar manner, but not in a crystalline form. The contact of moisture and an alkaline substance with the liquefied gas caused the formation of a brown solid body, apparently paracyanogen.

From these results it is evident that liquid cyanogen, at 60° F., is a remarkably inert body, and possesses very little solvent power for substances in general; out of 132 substances only 14 were dissolved, and not a single one exhibited signs of strong chemical action.

* See also "Gmelin's Handbook," vol. viii., p. 147, article "Cyanide of Phosphorus."

† See "Gmelin's Handbook of Chemistry," vol. vi., p. 388.

* Probably in consequence of the presence of a trace of moisture.

ON THE ANALYSIS OF CHROME ORE.†

By JOHN CLARK, Ph.D.

In 1862 Dr. Genth called attention to the discrepancies between his own and other chemists' analyses of chrome ore, and even at the present day there are few analyses in which, generally speaking, the results of chemists disagree to a more marked extent. In addition to the difficulty of obtaining concordant results by different chemists, the consumers of chrome ore complain that in the manufacture of bichromate of potash there is a loss of oxide of chromium which they can only account for on the supposition that the chemist generally reports too high a result.

These complaints do not appear to be altogether unfounded. Undoubtedly, many discrepancies are due to differences in the sample, but still more so to the inexperience of the analysts and the difficulty of obtaining correct results by the ordinary methods of analysis. The impossibility of obtaining by washing alone an oxide of chromium precipitate perfectly free from alkali, after fusing the ore with bisulphate of potash, was recognised by Dr. Genth, who recommended that, before weighing, the ignited precipitate should be boiled with water containing sulphurous acid, to reduce the chromate which had been formed, and that the oxide produced by the reduction should be precipitated with ammonia. By this means the weight of the precipitate of oxide of chromium is considerably reduced, but in the experiments I have made never quite pure. Instead of boiling the ignited precipitate with water containing sulphurous acid, the precipitate may be boiled with dilute acetic acid, and the chromic acid thus removed estimated with a dilute solution of double sulphate of iron and ammonia of known strength. The oxide of chromium in the form of chromate usually amounts even in the most carefully washed precipitate to 0·76 per cent. Perfectly accurate results by the precipitation method without subsequent correction can, I believe, only be obtained in the absence of sulphates, as, for example, by the process recommended by M. Clouet, manufacturer of bichrome in Havre (see *Annales de Chemie et Phys.*, 4 series, t. xvi., p. 90). M. Clouet's process consists in fusing the finely pulverised chrome ore with from five to six times its weight of pure carbonate of soda in a platinum crucible for five or six hours at a bright red heat without the addition of any oxidising agent, reducing the purified chromic acid formed with alcohol in presence of hydrochloric acid, and precipitating

† Read before the Chemical Section of the Glasgow Philosophical Society. The author not thinking the official report of his paper sufficiently clear, has requested us to publish it in full.—Ed. *C.N.*

the oxide of chromium with ammonia. In this case, owing to the comparatively small amount of salts present and the absence of sulphates, a perfectly pure oxide of chromium precipitate may be obtained. Although M. Clouet's method yields the correct amount of oxide of chromium, it is not well adapted for the laboratory on account of the length of time required for the complete oxidation of the oxide of chromium in the ore.

Perfectly accurate results may be obtained by the following volumetric method, which is at once simple and expeditious.

25 grs. of the finely powdered ore are intimately mixed with 200 grs. of hydrate of sodium and calcined magnesia in the proportion of five parts of hydrate of sodium to three of magnesia, and the mixture exposed in a platinum crucible to the heat of an ordinary Bunsen burner for three-quarters of an hour with the lid off, and afterwards for a quarter of an hour with the lid on. Under the influence of the hydrate of sodium and magnesia oxidation takes place at once, and is practically complete in less than an hour. The crucible with its contents is then placed in a basin containing water; the contents are washed out as far as possible with water, and afterwards with dilute sulphuric acid, which must be free from nitric acid. An additional quantity of pure dilute sulphuric acid is then added to the contents of the basin, and heat applied, when everything should dissolve (except, perhaps, a few flakes of silica). To the clear yellow solution is added a weighed quantity of double sulphate of iron and ammonia of known strength and more than sufficient for the reduction of the chromic acid. The excess of unoxidised iron is then estimated with a weak standard solution of bichromate of potash, and the amount of oxide of chromium in the ore calculated from the quantity of iron oxidised. It not unfrequently happens that a little of the chrome ore escapes decomposition, this must be filtered off after the chromic acid in solution has been estimated, and re-fused with hydrate of sodium and magnesia as before, as it is generally richer in oxide of chromium than the original ore. It may readily be supposed that soda-lime or a mixture of hydrate of sodium and lime would induce oxidation quite as readily as a mixture of hydrate of sodium and magnesia, but this is not the case. When chrome ore is heated over an ordinary Bunsen burner with soda-lime —hydrate of sodium and lime—or even with a mixture of hydrate of sodium and magnesia which has been ignited before admixture with the ore, only a trifling oxidation takes place.

The results obtained by the process which I have described seldom vary 0·2 per cent. I have had occasion to submit this process to several chemists ; among others to the director of the School of Mines in St. Petersburg, who has not only expressed a very favourable opinion of its accuracy, but, as I understand, adopted it in the testing of the Russian ores.

The other ingredients usually existing in chrome ore (viz., oxide of iron, alumina, magnesia, and silica) may be estimated by the process described by Fresenius. I consider, however, that M. Clouet's method of estimating the iron, as described in the paper to which I have referred must give incorrect results, and I direct attention to this more especially on account of the formulæ which that gentleman has given to express the various proportions in which the oxide of iron and oxide of chromium exist. After fusing the ore with carbonate of sodium, M. Clouet assumes that all the alumina is soluble in water (as aluminate of sodium), and that the residue, when the ore is decomposed, consists only of oxide of iron, magnesia, and silica, so that when the residue is dissolved in hydrochloric acid, evaporated to dryness to render the silica insoluble, and filtered, the precipitate produced by the addition of ammonia to the filtered liquid will be pure oxide of iron, which may be collected, washed, dried, ignited, and weighed. This, so far as I understand from his paper, is the method which M. Clouet employed in estimating the iron, although he mentions that the iron might also be estimated by a standard solution of permanganate of potash. By this method of analysis M. Clouet finds that all the varieties of chrome ore he has analysed have a definite chemical composition, and contain the oxide of chromium and oxide of iron in definite proportions after deducting the silica, alumina, and magnesia, which he regards as the matrix of the true ore.

In a number of analyses which I have made by M. Clouet's method I was never able to render the alumina completely soluble in water by fusion with carbonate of sodium, but always found a considerable portion of the alumina in the precipitate which M. Clouet regards as pure oxide of iron, and in numerous analyses of chrome ore which I have made very few of them would be represented by any of M. Clouet's formulæ. Unfortunately, I am not aware of the localities from which my samples were derived, but I do not think it will be out of place to mention the average results which I obtained.

In seventeen analyses of ores containing from 30 to 40 per cent of oxide of chromium, the average amount of protoxide of iron was 15·4 per cent.

In twenty-three analyses of ores containing from 40 to 50 per cent of oxide of chromium, the average amount of protoxide of iron was 14·3 per cent.

In thirteen analyses of ores containing from 50 to 60 per cent of oxide of chromium, the average amount of protoxide of iron was 15·0 per cent (the lowest amount of oxide of iron being 10·6, and the highest 23·14 per cent).

In each case the iron was estimated in the ammonia precipitate by a standard solution of bichromate of potash after reduction with stannous chloride.

I am not prepared to say that the protoxide of iron and oxide of chromium do not exist in definite portion, but if so, then other formulæ in addition to those given by M. Clouet will be required to express their composition.

NOTE ON THE

ESTIMATION OF OXIDE OF CHROMIUM IN CHROME-IRON ORE,

AND ON THE

ANALYSIS OF THIS MINERAL.

By HUGO TAMM.

As I have had much practice and experience in the analysis of chromium ores from all parts of the world, this induces me to discuss Dr. Clark's paper on the same subject, read before the meeting of the Glasgow Philosophical Society of the 4th of December, 1871, and published in the Chemical News, vol. xxiv., p. 286.

1. Dr. Genth's observation must have been corroborated by every chemist. It is *impossible* to obtain oxide of chromium free from alkaline salts by mere washing, after fusing chrome ore with bisulphate of potash, nitre, or a mixture of nitre and carbonate of potash ; and in general the presence of alkaline salts is the chief cause of error in the estimation of the percentage of oxide of chromium, which, on that account, is usually reported as too high.

2. A second and not less important cause of error is due to the invariable presence of silica, alumina, and a little oxide of manganese, in the precipitated oxide of chromium, contributing also to the too high result.

3. Dr. Genth's and Dr. Clark's suggestions, relative to the use of sulphurous and acetic acid, are practically of no value.

4. Clouet's process has all the disadvantages inherent to the general process, plus the length of time required by his way of oxidising.

5. If, as Dr. Clark says, one part of chrome ore is thoroughly oxidised in less than an hour by 8 parts of soda and magnesia, this process will prove valuable for the

mere assaying of chrome ores, but it is most objectionable in the case of an analysis, for magnesia is one of the constituents of chrome-iron ores, and, besides, it is difficult to separate from most substances. On the other hand, it is difficult to find caustic soda free from silica and alumina.

The following process, which I have used with advantage, overcomes the difficulties inherent to the analysis of chromium ores:—

(*a*.) Bisulphate of potash is the substance by which chrome-iron ore is most readily attacked; consequently the ore is fused with 15 parts of pure bisulphate of potash, and when the action is over the mass is brought to a bright red-heat, to drive off the excess of sulphuric acid.

The sulphate of chromium thus obtained being insoluble in water and in acids, a mixture of 10 parts of nitre and 10 parts of pure carbonate of potash is thrown in the crucible, and the whole mass is fused and stirred.

In this operation the whole of the oxide of chromium is readily converted into chromate of potash.

The crucible and its contents are thrown into water, and when the disintegration and solution are complete the solution is separated by filtration from the insoluble precipitate, which is then submitted to analysis, and is found to contain, in general, oxide of iron, silica, alumina, magnesia, lime, and a little oxide of manganese.

(*b*.) The alkaline liquor contains chromic acid, silica, alumina, and a little oxide of manganese.

A piece of litmus paper is introduced in the solution, which is well stirred with the left hand, while with the right hand hydrochloric acid or nitric acid, previously placed in a beaker, is rapidly poured in the alkaline liquor until the litmus paper turns red. This being done, and without a moment's interruption, ammonia, previously placed in a beaker, is thrown in the liquor in sufficient quantity to turn the litmus paper blue, and some carbonate of ammonia is then added. By this means silica, alumina, oxide of manganese, and generally a very small proportion of oxide of chromium, are precipitated.

The success of this most important operation depends on the rapidity with which the alkaline liquor is first acidulated and then neutralised. It is absolutely necessary to perform this operation as rapidly as possible, because, on addition of an excess of acid, nitrous acid is evolved, and if ammonia was not used instantly to saturate the acids, a considerable proportion of chromic acid would be reduced.

(*c*.) The liquor is filtered, and thus separated from the source of error,—silica, alumina, &c.,—and the chromium existing in this liquor has only now to be separated from alkaline salts to be obtained perfectly pure.

To effect this object the liquor is acidulated with a large excess of hydrochloric acid. Nitrous acid is evolved, and chromic acid is rapidly reduced to the state of oxide. When the reduction is complete water is added, and then an excess of ammonia, and the whole is boiled. A large excess of chloride of ammonium has been formed, and it is this salt which assists mostly in the separation of oxide of chromium from alkaline salts. The oxide is washed three or four times by decantation. This oxide is not quite free from alkaline salts, sulphates especially. It is absolutely necessary to dissolve it a second time in a large excess of hydrochloric acid, and to re-precipitate it a second time by ammonia, and to wash it until the washings are free from sulphates or fixed salts.

This second operation, which is indispensable, is most efficient, and the oxide then obtained is practically free from alkaline salts.

If we consider (1) that by this process the correct amount of oxide of chromium can easily be estimated in the course of 6 or 7 hours, (2) that the oxide of chromium obtained is quite pure, (3) that all the other substances accompanying chrome oxide may easily be determined and estimated, we must arrive at the conclusion that this process is one of the best that can be proposed.

ON THE

SOLUBILITY OF SOME FORMS OF PHOSPHATE OF LIME.*

By CHARLES P. WILLIAMS,
Director of the Missouri School of Mines.

Agricultural experience has long appreciated the difference in the rapidity of action of ground bones on the one hand and of some of the phosphatic guanos on the other. The decided preference given to the first form of phosphate of lime and to the various manipulated guanos and so-called superphosphates is not merely the result of prejudice, but is in exact accordance with the results obtained by chemical experimentalists, who have shown that the solubility of tricalcic phosphate in water containing carbonic acid is as various as the source from which it is obtained. Bischoff has shown† that while one part of apatite will dissolve in 393,000 parts of water saturated with carbonic acid, the artificially prepared basic phosphate requires only 1102 parts of the same for its solution. As theoretical considerations would appear to indicate that all forms of phosphate of lime must pass to a condition corresponding to that of the artificially precipitated phosphate before assimilation by vegetation, the rapidity of the action of carbonic acid water in rendering phosphates soluble becomes an indication, measurably, of the relative rapidity of their action when applied as fertilisers, and hence of their comparative values in such capacity. Analytical investigations in this direction would seem to be of more immediate practical value than the simple quantitative determination of the constituents of a phosphatic guano or fertiliser, and may yet serve to harmonise some of the apparent discrepancies now obtaining between the results of the laboratory and the farm. Condition of molecular aggregation, determined by solubility in carbonic acid water, is of at least equal importance as percentage richness in phosphate of lime, and a rapid and reliable analytical method that may discriminate between such conditions of aggregation in superphosphates is a desideratum alike to chemists, manufacturers, and farmers. Justice to all parties concerned makes it imperative that the analyst of an artificial phosphatic guano should distinguish between the original insoluble phosphate of lime and that which has become such by reactions in the article in question; and until this is done the analytical estimations of soluble and insoluble phosphoric acid fall short of furnishing fully reliable data for estimating commercial value. And this is equally true of natural or unmanipulated guanos.

The writer has endeavoured to determine the solubility of some of the best known forms of natural tricalcic phosphate by operating in the following manner:—

A weighed amount of the finely pulverised material was placed in a measured quantity of water (1000 cubic centimetres), and carbonic acid gas passed through the same for fifty hours at a temperature of 60° to 70° F. At the end of this time the liquid was filtered off, nitric acid added to strong acid reaction, the solution concentrated by evaporation, and the phosphoric acid separated by means of molybdate of ammonia. The precipitate thus obtained was treated in the usual manner to convert the phosphoric acid into ammonio-magnesic phosphate, care being taken to allow the solutions in which this was forming to stand at least twelve hours before filtration. To avoid loss, the ammonia water used for washing was in all cases made of uniform strength; the amount used in each analysis was measured, in connection with its proper filtrate, and for each 54 cubic centimetres of the liquor 0·001 grm. was added to the weight of the pyrophosphate of magnesia obtained. This correction for the solubility of ammonia-magnesic phosphate in ammoniated

* Communicated by Dr. Wahl. From advance-sheets of the *Journal of the Franklin Institute*.

† "Elements of Chemical and Physical Geology," Cavendish Edition, vol. iii., p. 27.

water was made in all cases. To render the conditions of the experiments as nearly as possible uniform, the amount of phosphate of lime present was made identical in each case, an analysis of the sample being previously made and a proportionate increase or decrease of amount being taken to correspond to increased or decreased percentage of phosphate of phosphate of lime.

Experiment 1.—Apatite from near Perth, Canada, containing 89·27 per cent $3CaOPO_5$. Amount taken, 0·5 grm. Solution gave 0·0021 grm. PO_5, equivalent to 0·0045 $3CaOPO_5$. This amount corresponds to one part of the phosphate of lime of apatite dissolved in 222,222 parts of water saturated with carbonic acid.

Expt. 2.—Same as in No. 1, but the material levigated. Solution gave 0·0032 grm. phosphoric acid, equivalent to 0·0071 grm. $3CaOPO_5$ or one part in 140,840 parts of water saturated with carbonic acid.

Expt. 3.—Fine ground and pure bone containing 56·78 per cent of phosphate of lime. Amount taken, 0·733 grm. Solution gave 0·0804 grm. phosphoric acid, equivalent to 0·1753 grm. phosphate of lime. One part of the phosphate of lime in raw bones dissolves in 5698 parts of water saturated with carbonic acid. According to Bischoff* fresh ox-bone shavings require 4610 parts, while Liebig† says only 1500 parts of carbonic acid are required.

Expt. 4.—To determine whether the organic matter of the bone had any influence on its solubility, a portion of the material used in Expt. 3 was calcined and the organic matters burned off. The ash corresponded to 61·13 per cent of the original bone, and therefore contained 92·88 per cent of tricalcic phosphate. Amount of bone-ash taken, 0·4805 grm. Solution gave 0·0569 grm. phosphoric acid, equivalent to 0·1246 grm. phosphate of lime, or one part in 8029 ports of water saturated with carbonic acid.

Expt. 5.—A sample of adulterated bone dust of commerce, containing 24·32 per cent organic and volatile matters, 35·06 per cent phosphate of lime, and 26·13 per cent of sulphate of soda (salt cake with a small amount of acid sulphate). Amount taken, 1·3157 grms. Solution gave 0·1111 grm. PO_5, equivalent to 0·2426 grm. $3CaO\ PO_5$—or one part in 4122 parts carbonic acid water. The greater solubility of this sample is, in all probability, due to the formation of some acid phosphate of lime

$$(CaO2HOPO_5)$$

by the small amount of free sulphuric acid present in the salt cake with which it was adulterated.

Expt. 6.—South Carolina phosphate, from the property of the Charleston Mining and Manufacturing Company, containing 57·89 per cent phosphate of lime. Amount taken, 0·771 grm. Gave PO_5, 0·0647 grm., equivalent to 0·1413 grm. $3CaOPO_5$, or one part in 6983.

Expt. 7.—Same as Expt. 6, but levigated; gave 0·1528 grm. $3CaOPO_5$, or one part in 6544.

Expt. 8.—Phosphatic guano from Orchilla Island. Containing—Moisture, 12·88 per cent; organic and volatile matters, 14·60 per cent; $3CaOPO_5$, 49·67 per cent; $CaOCO_2$, $CaOSO_3$, sand, clay, &c., 22·76 per cent. Amount taken, 0·8970; gave 0·0588 PO_5, equivalent to 0·1248 grm. $3CaOPO_5$, or one part in 8009 parts of water saturated with carbonic acid.

Such well-known guanos as the Navassa and Swan Island were not experimented with on account of their larger percentages of phosphates of iron and alumina.

It is not claimed that these results will indicate the absolute degree of solubility of the several materials in the soil when the water is not saturated with carbonic acid and where there are so many modifying and controlling conditions, but they serve to indicate, with some degree of exactness, the relative rapidity of action of the different forms of phosphate of lime, and to show the wide range of solubility of the compound under similar conditions, according to the source from which it is obtained. They, perhaps, rather enhance than decrease the difficulties in the way of discriminating between the chemically precipitated and the original undecomposed phosphates of a "superphosphate" by throwing suspicion on the absolute exactness of all those methods of separation based upon solubility in weak or organic acids, unless, indeed, the operator is acquainted with the raw materials employed by the manufacturer of such "superphosphate." They and all similar experiments, however, fix the great value of this precipitated or "returned" phosphate, by showing how much more rapid it is in its action than is any form of phosphate, to whatever degree of fineness it may be brought by purely mechanical means of subdivision.

* *Loc. cit.*
† Quoted by Bischoff, *loc. cit.*

SEWAGE AS A FERTILISER OF LAND, AND LAND AS A PURIFIER OF SEWAGE.*

By J. BAILEY DENTON, C.E., F.G.S.,
Hon. Member of the Royal Agricultural Societies of Norway, Sweden, and Hanover.

Having recently appeared as a correspondent of the *Times* on the sewage question, it may very reasonably be assumed that I have exhausted the subject, as far as I am personally able to do so; but the fact is, that having in the letters to which I refer explained the advances made by the chemist and the engineer, and shown that there has prevailed, up to this time, a disregard of the properties of different soils for the retention of the fertilising ingredients of sewage, and the purification of the water with which the sewage is mixed, I left the subject where I considered the agriculturist should take it up. Hence my appearance before our Society, at a season when many of its members connected with agriculture will be in London.

I will promise to condense the remarks I have to make as much as possible, in order that there may be sufficient time for the expression of opinions which I shall do my best to challenge.

Though large figures have been put forth, by sundry writers and speakers, of the immense loss this country suffers by casting the sewage of its towns into the rivers, and everybody acknowledges, not only that such waste ought not to continue, but that our rivers should be restored to their original purity, we have not yet brought to practical test the value of sewage to the farmer and the market gardener. Chemists have done their best to rouse public attention to the loss we suffer, and it now remains with the country to adopt those measures which will best conduce to its recovery.

Large as the intrinsic value of the fertilising matter has been shown to be by the chemist, the value of the water in which it is contained has been excluded from his consideration, though farmers and gardeners alike are prepared, after the experience of the recent years of drought, to put a high value on water for its own sake, irrespective of the fertilising elements it contains after sewage has been mixed with it, for they know how serviceable is timely moisture to the germination of seed, and for reviving and sustaining plant growth, independently of its special power of conducting to the roots of plants, in the most acceptable way, those fertilising ingredients which the chemist has valued so highly.

Hitherto, the benefit to be gained by a command of water has been more than counterbalanced by the disadvantages of excess, and the obligation of disposing of the liquid sewage at all times and under all conditions. In referring to water, therefore, I do so only to remark that, large as the theoretical value of the manurial properties of sewage has been declared to be, it may yet bear an increase when the practical mind of the agriculturist is brought to bear on its utilisation, and the dis-

* Read before the Society of Arts, December 6, 1871.

advantages under which a new branch of industry always suffers are overcome.

A High Standard of Purity of Water Essential.—But so slow and so naturally sceptical, in respect of new appliances, is the agricultural mind, that we must not wait for the recognition of the cultivator as the only thing necessary for the development of the value of sewage. We must rather trust to the obligation which will before long be imposed on all sewer authorities, so to treat the liquid refuse of towns that the effluent liquid shall conform to a recognised standard of purity; for it will only be by the most stringent enforcement of the law in this respect that all the manurial properties of sewage will be rendered available for reproduction.

Taking this view, I think it is much to be regretted that the Conservators of the Thames have, without pledging themselves to any positive decision, recognised a standard of purity* in some degree inferior to that suggested by the present Rivers Pollution Commissioners in their first report, and that they have done so in the face of a statement by the Commissioners, that they made the suggestion with the "belief that, as science progresses, improved methods of purifying polluted liquids will be discovered, and that eventually standards of purity considerably higher than those recorded may, if necessary, be enforced." Without presuming to give any opinion upon the details of the standard suggested by the Commissioners, which I know is regarded by some chemists as objectionable, I am content to record the fact that their anticipation has already been in a measure realised. This is not mere assertion; it has been conclusively shown that when natural soil is so prepared, by properly designed deep drainage and deep surface cultivation, that the whole of the sewage distributed upon its surface is absorbed and percolates *evenly* through the soil, the effluent liquid passes into the arterial outfalls from the under-drains purified to a very high degree, and unobjectionable in every respect. Such, in point of fact, appears to be the purification effected by oxidation, resulting from the aëration of drinage and the intermittent use of soil for filtration, that it is not at all a too sanguine view to take, that, with increased experience, we may arrive at a power of restoring water with which sewage has been mixed to its original potable condition.

For the convenience of those interested in the matter, I here give the standard suggested by the Rivers Pollution Commissioners, and will add that which has been circulated by the Thames Conservators. The Commissioners suggest that the following liquids be deemed polluting, and inadmissible into any stream:—

(*a*). Any liquid containing in suspension more than three parts by weight of dry mineral matter, or one part by weight of dry mineral matter in 100,000 parts by weight of the liquid.

(*b*). Any liquid containing in solution more than 2 parts by weight of organic carbon, or 0·3 part by weight of organic nitrogen in 100,000 parts by weight.

(*c*). Any liquid which shall exhibit by daylight a distinct colour when a stratum of it 1 inch deep is placed in a white porcelain or earthenware vessel.

(*d*). Any liquid which contains in solution, in 100,000 parts by weight, more than two parts by weight of any metal except calcium, magnesium, potassium, and sodium.

(*e*). Any liquid which, in 100,000 parts by weight, contains, whether in solution or suspension, in chemical combination or otherwise, more than 0·05 part by weight of metallic arsenic.

(*f*). Any liquid which, after acidification with sulphuric acid, contains, in 100,000 parts by weight, more than 1 part by weight of free chlorine.

(*g*). Any liquid which contains, in 100,000 parts by weight, more than 1 part by weight of sulphur, in the condition either of sulphuretted hydrogen or of a soluble sulphuret.

(*h*). Any liquid possessing an acidity greater than that which is produced by adding two parts by weight of real muriatic acid to 1000 parts by weight of distilled water.

(*i*). Any liquid possessing an alkalinity greater than that produced by adding 1 part by weight of dry caustic soda to 1000 parts by weight of distilled water.

The following standard of purity for defecated water is that recommended by the chemists consulted by the Thames Conservators, and it will be seen that it is, as I have stated, less stringent than that suggested by the Rivers Pollution Commissioners. They say:—(1). It should be free from an offensive odour. (2). It should be free from suspended matters, or, in other words, be perfectly clear. (3). It should not be alkaline to turmeric paper, nor acid to litmus paper. (4). It should not contain per gallon more than 60 grs. of solid matter dried at 260° F. (5). It should not contain more than three-quarters of a grain of organic and ammoniacal nitrogen per gallon. (6). It should not contain more than 2 grs. of organic carbon per gallon. (7). It should contain not less than 1 cubic inch of free oxygen in a gallon." It should be observed, however, that one of the eminent chemists who signed this recommended standard, Dr. Frankland, being himself a member of the Rivers Pollution Commission, added these words:—"The conditions under which fluid which has been contaminated with sewage may be admitted into the Thames, as prescribed in the foregoing report, will, I have every reason to believe, preserve the river from being offensive to the inhabitants upon its banks; but, whilst thus far agreeing with my colleagues, I wish it to be distinctly understood that, in my opinion, such fluid can only be safely admissible into the Thames on condition that the water is not afterwards used for domestic purposes."

The conservators of the River Lea, in the absence of any standard recognised by the Government, have hitherto abstained from issuing one of their own, and the consumers of water iu the metropolis are to be congratulated that they have done so, for the publication, limited though it has been, of the lower standard recommended to the Thames Conservators has already had the effect of encouraging results inferior to those which are to be desired. The Lea Board reserves to itself judgment until the towns discharging into the river have completed their purifying works, for which they have extended the time, at the expiration of which it is to be hoped that some positive action towards the establishment of standards to fit different circumstances will have been taken by the Central Local Government authority. Until such is the case, we shall probably see, both on the Thames and on the Lea, the sewer authorities of towns disregarding, naturally enough, the higher standard of the Rivers Pollution Commissioners, and in spite of the protest of Dr. Frankland, and the general sense of the country, the inhabitants of London may be compelled to drink polluted water, and as a natural consequence, the contamination of our streams will continue throughout the length and breadth of the land.

* The following notes to and from Captain Burstal, the Secretary of the "Thames Conservancy, will explain the position of this particular question at the present moment:—

"Stevenage, 24th November, 1871.

"Dear Sir,—I presume I am right in assuming that the standard of purification recommended by Drs. Frankland and Letheby, and Professor Odling is that which your Board of Conservators recognise as sufficient to regulate the influx of liquid sewage from towns on the banks of the Thames. When answering this question, would you kindly tell me whether the standard applies equally to the towns above Hampton as below.—"I am, dear Sir, yours faithfully,

(Signed) "J. Bailey Denton.

"Captain Burstal, Thames Conservancy."

"Thames Conservancy Offices, 41, Trinity Square, Tower Hill, E.C., 1st December, 1871.

"Dear Sir,—In reply to your letter of the 24th ult., I beg to inform you that the Conservators do not recognise any standard of purity for effluent water from sewage from places on the banks of the river above Teddington.—I am, dear Sir, yours faithfully,

"E. Burstal, Secretary.

"J. Bailey Denton, Esq., Orchard Court, Stevenage, Herts."

This point, however, is not that upon which I desire to dwell. It is of sewage as a fertiliser of land that I must speak, though it is right to repeat emphatically, what must be manifest to every practical mind, that so long as the pollution of rivers is permitted in a modified degree, by the recognition of any standard of inferior character, the fertilising ingredients of sewage will not be wholly recovered from the water with which they are mixed.

Sewage as a Fertiliser of Land.

To show what is the intrinsic value of the fertilising ingredients of sewage I will, in the shortest manner possible, state the conclusion to which Messrs. Lawes and Gilbert came in 1865, in their very complete and careful paper on the "*Composition, Value, and Utilisation of Town Sewage*" read before the Chemical Society, and which, I believe, expresses pretty accurately views in which the majority of those who are competent to deal with the subject concur. Having adopted the case of Rugby as a fair sample of water-closet towns, the discharged sewage being equal to 36 gallons per diem, or 60 tons per head per annum, including surface and subsoil waters, they stated that, "looking to the average results of 93 analyses," they found "that the sewage contained about 87½ grs. per gallon of total solid matter, of which about two-thirds was inorganic, and one-third organic. About half the total solid matter was in suspension, and half in solution; of the half in suspension, about four-sevenths was inorganic, and three-sevenths organic, and of the half in solution about four-fifths was inorganic, and one-fifth organic. Lastly, of the nitrogen, reckoned as ammonia, about one-fourth was in suspension and three-fourths in solution. The mean of the ninety-three analyses showed about 6½ grs. of ammonia per gallon, indicating a value of 1⅔d. for the total constituents in 1 ton of sewage." These figures, multiplied by the 60 tons of sewage per head per annum, resulted in showing "that 12½ lbs. of ammonia were contributed annually for each average individual of the mixed population of both sexes and all ages." This quantity of ammonia, at 8d. per lb., gives 8s. 4d., or 100 pence, as the value of sewage per head from water-closet towns. Various other estimates have been made of the sewage of water-closet towns. Dr. Letheby took samples at noon and at midnight, from a number of sewers in the metropolis, and arrived at the conclusion that 7·24 grs. represented the mean quantity of ammonia per gallon. Messrs. Hofmann and Witt, having treated one particular sewer, considered that 8·21 grs. represented the quantity of ammonia. These two quantities would, if taken at the same price of ammonia, result in larger figures than those of Messrs. Lawes and Gilbert.

There have been several estimates made of the value of sewage, by modes of computation differing from that based on the whole sewage of towns as discharged by the sewers, and as they will assist us in considering what proportion of the excrementitious matter of the closet may be kept out of the sewers, with benefit to agriculture and profit to the ratepayers of sewered districts, I will shortly refer to them. Messrs. Hofmann and Witt, and Dr. Thudichum, having ascertained the amount of urine and fæces voided by individual persons, taking an average of both sexes of all ages, valued the urine at 7s. 3d. and the fæcal matter at 1s. 2¾d., which together, it will be observed, is very nearly the same amount as that put upon the whole sewage by Messrs. Lawes and Gilbert.

There is an anomaly in these estimates which has to be reconciled, inasmuch as it appears that the excrements of human beings alone, exclusive of the refuse from slaughter-houses, stables, cow-houses, and dog kennels, as well as that discharged from the kitchen, with its refuse of vegetable and animal food, is more valuable than the whole liquid refuse of a town, when the contents of the closet are discharged into the sewers as well as all other refuse. And the anomaly becomes more difficult of reconciliation when we have to consider a statement by the Rivers Pollution Commissioners to the effect that, comparing water-closet towns, in which the whole of the sewage issues from the sewers, with "midden" towns, in which a considerable portion of the human excreta is detained and disposed of separately, there is a remarkable similarity of composition between the two.

I will not detain you by any endeavour to reconcile these analyses and statements, but will only remark that, assuming them to be correct, an important consequence follows, viz., that, in an agricultural view, it is desirable to treat the excremental contents of privies separately, for if no appreciable loss of fertilising matter is found to exist in liquid sewage when separated from that of the privies, it is manifest that a decided national gain is obtained by the maintenance of the two systems, inasmuch as the dry, portable manure obtained from the privy contents will be so much fertilising matter available for distant lands, in addition to the liquid sewage, which may be utilised by irrigation near at home.

But the realisation of the fertilising value of sewage in the liquid state depends necessarily upon two precedent conditions, the first being the obligation which should be imposed on all towns by the central local government authority, to *perfectly* cleanse their sewage; and the next, the preparation by the sewer authorities of the land designed to receive the sewage, in such a way that the whole may be *fully* utilised. With these two duties performed, and not otherwise, there is a fair prospect of at least a penny a ton being realised for liquid sewage of average strength, half of which (as I have stated on former occasions) should go into the pockets of the ratepayers, in repayment for the necessary works, while the other half will be due to the cultivator as a return for his industry and the employment of his capital.

Excluding from consideration the value of the water, which, I contend, will become a great item in the profitable treatment of sewage, the subject before us may be classified under three heads, viz.—(1) Where the whole of the sewage is treated by chemical process at the mouth of the sewer. (2) Where it is transported from the sewer mouth to land for distribution there. And (3) Where a part of the excrementitious refuse is treated separately from the remainder. The question which addresses itself, therefore, to the authorities of all sewered districts is, which of these methods of treatment will best enable them to effect the twofold object of purifying the sewage and utilising it to the greatest advantage; while the question which the agriculturist has to consider is, which method will place at his command, at a fair price and in the most productive shape, the fertilising matter which the sewer authorities must extract in order to cleanse the sewage perfectly.

(To be continued).

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 21st, 1871.

Dr. Williamson, F.R.S., Vice-President, in the Chair.

After the minutes of the previous meeting had been read and confirmed, Mr. William Gray and Mr. Reginald C. Woodcock were formally admitted as Fellows of the Society.

The names of the following gentlemen were read for the first time:—Benjamin P. Medcalf, William H. Chandler, Charles F. Chandler, Ph.D., and John Watts, D.Sc.

For the third time—William W. Abney, Jonathan Ingle Calvert, Christopher Childs, B.A., and Frederick J. Montague Page, who were balloted for and duly elected.

The Chairman having announced that the distinguished Italian chemist, Professor Canizzaro, had consented to deliver the Faraday Lecture, called upon Mr. Henry Bassett to read his paper on "*Eulyte and Dyslyte*."

Mr. Bassett first gave the method employed to obtain these two substances which had already been briefly described in 1851 by Baup. Citraconic acid prepared by the dry distillation of citric acid, when treated in small portions at a time with strong nitric acid, yielded an oil which solidified to a crystalline mass on standing. This product consisted of a mixture of the crystalline compounds eulyte and dyslyte, contaminated, however, with a small quantity of a yellow oil. The *eulyte*, which can only be separated with difficulty, is more soluble in alcohol than the dyslyte. It crystallises from warm chloroform in large prisms, melting at 99·5° (cor.), the results of its analyses corresponding to the formula $C_6H_6N_4O_7$. Submitted to the action of tin and hydrochloric acid it gave large quantities of ammonium chloride, together with a small quantity of a tarry matter, soluble in potash, with the evolution of an odour of picoline. In one experiment the author obtained indications of a solid basic substance, but the material at his disposal was too small to enable him to determine its nature. *Dyslyte*, $C_8H_6N_4O_6$, is less soluble in alcohol than eulyte, crystallising therefrom in fine long needles, which melt at 189° (cor.). The yellow oil, separated from the mother-liquors and purified by distillation in a current of steam, had the characteristic odour of volatile nitro-compounds, and exploded when heated. It is the author's intention to further investigate the nature of these compounds as soon as he has sufficient material at his disposal for that purpose.

In reply to a question put by the Chairman as to what were the properties of the compounds he had described, whether acid or basic, Mr. Bassett said that he agreed with Baup, who described them as neutral substances, for, as far as he had been able to ascertain, they were not possessed either of acid or basic properties.

Dr. Debus having enquired as to the comparative amount of these substances obtained from citric acid, and also what was the precise action of reducing agents on them, Mr. Bassett stated that he had distilled 30 lbs. of citric acid, and had only obtained about 50 grms. of the substances; but from the experience he had gained in the method of preparing it he hoped to be able in future operations to obtain a larger yield. In acting upon them by reducing agents almost the whole of the nitrogen was eliminated as ammonia when the reduction was complete, only a small proportion of the nitrogen being found in the tarry product; the solid basic compound he had mentioned being formed before the reduction was entirely finished.

Dr. H. E. Armstrong then read the following paper:—"*The Nitration Products of the Dichlorophenol-sulphonic Acids*," No. IV.

The author first remarked that the action of nitric acid on the sulpho-acids prepared by treating dichlorophenol melting at 103°, which would indicate that this sulpho-acid was only isomeric with those obtained by the chlorination of the meta- and para-phenol-sulphonic acids, as these yielded chloronitrophenols melting at 121·5° and 125°, corresponding respectively to dinitrochlorophenols melting at 80·5° and 111°. When, however, the potassium salt of the sulpho-acid obtained by acting on dichlorophenol with chlorhydric sulphate, SO_2OHCl, was treated with nitric acid, the sole product obtained was invariably the nitrodichlorophenol melting at 121·5°, even under varying conditions of temperature and strength of acid. From former observations which the author has made he believes that the acid formed by the action of SO_2OHCl is dichlorophenol *meta* sulphonic acid, and hopes to be able to obtain the phenol-metasulphonic acid from it by the action of nascent hydrogen. The difference in the results obtained by the nitration of the two acids prepared from dichlorophenol by the action of sulphuric acid and chlorhydric sulphate respectively, would indicate that they were *isomeric* and not identical; this view, moreover, is borne out by an examination of other sulpho-products of the benzol series obtained by the use of these two reagents. This, the author thinks, might have been theoretically predicted if the conditions are considered under which the various substituted phenols are formed; the "reactive energy" of sulphuric acid being feeble compared with that of chlorine, for by its action on phenol it produces *meta*- and *para*-sulphonic acids, whilst chlorine in the cold gives rise to two chlorophenols; but by far the larger proportion of the mixture consists of *ortho*-chlorophenol. The "reactive energy" of the chlorhydric sulphate is far greater than that of sulphuric acid, being comparable in its action to chlorine rather than to sulphuric acid, and should, therefore, give rise to derivatives belonging to a different series. In all probability, however, there is a direct relation between the amount of heat evolved during the formation of a substitution derivative and the place it occupies in the isomeric series. The consideration, therefore, of the heat evolved in the formation of isomeric bodies would doubtless throw great light on the subject.

Dinitrochlorophenol melting at 130°.—This body, which was obtained by Stenhouse, by the action of chloride of iodine on picric acid, in the author's opinion is not identical with that prepared by Griess by nitrating crude chlorophenol, the latter being the β dinitrochlorophenol melting at 110° to 111°, especially as the amido-derivatives obtained from the two compounds differ considerably in appearance and properties. This discrepancy appears to have arisen from Griess's compound being contaminated with traces of the isomeride, melting at 80·5°. The author has also obtained trichlorophenol-sulphonic acid by acting on trichlorophenol with chlorhydric sulphate.

Professor Williamson remarked that these compounds were very interesting, particularly to those who had made the subject their especial study, and he should be very glad if Dr. Armstrong would give the members his opinion as to the difference between the action of hydric sulphate and chlorhydric sulphate, as he understood him to say that they only differed in degree.

Dr. Armstrong replied that the question was one of so complex a character that he could not at present venture to give any opinion on the subject, but he believed that there was a direct relation between the amount of heat evolved during the reaction and the position which the resulting compound occupied in the series; he had undertaken some experiments in this direction, and hoped that the results would throw some light on this matter.

Dr. Muller, in connection with the difference observed in the action of sulphuric and chlorhydric sulphate, called attention to the action of chlorine on toluol under varying conditions, producing chlortoluol in the cold or in the presence of iodine, even when the latter is in comparatively small quantity, whilst at boiling heat it yields the isomeric benzylic chloride.

Dr. Armstrong said that in the case of chlorhydric sulphate the action was not at all the same as that of sulphuric acid, being far more energetic and in that respect comparable to chlorine rather than to sulphuric acid. Again, iodine alone did not produce a substitution compound with benzol, but it did so when iodic acid was present; the action of the latter had been supposed to be due to its removing the hydriodic acid as soon as formed, but this would seem to be doubtful, as iodine in the presence of mercuric oxide produced iodine substitution compounds with benzol, and Lippmann had observed that amylene under similar circumstances gave compounds containing oxygen.

The meeting was then adjourned until Thursday, January 18, 1872.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section).

Ordinary Meeting, December 18th, 1871.

John Jex Long, Esq., Vice-President, in the Chair.

A paper was read by Mr. John Ferguson, M.A., Assistant Professor of Chemistry in the University of Glasgow, on "*Historical Notes on the Discoveries of Dr. Joseph Black.*" After briefly tracing the early life of Black, the author proceeded to notice his career as a student, first at the University of Glasgow and afterwards at the University of Edinburgh. In the former, Black was brought into intimate contact and personal friendship with Dr. Cullen, who was then the Professor of Chemistry in Glasgow, and it was under the tuition of that eminent philosopher that Black laid the foundation of his own future eminence as a chemist. Black afterwards went to Edinburgh, where he re-commenced and completed his medical studies, and while residing in that city his attention was specially taken up with the explanation of the facts connected with the difference of properties manifested by the caustic and so-called mild alkalies. It was this subject and his discovery of fixed air that he chose for his inaugural dissertation when he proceeded to take his medical degree. The author dwelt at considerable length on this dissertation, and treated it with marked critical ability. He showed how, step by step, Black arrived experimentally at the grand general conclusions which have now been universally accepted by the scientific world; and he gave him all due praise for the simplicity, perspicuity, and precision of his reasonings, while he at the same time regretted that Black, with such great abilities, had contributed so little to the sum total of the science of chemistry. Mr. Ferguson also referred to Black's discovery of the principle of latent heat, and to his career as a Professor in Glasgow and afterwards in Edinburgh, and in both cases in succession to his former master and friend, Dr. Cullen. A few remarks were also made in reference to the relationship in which Black and Lavoisier stood to each other as men of science.

A brief discussion followed, in the course of which Mr. Sutherland took exception to the unfavourable estimate formed of Lavoisier by Mr. Ferguson, to which that gentleman replied that if it were thought that he had done Lavoisier any injustice, he would willingly go over the whole subject of his life again, and give the results of his inquiries to the section. He also stated, in reply to a question, that he was not sure that Priestley's discovery of oxygen was published in this country before the fact was communicated to Lavoisier.

A most cordial vote of thanks was awarded to Mr. Ferguson for his exceedingly interesting paper.

NOTICES OF BOOKS.

A Systematic Handbook of Volumetric Analysis; or the Quantitative Estimation of Chemical Substances by Measure, Applied to Liquids, Solids, and Gases. By Francis Sutton, F.C.S., Norwich. Second Edition. London: Churchill. 1871.

The second edition of Mr. Sutton's well-known work on Volumetric Analysis, fully realises any expectations that may have been formed by chemists using the former edition of this handbook. Many changes have occurred in theoretical chemistry since the issue of the first edition seven years ago, and general advance has been made in chemical analysis, but there is nothing remarkable in the progress of volumetric analysis as a method, although its application has been greatly extended. The usefulness of the work has been much increased by the additions made by Dr. Frankland and Mr. W. Thorpe, F.C.S., to the subject of water analysis. The analysis of gases has been elaborated by Professor McLeod of the Indian Civil Engineering College, whose labours in relation to this subject are well known. The extensive illustration of this section of the work prevents the quotation, with fairness to Mr. Sutton, of any matter likely to interest our readers. The modern system of atomic weights has been adopted in this edition. There has been much done to render the work easily understood in the technical laboratory to which this method of analysis is peculiarly suited. It is too generally considered a standard work to require any further recommendation.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, December 4, 1871.

In addition to several important original papers and memoirs relating to astronomy, meteorology, geology, and natural history, this number contains the following original papers more particularly bearing upon chemistry:—

Separation of some Metals from each other, and Quantitative Estimation thereof by means of a Galvanic Current.—Dr. Lecoq de Boisbaudran.—After first referring to his former researches on this subject, the author states that it is by no means difficult to separate the more readily reducible metals when in acid solution from the less readily reducible metals present in the same solution, by the application of a moderately strong galvanic current; in this way the different metals may be classed in groups. As regards such metals as cobalt, nickel, and zinc, they are best precipitated from solutions containing excess of ammonia. Iron cannot be well estimated by this process because peroxide is formed.

Observation on Mr. Ritter's Paper on the Formation of Urea from Albuminoid Matter by the Action of Permanganate of Potassa.—A. Béchamp.—The contents of this paper simply bear upon the fact that the author, many years ago, discovered and published in various scientific periodicals some particulars which Ritter (see Chemical News, vol. xxiv., p. 288) states to be new.

New Method of Preparing the so-called Supersaturated Solutions.—L. C. de Coppet.—Anhydrous sulphate of soda, and likewise anhydrous carbonate of soda, and partly dehydrated sulphate of magnesia, are employed by the author to produce with cold water so concentrated solutions of the salts alluded to that, upon some small crystal of any of these salts being immersed into these solutions, they at once crystallise. It is, however, necessary for the success of the experiment that the salts be added to the water in small quantities at a time; by doing this carefully it is possible to dissolve in cold water five times as much anhydrous sulphate of soda, as water of the same temperature will keep in solution of the salt $Na_2SO_4,10H_2O$.

Comparison between Two Kinds of Arable Soil, One of which was Formerly Woodland, the Other a Partly Broken-Up and Limed Soil.—Th. Schlœsing.—The author records a series of experiments made with samples of surface soil and subsoil, taken from a locality in the Département de la Manche, chiefly with the view of ascertaining the effects, both physical and chemical, of the liming and non-liming of soils of a very poor nature. One of the effects of liming appears to be the conversion of chloride of sodium present in the soil into chloride of calcium, while nitrification also appears to be promoted by the lime. The greater part of the contents of this elaborate essay is of local interest only.

Testing and Quantitative Estimation of Arachis Oil in Olive Oil.—A. Renard.—The author bases this process upon the detection of arachidic acid. A quantity of 10 grms. of the oil to be tested is first saponified; the soap obtained having been decomposed by hydrochloric acid, the fatty acids set free are dissolved in 50 c.c. of alcohol at 95 per cent, the warm solution is precipitated by acetate of lead, and filtered after having become cold. The residue on the filter is treated with very strong and pure ether, which dissolves the oleate of lead, leaving margarate, palmitate, and arachidate of that metal. This compound

is heated, and then treated with warm dilute hydrochloric acid; the fatty acids are separated by decantation from the solution of chloride of lead. When the fatty acids are cooled, and thereby solidified, the cake thus obtained is dissolved in 50 c.c. of alcohol at 95 per cent by the aid of heat; a single drop of hydrochloric acid may have to be added to this solution in order to render it free from a slight cloudiness. If the olive oil operated upon happens to contain arachis oil, there will separate from the alcoholic solution, on cooling, crystals of arachidic acid. In order to estimate the quantity thereof, the crystalline mass is collected on a filter, first washed with a quantity of from 10 to 20 c.c. of the strong alcohol just alluded to, and next with ordinary alcohol, wherein this acid is insoluble. The substance upon the filter is next treated with boiling hot absolute alcohol, wherein the acid is dissolved, the filtrate collected in a previously weighed capsule, and the residue, left after a carefully conducted evaporation, weighed. The fusion-point of arachidic acid, obtained in this manner, is about 71°; of the pure substance, 73°. The author enters further into lengthy details as to the method of estimating the minute quantity of the arachidic acid dissolved (and therefore not collected along with the great bulk) in the strong alcohol used in these operations; the process is such that it may with due care yield very accurate results. Arachis oil is better known as ground-nut oil.

Composition of Lignites, and the Heat they Yield by Combustion.—Drs. Scheurer-Kestner and C. Meunier.—The authors communicate in this lengthy essay another portion of their very valuable and excellent researches on fossil fuel: this paper records the analysis of six different samples of lignite, three of these being obtained from different localities in France, and three from Bohemia. The analyses give—(1) The composition of the mineral as met with; (2) of the same, deducting ash and hygroscopic water; (3) the composition of the volatile portion of the mineral, less the water; next, the heat evolved by combustion as found by experiments is quoted; further, the calculated caloric; and, lastly, the sum of the caloric due to the combustion of the elements of which the lignites are composed. Lignite, the authors found, is distinguished from coal also in this particular—that the latter emits a far greater quantity of heat than that due to the combustion of its elements (carbon and hydrogen). Attention is again called to the fact that it is impossible to judge of the value of a fuel according to its elementary composition; all calculations based upon such data are quite fallacious, and the authors prove this conclusively by referring especially to one of the samples of lignite they investigated.

Analysis of Cows' Milk Taken from the Animals while Attacked by Typhus.—Dr. Husson.—The milk of twenty-two cows, belonging to the same proprietor (of which number four were so badly attacked by contagious typhus as to necessitate the immediate killing of the same, while another batch of four were apparently quite well, and fourteen in a doubtful condition), has been investigated by the author. It appears that, as compared with the composition of normal milk, the milk of all these animals became more or less altered as regards the quantity of normal constituents, and may be termed very poor; yet, with the exception of the milk taken from the four cows which were very ill, there was nothing disagreeable about these samples of milk, and of the milk, which had got a bad taste and colour, a cat drank some 50 grms. without experiencing any bad effects. The author draws this conclusion, among others, from his researches—that neither the milk nor meat from cows so diseased can give the disease to men or other animals not belonging to the *Ruminantia*; yet, very properly, the author urges that severe measures should be taken to prohibit the use of milk as well as meat of cattle even suspected to be attacked by contagious typhus to be used as food; in fact, the milk, even at the first beginning of the disease, is entirely altered chemically as well as in its histological characters, as revealed by the microscope. Samples of milk:—A. From the apparently healthy cows. B. From the least ill. C. From the worst ill. The Sample A appeared to be milk in its normal condition; the two other samples exhibited a yellowish rose-red hue, and the taste of Sample C was very disagreeable. In 1000 grms. the samples contained:—

	A.	B.	C.	Average Composition of Milk in its normal state.
Butter	16·96	14·93	12·60	30
Milk sugar ..	33·90	31·40	16·45	50
Casein	,,	50·25	,,	34
Albumen	,,	20·60	,,	6
Salts	,,	18·50	,,	7

New Researches on the so-called Widmannstätten Figures.—Dr. S. Meunier.—The author states that when a piece of meteoric iron is fixed to the positive pole of a Bunsen battery, the other pole being a piece of silver, and the electrodes are placed in an aqueous solution of bisulphate of potassa, and contact made, there will appear on the iron an iridescent colouration akin to the colouration brought about by heating the polished iron; if no contact takes place, there is produced upon the iron a figure similar to that which acids produce, but by this method it is more readily and more neatly brought out.

Revue Universelle des Mines, de la Métallurgie, des Travaux Publics des Sciences et des Arts Appliquées à l'Industrie, July and August, 1871.

In addition to important original papers on mining and on safety-valves of steam-boilers, this number contains the following original memoir relating to chemistry:—

Progress Made in the Chemical Works Situated in the Valley of the Sambre (Belgium) in the Condensation of Noxious Vapours.—Dr. J. T. P. Chandelon.—This exhaustive and very important essay is the published reproduction of a report made by the author to the Belgian Minister of Home Affairs, and may be considered akin to the reports annually made by the Inspector under the Alkali Act, and published in this country; but, in this instance, the sulphuric acid manufactories are included, and the arrangement of the memoir is retrospective—that is to say, the present condition of all the chemical works alluded to is compared with the condition prevailing a few years ago. It appears that a very general improvement has taken place in every respect, and notably, also, in the quantity of sulphuric acid obtained from a given quantity of sulphur burnt in the shape of pyrites. The condensation of hydrochloric acid resulting from the decomposition of common salt in the alkali-works is also very complete.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, November 30, 1871.

Preparation of Pyrophosphate of Lime for Agricultural Purposes.—E. Deligny.—The coprolites, or other native tribasic phosphate, or bone-ash, is first treated with hydrochloric acid, and the mixture thus obtained dried in reverberatory furnace, leaving a pyrophosphate of lime, which, according to the author, contains 55 per cent of phosphoric acid, while the hydrochloric acid used is—at least in a great measure—recovered. The reaction is based upon the fact observed by the author, that from a mixture of acid phosphate of lime and chloride of calcium, when heated to 100°, the hydrochloric acid is driven off by the acid phosphate, leaving a bibasic phosphate, which is very readily assimilated by plants.

Use of Manure for Beet-roots.—M. Pagnoul.—It appears, from the contents of this paper, that soluble alkaline chlorides are not only not required for the healthy development of beet-roots, but that, these salts cause the roots to become less filled with saccharine juice. The quantity of alkaline carbonates left, after the incineration of the organic substance of the roots, as ash, and derived from organic salts present in the root, appears to decrease with an increase of the sugar; yet the author states that, whereas alkaline chlorides are not necessary to the life and development of beet-roots, alkaline carbonates ought, in small quantity, to be present, either in the soil wherein the roots grow or in the manure supplied to them, otherwise a healthy growth is not possible.

Continuation and End of the Lengthy Essay on the Chemical Dissociation of Bodies.—C. Mène.

Apparatus for the Combustion of Petroleum Oils to be used as Fuel.—H. Sainte Claire Deville and M. Wiesnegg.—This paper is illustrated by a woodcut. The furnace and accessory contrivances appear to be well suited for laboratory use when made on the small scale, and for manufacturing purposes when constructed in large size; the heat developed is very great, and there is no inconvenience of ash or smoke.

December 7, 1871.

On Fermentation in General.—C. Mène.—This paper is an excellent and very clearly written account of fermentation as understood by the ancients, the alchymists, the iatro-chemists. The microscopical researches made on ferment in 1680 by Antony van Leeuwenhoeck are also briefly stated.

Process of Purification of the Crude Suet of Commerce.—J. Costhelys.—The author describes at length a process of purifying such fat-tallow as has been rendered, as it is termed, by the aid of sulphuric acid. The new process here described aims at the refining of the tallow, so that it may be used as dripping. From what is stated it appears that the result is, as was practically tested in Paris during the late siege, highly satisfactory.

New Rheometric Regulator for Gas-Burners.—M. Girond.—The contents of this valuable paper, illustrated by woodcuts, make us acquainted with a very ingeniously contrived regulator for gas-burners, whereby the consumers of gas who apply it to their burners have a perfect control over the quantity of gas consumed by each burner in a given time. As regards the further details on this subject, it would require the reproduction of the woodcuts. We hope the author wil introduce this useful instrument in this country.

New Use for Silicate of Soda.—C. Mène.—The substance alluded to, in rather concentrated state, is first mixed with zinc-white (oxide of zinc of commerce), and may then be, as is actually the case in France, used as an excellent and resisting paint for out-door work on wood, metal, stone, paper, roofing felt, &c. Combustible substances coated with this material are, moreover, rendered uninflammable.

Les Mondes, December 14, 1871.

Extraordinary Cold Weather.—Rev. F. Moigno.—On Saturday, December 9th, the reading of the thermometer at the National Observatory at Paris was, in the morning (8 o'clock), −21·92° = about −7° F. Never since January 23rd, 1788, has the temperature been so low in Paris; at the Montsouris Observatory, situated beyond Paris proper, in the suburbs, the reading on the same day and hour was −23·7°. The late Arago states, in his work on Astronomy, that the lowest temperature observed in Paris since 1665 was −23·5°, on January 25th, 1795.

Newly-invented Apparatus for Evaporating Liquids.—A. Wérotte.—An ingenious contrivance, illustrated by a woodcut. The apparatus is designed for evaporation on the large scale.

Although not exactly belonging to the subjects usually treated in our columns, we quote the title of the following work, which is highly spoken of in the above-named periodical:—"Dictionnaire Général des Forêts, Legislation et Administration, recueil complet comprenant le résumé el l'analyse des lois, règlements, ordonnances, arrêts, decisions, &c., concernant les forêts depuis 1672 jusqu'au 1 Janvier, 1871," par A. Rousset, Sous-Inspecteur des Forêts. 2 vols., avec planches et modèles publié chez l'auteur à Nice, rue Cassini, 15. 1871.

December 21, 1871.

Observatory on the Puy de Dôme.—Rev. F. Moigno.—The locality alluded to is a rather elevated mountain situated in the Département of the same name, and not very far distant from the city of Clermont-Ferrand. It appears that, just previous to the breaking out of the late war Dr. Alluard, Professor of Natural Philosophy at the city above named, had proposed to the French Government to establish an observatory on the top of the mountain just named; to establish in the city a laboratory, to which a special room for meteorological observations should be attached; and to construct a line of telegraph wires, to communicate, on the one hand with the two establishments, and on the other, by a separate wire, with the Observatory at Paris. The present French Government and the local departmental and municipal governments, having had this plan surveyed, have agreed to execute the necessary works at once.

Some Observations und Objections on the Supersaturation of Liquids by their own Vapour.—Rev. Father Sanna Solaro, S.J.—This very lengthy essay bears upon a portion of Mr. Tomlinson's paper which was reproduced in the above-named periodical. We reserve this paper for full translation.

Preservation and Improvement of Beet-Root Leaves to be Used as Fodder for Cattle.—Dr. Méhay.—The process here described essentially consists in steeping for a few minutes the leaves and heads of the beet-roots in weak hydrochloric acid (4° Baumé=1·027 sp. gr.), leaving the vegetable matter to drain for a moment, after which it is placed in heaps into a kind of tank-like hole dug into the soil, care being taken to line its bottom and sides with straw. When filled the heap is first lightly covered with straw and then with earth—in fact, arranged in the manner used for preserving potatoes, carrots, &c. From the testimony of competent agriculturists and veterinary surgeons, the process here alluded to is indeed to be recommended for its good effect upon the cattle fed by vegetable matter thus preserved.

La Revue des Scientifique de la France et de l'Etranger, December 16, 1871.

This number does not contain any original papers relating to chemistry.

Journal für Praktische Chemie, No. 18, 1871.

This number contains the following original memoirs and papers:—

On the Compounds of Tin and Titanium Crystallising from Glassy Fluxes, namely, Fused Beads obtained by the Blowpipe Flame.—G. Wunter.—The contents of this paper record a series of chemico-crystallographical experiments made by the author with a view to ascertain whether it is possible to obtain definite crystalline compounds and titanic acid by fusing together oxide of tin with borax and phosphor salt; the method of analysing these substances is also fully described. Among the tin compounds we quote the formulæ of the following:—

$$\underbrace{Sn_2Na(PO_4)_3}_{\text{Rhombohedra.}}+Na_3PO_4=2\underbrace{[SnNa_2(PO_4)_2]}_{\text{Tetragonal pyramids.}};$$

$SnNa_2(PO_4)_2$ pyramids in 100 parts:—SnO_2, 42·37; P_2O_5, 40·11; Na_2O, 17·51. Rhombohedra, $Sn_2Na(PO_4)_3$, in 100 parts:—SnO_2, 54·82; P_2O_5, 39·44; N_2O, 5·74. Titanium compound, $TiO_2Na(PO_4)_3$:—TiO_2 40·80; P_2O_5, 52·20; N_2O, 7·60.

Relation Existing between the Specific Gravity of, and the Quantity of Pigment contained in, Indigo.—G. Leuchs.—The author relates a series of experiments quoted in tabulated form, exhibiting the sp. gr. of various samples of indigo and the quantity of indigotine therein contained, the latter particular being estimated by a process described in one of the earlier published volumes of this periodical; it appears that in forty-nine different samples of dye-stuff alluded to, the best contained 60·5 per cent of indigotine and the worst 24 per cent, the sp. gr. of the former being low and the latter high.

Mineralogical Miscellany.—A. Frenzel.—This paper contains the following sections:—Lithiophorite; hypochlorite; pucherite.

Preparation of Carboxycyanide.—Dr. W. F. Gintl.—At present this paper contains only an incomplete account of the author's researches on this subject now made public in consequence of an account of similar researches having been lately published by other German *savants*. A complete account of this investigation will be given,

On Hygienico-Chemical Methods of Investigation.—Dr. H. Fleck.—First instalment. Detection and estimation of organic matter in water. Reserved for full translation; an observation also applicable to the following paper:—

Determination of Ammonia in River and Well Waters by Means of Nessler's Test.—E. Schürmann.

Electrolysis of Itaconic Acid.—G. Aarland and E. Carstanjen.—After first referring to Kekulé's, Kolbe's, and Liebermann's experiments on the electrolysis of some organic acids, the authors describe the method of experimenting with itaconic acid, which is decomposed by the electric current, yielding carbonic acid and allylen, C_3H_3.

Monochloracetate and Amidoacetate of Phenol.—E. W. Prevost.—Monochloracetate of phenol smells like phenol, exhibits an acid reaction, is insoluble in water, readily soluble in alcohol and ether, fuses at 40·2; formula, $C_6H_5.O.(C_2H_2ClO)$; when this compound is heated up to 140° along with ammoniacal alcohol in a sealed tube, there is formed amido-acetate of phenol, $C_6H_5.O.(C_2H_2,H_2N,O)$, a crystalline white-coloured body, acid reaction. soiuble in water, almost insoluble in alcohol and ether; may be heated to 133° without undergoing any other change than becoming soft; at a higher temperature it is decomposed.

Probable Existence of Two Oxysulphides of Carbon.—Dr. H. Kolbe.—The contents of this paper are devoted to a theoretical discussion of what may be, though not yet experimentally proved to be, the result of the decomposition of sulphocyanide of potassium and isosulphohydrocyanic acid under the influence of sulphuric acid. The author illustrates this subject by a series of formulæ, and intimates that one of his assistants has commenced experimental researches on this subject.

NOTES AND QUERIES.

Residue from Olive Oil Presses.—Can your readers inform me if it is possible, and where, and how, I can obtain some of the residue from olive oil presses; I mean the fruit which remains after the oil is pressed out.—Oleum.

Dehydrating Oxalic Acid.—(Reply to "Q. R.")—Crystallised oxalic acid = $HO,C_2O_3,2aq$. The dehydrated HO,C_2O_3 can be obtained by drying the crystallised acid at 100°, or at utmost 120°. Oxalic ether cannot be made in the way proposed by you, but is made by distilling a mixture of an oxalate along with strong alcohol and strong sulphuric acid. Dr. Miller's excellent work on Chemistry will give you full particulars.

Adulterations in Food and Drink.—(Reply to "An Amateur Chemist.")—You will find the work published under the following title a valuable and reliable aid:—"Die wichtigsten Lebensbedürfnisse, ihre Aechtheit und Güte, ihre Zufälligen Verunreinigungen und ihre Absichtlichen Verfälschungen mit gleichzeitiger Berücksichtigung der in Haushaltung, den Künsten und Gewerben Bernutzten Chemische Gifte (Polizeilich-Gerichtliche Chemie)," von Dr. Adolf Duflos (Breslau; F. Hirt.

NOTICE TO AMERICAN SUBSCRIBERS.

In answer to numerous inquiries, the Publisher begs to state that Subscribers in the United States can be supplied with the CHEMICAL NEWS from this Office, post free, for the sum of £1 2s. 4d. per annum payable in advance.

THE

QUARTERLY JOURNAL OF SCIENCE,

AND

ANNALS OF MINING, METALLURGY, ENGINEERING, INDUSTRIAL ARTS, MANUFACTURES, AND TECHNOLOGY.

Edited by WILLIAM CROOKES, F.R.S., &c.

This day, No. XXXIII., *January*, 1872, price 5s., Illustrated.

CONTENTS.

I. The Dolmen-Mounds and Amorpholithic Monuments of Brittany, By S. P. Oliver, Capt. Royal Artillery, F.R.G.S.
II. The Illumination of Beacons and Buoys.
III. Natural and Artificial Flight. With Seven Woodcuts.
IV. The Coal Commissioners' Report.
V. The Spectroscope: its Imperfections and their Remedy.
VI. Modern Cannon Powder. With Three Page Plates.

Notices of Books. Progress of the Various Sciences. Recent Scientific Literature, &c., &c.

London: Offices of the Quarterly Journal of Science, 3, Horse-Shoe Court, Ludgate Hill, E.C.

TEXT-BOOKS OF SCIENCE.

Now ready, in small 8vo., price 3s. 6d.,

The Theory of Heat. By J. Clerk Maxwell, M.A., F.R.SS. L. & E., Professor of Experimental Physics in the University of Cambridge.

Being the Sixth of the New Series of Elementary Works on Mechanical and Physical Science in course of publication, edited by Professor T. M. Goodeve, M.A.

Text-Books previously published, price 3s. 6d. each:—

1. GOODEVE'S MECHANISM.
2. BLOXAM'S METALS.
3. MILLER'S INORGANIC CHEMISTRY.
4. GRIFFIN'S ALGEBRA AND TRIGONOMETRY.
5. WATSON'S PLANE AND SOLID GEOMETRY.

London: Longmans, Green, and Co., Paternoster Row.

PRACTICAL CHEMISTRY.

Laboratory, 60, Gower Street, Bedford Square, W.C.

Mr. Henry Matthews, F.C.S., is prepared to give Instruction in all branches of PRACTICAL CHEMISTRY, particularly in its application to MEDICINE, AGRICULTURE, and COMMERCE.

The Laboratory is open daily, except Saturday, from ten to five o'clock; on Saturday, from ten till one o'clock.

Mr. Matthews is also prepared to undertake ANALYSES of every description.

For Particulars and Prospectuses, apply to Mr. Henry Matthews, the Laboratory, 60, Gower Street, Bedford Square, W.C.

BERNERS COLLEGE of CHEMISTRY.—EXPERIMENTAL MILITARY and NAVAL SCIENCES, under the direction of Professor E. V. GARDNER, F.E.S., &c.: of the late Royal Polytechnic Institution and the Royal Naval College.

The Laboratory and Class Rooms are open daily.

Especial facilities for persons preparing for Government and other examinations.

Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

For particulars, &c., apply to Prof. E. V. G., 44, Berners-street, W.

ANALYTICAL LABORATORY AND SCHOOL OF TECHNICAL CHEMISTRY.

7 and 9, HACKIN'S HEY, LIVERPOOL.

Conducted by A. NORMAN TATE, Analytical and Consulting Chemist, and Chemical Engineer.

Established for Educational Purposes connected with Chemistry in its practical Applications to Manufactures, Commerce, &c.; for the performance of Analyses, Assays, and Chemical Investigations; and for affording information respecting the construction, &c., of Chemical Manufactories, and the conduct of Chemical Manufacturing Processes.

The Course of Instruction, in addition to the ordinary Chemical studies, comprises, as far as possible, all such other subjects as are necessary to give the scientific and practical information required in the Arrangement, Construction, and Management of Chemical Manufactories, and in the Application of Chemistry to Industrial Pursuits.

Students' Fees may be known on Application.

Plans, &c., for Chemical Apparatus and Manufactories are supplied and the erection of Plant and Buildings is superintended when required.

AMSTERDAM EXHIBITION, 1869.

The GRAND DIPLOMA of HONOUR, being the First Prize, and SUPERIOR to the Gold Medal.

Liebig Company's Extract of Meat.—Paris EXHIBITION, 1867, TWO GOLD MEDALS; HAVRE EXHIBITION, 1868, THE GOLD MEDAL.—Only sort warranted perfect and genuine by Baron Liebig, the Inventor. "A success and a boon."—Medical Press and Circular. One pint of delicious beef-tea for 2½d., which costs 1s. if made fresh from meat. Cheapest and finest-flavoured "stock" for soups, &c.

CAUTION.—Require Baron Liebig's signature upon every jar Sold by all Italian Warehousemen, Grocers, Chemists, and Ships. Store Dealers; all Wholesale Houses; and of LIEBIG'S EXTRACT of MEAT COMPANY (LIMITED), 43, Mark Lane, E.C.

NOTICE.—Various chemical analyses have been published purporting to show a fraction more of moisture to exist in the Company's Extract than in some imitation sorts. It is extremely easy to evaporate the water almost to any extent, but it is quite as certain that the fine meaty flavour which distinguishes the Company's Extract from all others would be destroyed if the concentration of the Extract were carried beyond a certain degree. Beef-tea made from Liebig Company's Extract with *boiling-hot water* will be found to be greatly superior in flavour, strength, clearness, to any other sort. This explains the universal preference it obtains in the market.

This Extract is supplied to the British French, Prussian, Russian and other Governments.

Chemical Technology, or Chemistry in its Applications to the Arts and Manufactures. By Thomas Richardson and Henry Watts. Second Edition, illustrated with numerous Wood Engravings.

Vol. I., Parts 1 and 2, price 36s., with more than 400 Illustrations.

Nature and Properties of Fuel: Secondary Products obtained from Fuel: Production of Light: Secondary Products of the Gas Manufacture.

Vol. I., Part 3, price 33s., with more than 300 Illustrations.

Sulphur and its Compounds: Acidimetry: Chlorine and its Bleaching Compounds: Soda, Potash: Alkalimetry: Grease.

Vol. I., Part 4, price 21s., 300 Illustrations.

Aluminium and Sodium: Stannates, Tungstates, Chromates, and Silicates of Potash and Soda: Phosphorus, Borax: Nitre: Gun-Powder: Gun Cotton.

Vol. I., Part 5, price 36s.

Prussiate of Potash: Oxalic, Tartaric, and Citric Acids, and Appendices containing the latest information and specifications relating to the materials described in Parts 3 and 4.

Bailliere and Co., 20, King William Street, Strand.

New Laboratory Apparatus:—

CENTRE BLAST BUNSEN, combining a Bunsen, and a very powerful Herapath, 10s. 6d.

HOT-BLAST BLOWPIPE, giving the temperature exceeding the fusing-point of platinum, 9s. 6d.

TABLE FURNACE, without blast, for operations below a white heat, 30s.

The above were awarded the first medal of the Royal Cornwall Polytechnic Society, 1871. Drawings, &c., one stamp.

T. FLETCHER, 15, Bold St., Warrington.

Methylated Spirits.—David Smith Kidd, Licensed Maker, Commercial Street, Shoreditch, N.E. Also FINISH, FUSEL OIL, and RECT. NAPHTHA.

Water-glass, or Soluble Silicates of Soda and Potash, in large or small quantities, and either solid or in solution, at ROBERT RUMNEY'S, Ardwick Chemical Works, Manchester.

Silicates of Soda and Potash in the state of Soluble glass, or in CONCENTRATED SOLUTION of first quality, suited for the manufacture of Soap and other purposes, supplied on best terms by W. GOSSAGE and Sons, Widnes Soapery, Warrington.

London Agents, CLARKE and COSTE, 19 and 20, Water Lane, Tower Street, E.C., who hold stock ready for delivery.

Established 1798.

ROBERT DAGLISH & CO.,

BOILER MAKERS, ENGINEERS, AND MILL-WRIGHTS,

BRASS AND IRONFOUNDERS,

St. Helen's Foundry, Lancashire.

Makers of every description of Chemical, Colliery, Copper Ore Mining, and Glass Machinery, including Crown, German Sheet, and Plate Glass Plant, as supplied to some of the largest Firms in England, Ireland, Scotland, and Wales.

Makers of the latest Improved Revolving Black Ash Furnace, with Siemens's Patent Gas Arrangement, and as used in the Manufacture of Soda.

Improved Vertical Blowing Engines (which have given a much higher Blast than any others have yet obtained), and as supplied to the entire satisfaction of most of the largest Bleaching Powder Manufacturers who have adopted "Weldon's Patent Process."

Authorised by Patentee to supply the Ironwork and Plant required in the Manufacture of Bleaching Powder by "Deacon's Patent."

Plans and Estimates of the Plant required for working these Patents in accordance with the Patentee's instructions.

Photographs, Prices, and other information, supplied on receipt of Order.

FLUOR SPAR.
LEVIGATED SULPHATE OF BARYTES.
CHLORIDE OF BARIUM.

Mr. Matthew Greene, 14, Pinner's Hall, London, E.C., is in a position to supply the above articles on the best terms. Samples and prices on application.

INDEX.

AARLAND, G., electrolysis of itaconic acid, 313
Abbe, C., weather telegraphy, 146
Abel, F. A., recent investigations and applications of explosive agents, 93, 101, 104, 126, 136, 150
Acetnaphthalid, 264
Acid and salt, inequality and loss of, near the poles of a galvanic battery, 35
Aconitine, crystallised, 85
Acridine, 34
Adder bites, treatment of, 45
Ador, E., benzols, 109
Adulteration of food, 197
Adulterations in food and drink, 277, 289
Aëronautic journey of the Volta air-balloon, 156
Ainsworth, T., facts developed by the working of hæmatite ores in the Ulverstone and Whitehaven districts, from 1844 to 1871, 104
Air analysis applied to phuto-physiological research, 73
Air-balloon, resistance of air against the motion of an, 277
Air in water, 133
Albertier, Dr., Toepler's electrical machine, 265
Albuminoid matters, conversion into urea, 288
Albuminose or gelatiniform matter, 181
Albuminous liquids, diffusion when in contact with distilled water, 241
Alcohol, combination with bases, 180
  reagent for, 144
  varying quantity met with in wine, 229
Alcohols, monatomic and hexatomic, conversion of the glucoses into, 240
  normal, products of the oxidation of, 168
  of the amylic series, polariscopic rotatory power of, 216
  soluble in water, 167
Aldehyde action on the two primary ureas, 87
  and ammonium combinations, 195
  of bichloride upon perchloride of phosphorus, action of, 230
Alglave, E., University of Strasburg, 73
Alizarine, artificial, 205, 217
"Alkali Act, 1863" (review), 165
Alkali, 23
  waste, recovery of sulphur from, 289
Alkalies, preparation and use of manganates and permanganates of, 86
Alkaline silicates, use of gaize for, 21
  sulphites, behaviour of some of the diazo-compounds with, 217
Alkaloids, periodides of the, 73
Allantoine, 204
Allen, A. H., distinction between a phosphate and an arseniate, 119
Alloy, gold-like, 181
Alloys, use of, 156
Allyl-alcohol, specific volume of, 72
Allyl compounds, constitution of, 21
  and glycerine, 145
  group, 73, 97
Allylic alcohol, 109
  into acrylic acid, conversion of, 193
Alum in bread, test, 98, 131, 134, 154
  manufacture, 98, 110
Alumina acetate, for rendering woven fabrics waterproof, 35
Aluminium, electro-decomposition of, 194
Alvergniat, Dr., phosphorescence produced by frictional electricity, 288
Amagat, M., compressibility and expansion of gases, 85
Amalgams, 145
American laws, patent view, 117
Amides of the fatty acids, formation of, 35
Amido-acetate of phenol, 313
Amidon, animal, a starch-like substance, 45
Ammonia action on phosphorus, 241
  bases, estimation of the typical hydrogen in, 145
  engine, 169
  process, history of, 10, 19, 32, 180
  of water analysis, 203
  tension of dissociation of carbaminate, 217
Ammoniacal salts, thermo-chemical researches, 240
Ammonium and aldehyde combinations, 195
Amylen, new, 157
Analyses and investigations in the laboratory of the Geological Institute, 167
Analysis of entire wheaten flour, 100
  of manures, 19
  of Mexican grenate, 252
  of sugars, 9
  quantitative, 8, 213, 292
Andersohn, A., air in water, 133
Andrews, Dr., action of heat on bromine, 75
  address to the Chemical Section British Association, 56
  dichroism of the vapour of iodine, 75
  gaseous and liquid states of matter, 1
Andrewsite, 99
Anhydrite formation, 168
Anilides of the so-called carbohydrates, 300
Aniline black paste oxidised, 181
  China ink, 181
  methylisation of the phenyl group in, 133, 229
Animal organism, calcareous matter in, 108
Anthracene, 47, 74
Anthracen, 120, 241
Anthrachinon, nitrogen compounds of, 264
Anthraflavic acid, 226
Antimony, 207, 221
  a native sulphide of, 163
  chloride, action of water on, 23
  oxychlorides, 224
  preparation of chloride and oxide of, free from arsenic, 192
Antisell, T., cundurango, 46
Arachis oil in olive oil, 311
Argentiferous lead, separation of silver from, 45
Argol composition, 86
Armstrong, H. E., nitration products of the dichlorophenol-sulphonic acids, 310
  on nitrochlorophenols, 284
Aromatic amido-derivatives, 275
Arseniate and phosphate, distinction between, 119
Arsenic acid with hydrochloric acid, 35
  estimation, 300
  from antimony, 207, 221
  in note-paper, 86
Artesian well at Rochefort, water of, 216
Artus, Dr., shoe-blacking without acid, 120
  new zinc paint, 181
Ascher, M., bioxybenzoic acid, 72
Ash-constituents of the animal body, 252
Assay of gold and silver, 14, 42, 269
Assaying iron pyrites, 182
  silver in H.M. Indian mints, 243, 259
Atcherley, R. J., on trinitro-thymo-methol, 96
Atlas, physical, of France, 241
Atomic weights, 34
  of cobalt and nickel, 86, 234
Atomicity or valency, 156, 166, 189
Atmospheric electricity, celestial, origin of, 21
Aurine, 34, 232
Aurora borealis, 97
  spectrum, 270
Autier, M., economical method of application of steam, 169
Azo-compounds of resorcin, 34

BAERLE, VON, neutral water-glass for washing wool, 46
Baeyer, A., new class of dyes, 22
Balard, Prof., acetate of alumina for rendering woven fabrics waterproof, 35
  report on prize essay on utilisation of manufacturing residues, 109
Ball, R., conservation of energy, 299
Baltic Sea, exploration of, 193
Bancker collection, 84
Barbe, M., use of dynamite, 252
Bardy, C., methyl-diphenylamine, 181
  on phenols, 299
Barium, estimation of sulphur by, 61, 66, 140, 171, 220
  chloride, contamination with hyposulphite of baryta, 46
Barker, G. F., spectrum of the aurora, 270
Barometer tubes, method of filling, 276
Barran, M., petroleum and paraffin oils, 144
Barth, L., disulphobenzoic acid and dioxybenzoic acid, 72, 145
  protocatechutic acid from oxybenzoic acid, 72
Bassett, H., eulyte and dyslyte. 310
Battershall, J., aldehyde of the naphthaline group, 192
Battery, Leclanché, 162
Baudrimont, Dr., action of substances which aid the decomposition of chloride of potassa when employed for making oxygen, 85, 252, 204
  oxygen for pharmaceutical purposes, 181
Bauer, J., phosphorus poisoning, 253
Baume's hydrometers, specific gravities indicated by, 28
Baumhauer, H., action of hydrobromic acid upon mononitronaphthaline, 300
  constitution of rosaniline, 21
  freezing-point of bromine, 300
Beaumont, E. de, new book on applied Geology, 108
Béchamp, A., new method of incineration of vegetable and animal substances, and the application to the estimation of the mineral elements of yeast, 97
  on Ritter's paper on the formation of urea, 311
Becquerel, M., action of electricity upon the coloured tissues of plants, 84
  celestial origin of atmospheric electricity, 21
  transport of some salts by electrical discharge, 45
Beeler, J. L., analysis of silver ore, 120
Beer, annual consumption of per head of population, 194
  areometrical analysis of, 216
  carbonic and lactic acids in, 120
  tannin a substitute for hops in, 46
Beer-yeast, fat in, 276
Bees poisoning by means of yeast, 73
Beet-root leaves as fodder for cattle, 313
  molasses distillation, 182
  sugar, 86, 145, 289
Beet-roots, application of manures to, 86
  distribution of mineral constituents in, 85
  manure for, 312
  value of for sugar, 241
Behrens, B., microscopical investigation of the pechstein of Corbitz, 167
Beilstein, F., fourteenth treatise on the determination of the chemical position of some of the toluol derivatives, 35
  mono- and dinitro-naphthaline, 23

Bengal lights, improved mixtures for, 98
Benzo-phenon, modifications of, 34
Benzol from benzine, 110
sulpho-acids of, 97
Benzol-hexachloride, 192
Benzols, 109
Benzyl-ether, 132
Bérard, E. P., salant, 288
Berthelot, Dr., caloric set free during the formation of organic nitrated compounds, 85
combination of alcohol with bases, 180
contribution to the history of carbon, 144
cyanogen series, 144
formation of precipitates, 252, 288
reagent for alcohol, 144
saltpetre industry in France before the nineteenth century, 35
thermo-chemical researches on ammoniacal salts, 240
Bessemer converters, gases evolved from, 159, 173
flame through coloured glasses, 163
process, 203
Betain of the phosphorus series, 133
Bibasic acids, monochlorides of, 45
Bichromate of potassa battery, 241
Bimethyl- and biethyl-protocatechutic acid, 72, 145
Binocular vision, 86, 288
Biography, 134, 182, 253, 265
of the late Ramon de la Sagra, 74
Bioxybenzoic acid, 72
Birkbeck Literary and Scientific Institution, 115
Birnbaum, K., sulphurous acid action on platinum-chloride, 109
Bischof, C., Dinas brick-making, 181
improving fire-clays, 46
Bismuth, oxide of, with sulphuric acid, combinations of, 265
production in Saxony, 181
subnitrate of, 46
Bisulphite of potassa, 181
Black, Dr., letters from M. Lavoisier to, 272
Blacking for shoes without acid, 120
Blast-furnaces, 145, 181, 193, 216, 241
and pig-iron production, 264
Blaukenhorn, Dr., and Roesler, Dr., varying quantity of alcohol met with in wines produced in different countries, 229
Bleaching-powder, 5, 264, 271
Bleicher, Dr., comparative geology of the Vosges, Pyrenees, and central mountain plateau of France, 97
different methods of observation employed in stratigraphic geology, 194
Bljuducho, J., preparation of methylen iodide, 157
Blomstrand, C. W., combination value of the elements, 72
researches in the chemical laboratory of Lund University, Sweden, 133
Blood, manganese in, 230
and milk, constitution of, 288
Blossom, T. M., assay of gold and silver, 14, 42, 269
Blowpipe testing, 46
Bloxam, T., on clean and unclean surfaces in voltaic action, 123
Bobierre, A., alteration which the metal employed for coppering wooden ships undergoes, 21
Bode, F., on J. Stoddart's plan of concentrating sulphuric acid, 82, 106
Bodisson, M., manufacture of fatty acids, 193
Bœhme, C. A., on chloral hydrate, 120
Bœttger, Dr., detection of minute traces of manganese, 192
and Petersen, T., artificial alizarine, 217
some nitrogen compounds of anthrachinon, 264
Boiler incrustation, 241
Boillot, A., phenomena of incandescence, 168
Boisbaudran, Lecoq de, separation of metals by a galvanic current, 311
Bolas, T., note on oxycannabin, 77
Bone-black, furnace for reviving, 241
in sugar refining, 241
Bouis, J., detection of hydrochloric acid in cases of poisoning with that acid, 252
Boutigny, C., crenic and apocrenic acids, 85
Borax and phosphor salt, substances crystallised in fused beads of, 109
new method of preparing, 109
Borgmann, E., eugenol and methoxybenzoic acid, 34
Boron and silicium, apparent volatilisation of, 144
Bosc, P., lucifer-match industry at Marseilles, 205
Bouchardat, G., artificial production of dulcite, 85
conversion of the glucoses into monatomic and hexatomic alcohols, 240
milk sugar, 144
Boucherie, Dr., obituary, 109
Boumans, M., modified arrangement of Leclanché's manganese galvanic cell, 181
Bourget, J., velocity of sound in sonorous pipes, 288
Bourgoin, E., electrolysis of phthalic acid, 168
inequality of the loss of acid and of salt in the vicinity of the poles of a galvanic battery, 35
Bowman, J. E., "Introduction to Practical Chemistry, Including Analysis" (review), 274
Boussingault, M., freezing of water, 84
Boutlerow, A., trimethylcarbinol, 157, 206
Bowen, M., sugar refining, 108
Braithwaite, W., "Retrospect of Medicine" (review), 70
Brandberg, J., benzol from benzine, 110
Brass, copper in, 23
Braunschweizer, J. N., action of moist ultramarine upon silver, 98
Bengal lights, 98
Bread, alum in, test for, 98, 131, 134, 154
for the army, alteration of, 204
Breguet, J., magneto-electric explosion apparatus, 277
Breton, P., light and electricity, 97
Brevets d'invention, ancient, 108
Brewing industry of the Austro-Hungarian empire, 289
Brick and stone decay, 297
Brick-making, Dinas, 181
British Association, 49, 71
Brom-benzo-nitrile, 132
Brom-sulphotoluol and sulphotoluol, 97
Bromide of potassium, 276
Bromine, action of heat on, 75
and chlorine, action of light upon, 229
chlorine, and iodine estimation, 97
freezing-point of, 300
Bromine-water to detect phenol, 217
Bronze, phosphorus, 46
Brühl, J. W., derivatives of piperidine, 133
Brush, G. J., ralstonite, 86
Bryonicin, 300
Budde, E., action of light upon chlorine and bromine, 229
Buff, H. L., specific volume of allyl-alcohol, 72
Bullock, C., bromide of cerium, 120
Buquet, P., denaturation and utilisation of the residues of soda and chlorine manufacture, 182
Bunsen gas-burner, 182
Busteed, H. E., assaying silver in H.M. Indian mints, 243, 259
Butylic and propylic chlorides, 45, 181
Burckhardt, M., relative goodness and durability of timber felled in winter or summer, 264
Buys-Ballot, Dr., meteorological observatory on the Azores, 21
Byasson, H., 167

CADMIUM sulphuret as a pigment for colouring soap, 86
Calculi, detection of xanthine in, 45
Calomel, action of chlorides on, 120
Caloric coefficients of the hydro-electric and thermo-electric currents, 240
set free during the formation of organic nitrated compounds, 85
Calorimetry, 108
Calvert, F. C., protoplasmic life, 13, 37, 88, 138
sulphur in coal and coke, 76
vitality of disease germs, 203
Cameron, C. A., assimilation of kreatine by plants, 273
Campani, G., presence of manganese in blood as a permanent constituent of that liquid, 230
urea a product of the spontaneous decomposition of an aqueous solution of hydrocyanic acid, 230
Campbell, D., ancient Jewish glass, 283
history of ammonia process, 19
Camphor group, 204
Camphoric acid, 33
Canada oil and sulphide of carbon, relative value of for extracting oils from seeds, 168
Cane sugar, conversion into glucose, 252
Canizzaro, S., monobenzyl urea, 157
Caoutchouc, 134
of Bornéo, 144
Carbamate of ammonium, dissociation and restoration of, 265
Carbolic acid, 74, 98, 173
antidotes to poisoning with, 252
Carbon, history of, 144
probable existence of two oxysulphides of, 313
sulphide of, 230
solubility in alcohol, 34
Carbonic acid and sulphuretted hydrogen mixed, 300
and lactic acids in beer, value of, 120
oxide, gas poisoning with, 264
Carboxamidobenzoic acid ethyl-ether and uramidobenzoic acid ethyl-ether, 264
Carboxycyanide preparation, 313
Carius, L., decomposition of nitric acid by heat, 263
phenaconic and fumaric acids, 300
Carius's method of estimating chlorine, bromine, and iodine, 97
Carles, P., differences which the divers processes for the estimation of cream of tartar exhibit, 252
Carnin, new base met with in extract of meat, 35
Caro, H., aridine, 34
Carstanjen, E., action of ethylen iodide on acetylide of copper, 157
Carstangen, E., itaconic acid, electrolysis of, 313
Casselmann, A., alleged poisonous nature of certain kinds of fish, 110
Catcheside, W. F., soda from cryolite, 146, 158
Cattell, M., new method of preparing pulp for paper-making purposes from wood, 229
Caustic potassa upon sulphoxybenzoic acid, fusing action of, 193
Cazin, A., magnetism in mechanical units, 20
Cement, hard, 134
marl from Ulm and its affinity to lithographic stone, 253
Scott's, 241
to resist nitric acid, 47, 74
to resist sulphuric acid, 182, 194
Cerium, bromide of, 120
Cerusite crystals, 240
Chabrier, Dr., alternating predominance of nitrous and nitric acids in rain-water, 144, 299
nitrous acid in arable soils, 85
Champion, P., dambonite and nitrated dambose, 85
nitro-ethal, nitro-glycol, and the general method of converting alcohols into corresponding nitric ethers, 156
nitro-glycerine, 45
use of dynamite for breaking up heavy masses of cast-iron, 21
Chandelon, J. T. P., condensation of noxious vapours, 312
Chandler, C. F., reduction of nitrate of silver by charcoal, 10
Chapman, E. T., the ammonia process, 32
Chatard, T. M., evaporation to dryness of gelatinous precipitates, 270
determination of molybdic acid as plumbic molybdate, 175
of small quantities of manganese, 196
tests for nitrous acid, 225
Charcoal, animal, in sugar refining, 46
reduction of nitrate of silver by, 10
Chemical compounds, change of colour produced by heat, 188
dynamics, a law in, 4, 63
laboratory of Neufchâtel, 253
lectures, 113
products of Italy, 109, 205
researches on food substances, 229
school, 111
section of the British Association, address to the, 56
Society, 226, 250, 261, 283, 309
works, government prosecution of, 11
and electrical force, correlation of, 32
Chemistry at the forty-fourth meeting of German natural philosophers and physicists, 218
schools of, 131
modern methods of, 229
Chemico-crystallographical investigations on the ferrocyanides, 35
Chenot's process of iron and steel manufacture, 169
Chevreul, E., sample of incinerated paper found among the ruins of the recently burnt Ministry of Finance, 85
Chicory adulteration, 22
Chinese varnish, 98
Chlorcitramalic acid, rational composition of, 264
Chlorides and haloids, action on glucose, 35
Chlorine, action on aldehyde, 156
on ethyl chloride, 23
on various bodies of the C_3 series, and substances isomeric with trichlorhydrine, 240

Chlorine, bromine, and iodine estimation, 97
in bleaching-powder, 5
preparation, 205
and bromine, action of light upon, 229
soda manufacture, denaturation and utilisation of the residues, 182
Chloral hydrate, 120, 130
Chlorhydrates of hydroxylamin, 265
Chlorimetry, improvements in, 75
Chlormethyl-sulphurous acid, product of decomposition of, 97
Chlor-iod-propylen, 157
Chloro-nitro-phenol, isomeric, 265
Chrome ores analysis, 286, 304
Chromic acid, pure, preparation of, 228
pure, specific gravity of, 228
Chromium compounds, 229
oxide, estimating, 286
estimation in chrome-iron ore, 305
preparation of crystallised, 228
Chrysanissic acid, 72, 275
Chrysen, 34
Church, A. H., analysis of entire wheaten flour, 100
of pitticite, 135
cupric phosphate from Cornwall, 239
pure carbolic acid, 173
Citric acid, action of hydrobromic acid on, 73
Cinchona barks, 263, 301
valued by polarised light, 132
City of London College, 115
Clark, J., analysis of chrome ores, and a new method of estimating the oxide of chromium, 286, 304
Clarke, Rev. W. B., origin of the diamond, 16, 40, 64, 78
Clay coagulation, 265, 277
Claye, D., resistance of air to the motion of an air-balloon, 277
Clays of the coal formation, 204
Clermont, A., metallic trichloracetates, 145
trichloracetic acid, 85
Cleve, P. T., platinum bases, 73
Coal, calorific value of, 253
gases occluded in, 271
and coke, sulphur in, 76
Coal-gas combustion, sulphuric acid a product of, 192
photometry of, 37
purifying, 218, 230
Coals in Norway, 134
Coal-tar, colours from, 5
Cobalt, atomic weight, 86, 234
ultramarine, 73
Cobalting and nickeling by the wet way, 168
Cochineal, colouring matter of, 172
Coffin, W. H., galvanic battery elements, 231
Coggia, Dr., extraordinary meteor seen at Marseilles, 193
Coke and coal, sulphur in, 76
Cold weather, extraordinary, 312
Collenette, A., "Useful Chemical Tables Arranged for the Use of Teachers and Students" (review), 107
Colley, A., action of the haloids in free state, and of some chlorides, upon glucose, 35
Colorimeter, 276
Colours from coal-tar, 5
Comet, Encke's, 285
Cometary phenomena, 285
Commaille, A., diffusion of albuminous liquids when in contact with distilled water, 241
Comparative tables of hydrometers, 289
Compass, mariners, new form of, 47
Copper in brass, 23
certain waters, 205
nickel, and zinc, determination of by the battery, 100, 172
uses of a new precipitating reagent of, 91
plates, corrosion of by nitrate of silver, 76
Coppering wooden ships, alteration which the metal employed undergoes, 21
Coppet, L. C. de, supersaturated solutions, 311
Corbin, M., tramways for agricultural use, 169
Corenwinder, B., distribution of the mineral constituents of of beet-roots, 85
distillation of beet-root molasses, 182
Corona, spectrum of, 198
Corréa, J., mercury mines of Almaden, Spain, 74
Costhelys, J., purification of crude suet of commerce, 312
Cotton, iodated, 168
seeds, 73
Cowberry, chemical investigation, 301
Cow's milk, analysis, 312
Craig, Dr., variations of the temperature of the human body, 288
Creatinin, hydrochlorate of from urine, 146
Crenic and apocrenic acids, 85
Crimson spirit, 169, 182
Crom-oxychloride, chromate of, 133
Crowder, W., determination of nitrous acid, with special reference to the manufacture of oil of vitriol, 237, 249
Crump, C., reaction of phenol, 299
Crystalline dissociation, thermal researches relating to, 288
Cultivation of waste lands, 97
Crystallographico - optical researches, 276
Cummings, J., action of chlorides on calomel, 120
Cundurango, 46
Cupric phosphate from Cornwall, 239
Cuyper, C. de, influence which the cession of Alsace and Lorraine to Germany will have on metallurgical industry, 74
Cyanogen series, researches on, 144
solvent power of liquid, 303

DALE, R. S., aurine, 34, 232
Dalziel, J., existence of sulphur dichloride, 159
Dambonite and nitrated dambose, 85
Damour, A., analysis of a Mexican grenate, 252
idocrase, 252
Danks, T., paraffin and naphthalin, 230
Dareste, C., animal amidon, 45
Davis, G. E., estimation of nitrous acid in nitrosulphuric acid, 257
vitality of disease germs, 203
Deacon, H., formation of ring vortices, 60, 70
ring vortices in water, 154
De Beaumont, E., rocks met with in the Western Alps, 180
Debray, M., report on Thomas's gas burner, 109
Dehydrating oxalic acid, 313
De Laire, G., certain reactions of the sulpho-conjugated acids of phenol, 207
Delffs, Prof., on sorbit, 75
Deligny, E., preparation of pyrophosphate of lime, 312
Deliquescent substances, weighing, 253
De Mortillet, G., biography of the late E. Lartet, 194
Densities of elements and their oxides, 21
Denton, J. Bailey, sewage as a fertiliser of land and land as a purifier of sewage, 307
Denza, Rev., aurora borealis, 97
meteorites seen in Italy during March and April last, 74
Derrien, M., furnace for reviving bone-black, 241
Desclabissac, E., preparation and use of manganates and permanganates of alkalies, 86
Des Cloizeau, M., new mineral found in the tin ore deposit of Montebras, 97
optical and crystallographical observations on the Montebrasite and the amblygonite of Montebras, 299
Deville, H. Ste.-Claire, apparatus for combustion of petroleum oils, 312
low temperature in May and June last, 21
Dewar, J., a new Scotch acidulous chalybeate mineral water, 171
Dextrine and starch, behaviour of to iodine and tannic acid, 265
cheap mode of preparing pure, 181
Dial telegraph, 205
Diamilla-Mulder, Dr., Rev. Denza, and A. Secchi, experiments in Mont Cenis Tunnel, 264
Diamond dust, 98, 110
matrix, 191
origin of, 16, 40, 64, 78
in the Ural, 299
Diazo-compounds, behaviour of with alkaline sulphites, 217
Dibromo-benzol-sulpho acid, 288
Dichloraceton, conversion of into lactic acid, 145
Dichlorhydrine, 97, 157
Dichlorophenol-sulphonic acids, nitration products of, 310
Dichroism of the vapour of iodine, 75
Diethylic sulphate, new mode of formation of, 229
Diethyliden-lactamidic acid, 265
Dimethyl - pseudo - propyl - carbinol, 157
Dinas, M., brick-making, 181
Dingler, Dr., annual consumption of beer per head of population in different countries, 194
beet-root sugar industry, 86
gold-like alloy, 181
malleable iron gas retorts, 46
preservation of timber used in mines, coal-pits, and quarries, 264
tannin a substitute for hops in beer, 46
Dinitro-aniline, 23
Dioptase, localities of, 99
Dioxybenzoic acid, 72
Diphenylen oxide, 145
Disease germs, vitality of, 191
Distillate of the spirit distilleries, 133
Disulphobenzoic acid, 72
and dioxybenzoic acid, 145
Ditte, A., sulphuret of selenium, 167
Dorsett, H., anthracene, 47
Draper, H. N., colours from coal-tar, 5
J. C., decay of stone and brick, 297
Drechsel, E., sulphur compounds, 157
Drink, adulterations in, 313
Dublin Royal Society, 299
Dubois, E., new mode of formation of diethylic sulphate, 229
Duboscq, J., electrical metronome, 182
Duclaux, E., superficial tension of liquids, 35
Dulcite, artificial production of, 85
Dumas, J., constitution of milk and blood, 288
eulogium on T. J. Pelouze, 109
phosphatic mineral deposits, 240
Du Moncel, Count, bichromate of potassa battery, 241
Du Motay, T., bleaching cotton, hemp, flax, jute, and other vegetable fibres by the aid of permanganates, 229
chlorine preparation, 205
Duquesnel, H., crystallised aconitine, 85
Dürre, E. F., preparation of malleable cast-iron, 241
Dusart, Dr., on phenols, 299
Dust and smoke, 25
Dyes and pigments of the ancients, 134, 193
new class of, 22
Dynamite, 21, 85, 252
and ordinary blasting-powder in working quarries and mines, 205
Dyslyte and eulyte, 310

EARTHQUAKES, instrument for detecting intensity, 167
Eatable earths, 206
Edger, A., estimation of sulphur by barium, 140, 220
Eghis, A., action of sodium amalgam upon oxalic ether, 34
Ekman, J. L., sea water on the coast of Bohuslän, Sweden, 133
Electric currents, caloric coefficients of, 246
Electrical and chemical force, correlation of, 32
discharge, transport of some salts by, 45
machine, Tœpler's, 265
metronome, 182
phenomena, 169
power, 11
Electricity, action of upon the coloured tissues of plants, 84
and heat, 262, 289
and light, 97
a new source of, 63
frictional, phosphorescence produced by, 288
relation of heat to, 251, 274
Electro - decomposition of aluminium and other metals, 194
Electro-deposition, 169, 182
Electro-dynamical action, 109
Electro-magnetic engine, 164
Electro-thermo-chemical experiments, 193
Electrolysis of acetate of potassa, 157
of itaconic acid, 313
of the hydracids, thermal researches on, 240, 252
thermal researches on, 288, 299
Elements and oxides, densities of, 21
combination value of, 72
compounds, and mixtures, 204, 227, 230
"Elements of Plane and Solid Geometry" (review), 107
Embden, F. C. E. von, electro-thermo - chemical experiments, 193
Energy, conservation of, 299
Engelhardt, A., miscellaneous researches, 157
Engler, C., brom-benzo-nitrile, 132
Engraving on glass, 205
Equivalents *versus* atoms, 274
Ermolaien, M., a new amylen, 157
Ernst, F., gallic acid ethers, 109
Eserine, neutral sulphate of, 276
Etherification, 35
Ethyl-diacetic acid, 97
Ethylen bases, manufacture of, 73
bromide, decomposition of by water, 157
iodide, action of on acetylide of copper, 157
protocatechutic acid, 192
Eugenol and methoxybenzoic acid, 34
Eulyte and dyslyte, 310
Exalbumine, 181
Exhibition at Vienna, 1873, 216
International, of 1871, 141, 152
Maritime, of Naples, 120
Experiment, lecture, 30
Explosion of gun-cotton, 131
Explosions, cause of, 97
prevention of, 289
Explosive agents, investigations and applications of, 93, 101, 104, 126, 136, 150

Explosive compounds, variation of temperature upon the mode of decomposition of, 216
substances used in mining, 168
Eye, sensitiveness of for spectrum colours, 229

FABRICS, &c., mixtures for keeping from being injured by moths, 192
textile, charring-point of, 166
Falières, Dr., bromide of potassium, 276
Fat in beer-yeast, 276
Fats, animal, extraction of, 145
Fatty acids, manufacture of, 193
Faust, A., derivatives from naphthaline, 265
derivatives from phthalic acid, 265
frangulinic acid, a derivative from anthracen, 265
isomeric chloro-nitro-phenol, 265
Favre, M., anhydrous and hydrated salts, 253
thermal researches on electrolysis, 240, 252, 288, 299
researches on mixtures, 180
researches on the energy of the galvanic current, 240
researches relating to crystalline dissociation, 288
Fechtinger, Dr., Schweizer's coating for stereochromic and other purposes, 98
Felspar as manure, 216
Felz, M., value of beet-roots for sugar manufacture, 241
Ferguson, J., historical notes on the discoveries of Dr. J. Black, 311
Fermentation, 85, 289, 312
Féron, M., Association of Commerce and Industry of Roubaix, 194
Ferres, J., "Mineral Statistics of Victoria for the year 1870" (review), 83
"Reports of the Mining Surveyors and Registrars, quarter ending March 31st, 1871" (review), 83
Ferrocyanides, chemico-crystallographical investigations on, 35
Ferrocyanogen and iron, volumetrical estimation of, 264
Fibres, separating silk, wool, and vegetable, 85
Ficinus, O., cheap mode of preparing pure dextrine, 181
Finckh, T., composition of a dressing to be applied to calico fabrics, 168
Filtration, use of porous cones in, 77
Fire, new liquid, 20
Fire-clays, improving, 46
Fish, alleged poisonous nature of, 110
Fittig, R., ethylen-protocatechutic acid, 192
piperine, 145
synthesis of piperonylic acid, and new mode of formation of protocatechu-aldehyde, 192
Fitz, A., oil in the pips of grapes and raisins, 300
Fleck, H., apparatus for washing and absorbing gas, 73
hygienico-chemical methods of investigation, 313
rapid method of drying glue, 181
Flour, wheaten, analysis of, 100
Flückiger, F. A., cinchona bark, 301
cotton seeds, 73
essential oil of mustard seed, 252
Flückiger's reactions of water-glass, 46
Fluorescence, notes on, 291
Fluorescent solutions, colour of, 77, 171
Fluorine, process for estimation of, 226
Follenius, O., leukaniline, 205
Fonvielle, W. de, accidental kindling of a gas burner by lightning, 108
Food, adulteration of, 197, 313
and drink, adulterations in, 277, 289
boiling below 100°, 289
substances, chemical researches on, 229
Fore-run, 218
Formic acid, conversion into methylic alcohol, 157
conversion into methaldehyde, 204
Forster, A., colouration of smoky quartz, 133
Foster, W., on photometry, 124
Foucault's heliostate, 169
Franchimon, A., and T. Zincke, hexyl-alcohol from heracleum oil, 263
Francis, E. H., note on oxycannabin, 77
Frangulinic acid, a derivative from anthracen, 265
Fresenius, R., quantitative estimation of sulphuretted hydrogen mixed with carbonic acid, 300
H., rosolic acid, 110
Frenzel, A., mineralogical notice, 229
Friedel, C., action of chlorine on various bodies of the C_3 series, and substances isomeric with trichlorhydrine, 240
experiments to ascertain whether the two chlorinated propylens derived from the methyl-chloracetol and the chloride of propylen are identical, 216
hexabromide and hexachloride of silicium, 240
silico-propionic acid and its ether, 146
subchloride of silicium, 144
Friedlander, S., action of sodium amalgam upon oxalic ether, 132
Fritzche, Prof., obituary, 109
Fucusol, note on, 303
Fumaric and phenaconic acids, 300
Fungi, prevention in aqueous solutions of tartaric acid, 246
Furnaces, blast, 193
for iron, 181
Fürstenau, C., on ultramarine, 169

GAABE, J., picrotoxine and some of its derivatives, 230
Gaize for the preparation of alkaline silicates, 21
Galactine, 181
Galletly, J., J. Stoddart's plan of concentrating sulphuric acid, 106
paraffin having a high melting-point, 187
preparation of hydrosulphuric acid, 162
Gallic acid, 21, 230, 241, 253
ethers, 109
and tannic acids, relation between, 216
battery, 193
elements, 231
batteries, new forms of, 142
current, energy of, 240
to separate metals, 311
Gas apparatus, new form of, 282
for washing and absorbing, 73
self-acting, not requiring a gas-holder and not liable to explosion, 74
burner, Thomas's, 109
burners, rheometric, regulator for, 312
cold, manufacture, 299
metropolitan, quality of, 33
retorts, malleable iron, 46
Gas-meter testing regulations, 265
Gas-proof fabric, 277, 289, 301
Gaseous and liquid states of matter, 1
Gases, compressibility and expansion of, 85
evolved from the Bessemer converter, 159, 173
formed by the explosion of nitro-glycerine, 240
intrinsic nature of, 276
liquefaction of, 277, 289
occluded in coal, 271
Gelatiniform matter or albuminose, 181
Geographical researches in Madagascar, 156
Geology, applied, new book on, 108
comparative, of the Vosges, Pyrenees, and central mountain plateau of France, 97
stratigraphic, methods of observation employed in, 194
Germination process, influence on the fat in seeds, 277
Germs of disease, vitality of, 203
Geromont, F., constitution of the allyl compounds, 21
Geuther, A., a new phosphorus oxychloride, the pyrophosphoric acid chloride, 217
ethyl-diacetic acid, 97
Gibbons, J., spectrum of lightning, 96
Gibsone, B. W., smoke drainage, 275
Giffard, H., production of hydrogen on the large scale, 241
Gintl, W. F., carboxycyanide preparation, 313
Giordano, M., mineral statistics of Italy, 169
Girard, A., caoutchouc of Bornéo, 144
C., certain reactions of the sulpho-conjugated acids of phenol, 207
secondary monamines, 167
Girond, M., rheometric regulator for gas-burners, 312
Gladstone, J. H., on essential oils 283
on a law in chemical dynamics, 4, 63
corrosion of copper plates by nitrate of silver, 76
Glasgow Philosophical Society, 251, 286, 311
Glass, ancient Jewish, 283
engraving on, 205
gold-ruby, 168
vessels, cleaning, wherein petroleum has been kept, 168
Glendinning, N., and Edger, A., estimation of sulphur by barium, 140, 220
Glucinum, 158
Glucose, action of chlorides and haloids upon, 35
conversion of cane sugar into, 252
Glucoses, conversion into monatomic and hexatomic alcohols, 240
Glue, cements, lutes, 277
rapid drying, 181
vegetable, 169
Glycerine and allyl compounds, 145
Glycerin-ether, 300
Glycolic alcohol and its heterologues, chemical constitution of, 279, 296
Gold and silver assay, 14, 42, 269
ore of Nova Scotia, 99
Gore, G., fluoride of silver, 291
solvent power of liquid cyanogen, 303
Gottlieb, J., origin and properties of monochlorcitramalic acid, 264, 265
Grabowski, J., naphthol compounds, 133
Græbe, C., acridine, 34
eugenol and methoxybenzoic acid, 34
pyren, 34
Gräger, Dr., chemical investigation of the cowberry, 301
method for testing bleaching powder, 264
Gramme, M., magneto-electric machine which produces a constant current, 205
Grandidier, A., geographical researches in Madagascar, 156
Gray, J. St. Clair, new source of electricity, 63
Grease, utilisation of from leather cuttings, 109
Gréhaut, Dr., absorption of gases by organic liquids, 194
excretion of urea by the kidneys, 264
phenomena of respiration, 253
poisoning with carbonic oxide gas, 264
Griess, P., uramidobenzoic acid ethyl-ether and carboxamidobenzoic acid ethyl-ether, 264
Griessmayer, V., behaviour of starch and dextrine towards iodine and tannic acid, 265
Grosjean, B. J., estimation of phosphoric acid, 33
Groth, P., crystallographico-optical researches, 276
Guiot, A., destruction of torpedoes under water, 241
Gümbel, Dr., geognostic relation of the Ulm cement marl and its affinity to lithographic stone, 252
Gun-cotton explosion, 131
Gunpowder, pressure of gases generated by the explosion of, 158
Gustavson, G., preliminary notice on the reaction between oxychloride of phosphorus and phosphoric anhydride, 264
Guyot, P., dynamite, 21, 85
estimation of free hydrofluoric acid, 85
iodo-chromate of potassa, 45
new facts concerning selenium, 20
new liquid fire, 20
researches on lydine, 193

HAEDICKE, H., some applications of sulphide of carbon, 194
Habermann, J., protein compounds, 204
Hagenbach, E., melting of lead shot when fired against an iron target, 133
Haidinger, Wilhelm, in memory of, 86
Hall, M., weighing deliquescent substances, 253
Haloids and chlorides, action upon glucose, 35
Hamel, F., apparatus fer exhibiting the phenomena of cooling water far below its freezing point, and the effects of its expansion on freezing, 169
dynamite and ordinary blasting-powder in working quarries and mines, 205
Hansemann, G., intrinsic nature of gases, 276
Harlé, H., use of nitro-glycerine in the working of marble quarries, 168
Harting, M., production by artificial means of the calcareous matter such as is met with in the animal organism, 108
Hasenbach, C. W., hyponitric acid and nitrous acid, 157
Hautefeuille, P., apparent volatilisation of silicium and boron, 144
calorimetry, 108
subchloride and oxychlorides of silicium, 156
Heat, action of on bromine, 75
on protoplasmic life, 37
and electricity, 262, 289
change of colour produced by in certain chemical compounds, 177, 188
conduction of, 157
dissociation of molecules by, 123

Heat, effect of on protoplasmic life, 88, 138
evolved by combustion of coal, 35
molecular dissociation by, of compounds in solution, 199, 209, 220
relation of to electricity, 251, 274
Heintze, L. J., contribution to our knowledge of some of the chromium compounds, 229
Heintz, W., diethyliden-lactamidic acid, 265
Helmholtz, Dr., velocity of the progress of electro-dynamical action, 109
Hematite ores, working of, 104
Henry, A., explosive substances used in mining, 168
L., miscellaneous notices, 132
monochlorides of the bibasic acids, 45
propylen compounds, 34
synthesis of oxaluric acid, 72
Heracleum oil from hexyl-alcohol, 263
Hermann, R., ilmenium and niobium, 73
Herreshoff's method for valuing bleaching-powder, 271
Hesse, O., alkaloids of opium, 132
contribution to our knowledge of cinchona barks, 263
polarised light for determining the value of the cinchona barks, 132
Heys, Z., benzol-hexachloride, 192
Highton, Rev. H., correlation of electrical and chemical force, 32
electrical power, 11
heat and electricity, 289
magnetic motive power, 156
new forms of galvanic batteries, 142
performance of the electro-magnetic engine, 164
relation of heat to electricity, 251
the Leclanché battery, 166
Hirt, F., adulterations in food and drink, 313
Historical notes on the discoveries of Dr. Joseph Black, 311
Hlasiwetz, H., umbelliferon, 22
protein compounds, 204
Hofmann, A. W., manufacture of ethylen bases, 73
methylisation of the phenyl group in aniline, 133, 229
primary and secondary phosphine of the methyl series, 34
Hoffmeister, W., phenylic ether and diphenylen-oxide, 145
Houston, E. J., change of colour in chemical compounds by heat, 177, 188
Hopkinson, J., rupture of iron wire by a blow, 287
Hops, tannin for, in beer, 46
Horsley, J., alum in bread, 131
Hübner, H., brom-sulphotoluol and sulphotoluol, 97
conversion of dichlorhydrine boiling at 174° into that boiling at 182°, 97
glycerine and allyl compounds, 145
sulpho-toluol, 73
Huppert, H., behaviour of monochloro-acetic acid with methyl-guanidin, 275
Husemann, T., antidotes to poisoning with carbolic acid, 252
Husson, Dr., analysis of cow's milk, 312
Hydracids, thermical researches on the electrolysis of the, 240, 252
Hydrated carbonate of lime, 33
Hydraulic invention, 253
Hydriodic acid, action on hydrophthalic acid, 22
Hydrobromic acid, action upon citric acid, 73
action upon mononitro-naphthaline, 300
Hydrocarbon, 157
Hydrocarbonate of lime, sucrate of, for sugar refining, 108
Hydrochloric acid, arsenic acid with, 35
detection of in cases of poisoning with that acid, 252
Hydrofluoric acid, free estimation of, 85
Hydrogen in ammonia bases, 145
production on the large scale, 241
sulphuretted, temperature of decomposition of, 109
Hydrological researches, 206
Hydrometers, 277, 289
Baumé's, specific gravities indicated by, 28
Hydrometre Clausolles, 276
Hydrosulphuric acid, preparation of, 162
Hydroxylamin, chlorhydrates of, 265
Hygiene and therapeutics, 86
Hygienico-chemical methods of investigation, 313
Hyponitric and nitrous acids, 157
into nitric acid, conversion of, 108
Hyposulphite of baryta, contamination of chloride of barium with, 46

IDOCRASE, 252
Ignition of woven fabrics, preventatives for the, 98
Illumination of workshops and factories, 120
Ilmenium and niobium compounds, 73
Incandescence, production of the phenomena of, 168
Incinerated paper from Paris, 85
Incineration, new method of, 97
Indigo, specific gravity and quantity of pigment in, 313
Indigotine synthesis, 288
Induction coil, large, 129
Ink, aniline, 181
"Inorganic Chemistry for Elementary Classes" (review), 273
International Exhibition of 1871, 141, 152
"Introduction to Practical Chemistry, including Analysis" (review), 274
Iodine and tannic acid, behaviour of starch and dextrine towards, 265
chlorine, and bromine estimation, 97
vapour, dichroism of, 75
Iodo-chromate of potassa, 45
Iridium compounds, 280
Iron and ferrocyanogen, volumetrical estimation of, 264
and steel, burnt, 250
manufacture, 169
blast furnaces for, 181
cast, malleable, 241
manufacture, 216
meteoric, 86, 176, 239
ore, chrome, estimation of oxide of chromium in, 305
ores, blast furnaces for smelting, 241
oxide, separation of from oxide of uranium, 233
pyrites, assaying, 182
reduced, impurities in, 73
wire, rupture of by a blow, 287
Isodinaphthyl, 183
Isomeric bromtoluidines, 23
chloro-nitro-phenol, 265
Itaconic acid, electrolysis of, 313

JACOBI, J., removing and utilising phosphoric acid from iron ores, 145
Jacot, A., deposit of chloride of potassium, 240
Janssen, J., aëronautic journey of the Volta air-balloon, 156
Japan, mineral riches of, 289
Jazukowitsch, N., product of decomposition of the chlor-methyl-sulphurous acid, 97
Jean, F., testing by the blowpipe, 46
M., new method of preparing borax, 109
Jeannel, Dr., boiling food below 100°, 289
Jevons, W. S., Encke's comet, 285
Johnson, W. H., on burnt iron and steel, 250
Joly, A., hydraulic invention, 253
Jörgensen, S. M., periodides of the alkaloids, 73
Jouglet, A., artificial illumination of workshops and factories, 120
maritime exhibition of Naples, 120
Julien, A. A., quantitative analysis, 8, 292
C. E., "La Chimie Nouvelle ou le Crassier de la Nomenclature Chimique de Lavoisier Déblayé," 205
Jungfleisch, Dr., variation of temperature upon the mode of decomposition of explosive compounds, 216

KACHLER, J., the camphor group, 204
"Karlsbrunen" at Nauheim, analysis of the water, 192
Karsten, H., air analysis applied to phuto-physiological research, 73
Keiser and Schmidt, MM., galvanic battery, 193
Kekulé, A., so-called fore-run of the spirit distilleries, 133
Kelp liquors, 35
Kempf, T., products from electrolysis of acetate of potassa, 157
Kenyon, T., cement to resist nitric acid, 47
Ketons, oxidation of, 133
Kidneys, excretion of urea by the, 264
Kimtzel, M., phosphorus bronze, 46
King's College, 114
Kingzett, C. T., the oneness of matter, 131
Kirpitschow, M., copper in brass, 23
Knapp, F., gold-ruby glass, 168
Knop, A., substances crystallised in fused beads of phosphor-salt and borax, 109
Koelle, R., bimethyl- and biethyl-protocatechutic acid, 72, 145
Kokscharow, N., crystals of cerusite, 240
Kolbe, H., Methods of modern chemistry, 229
probable existence of two oxy-sulphides of carbon, 313
products from electrolysis of acetate of potassa, 157
rational composition of chlor-citramalic acid, 264
Koninck, L. de, on bryonicin, 300
Kopp, E., anthracen, 120, 241
detecting and separating silk, wool, and vegetable fibres in woven fabrics, 85
rendering wooden taps impervious for liquids and preventing their cracking, 45
separation of silver from argentiferous lead, 45
use of finely-divided metallic tin, 45
Krämer, G., on fore-run, 218
Kraut, K., decomposition of chloride of phosphorus by water, 35
potassium and sodium amalgams, 145
Kreatine, assimilation by plants, 273
Kreiger, M., self-acting gas apparatus, 74
Kriwaxin, W., decomposition of ethylen bromide by water, 157
Kuhlberg, A., fourteenth treatise on the determination of the chemical position of some of toluol deritives, 35
Kuhlberg, A., mono- and dinitro-naphthaline, 23
Künzel, use of divers alloys, 156
Kurbäton, A., olibanum, 23

LABORATORY instruction, 113
Lactic acid, conversion into dichloraceton, 145
and carbonic acids in beer, value of, 120
Lactometers and milk, 120
Ladenburg, A., stannum-triethyl-phenyl, 145
reduction of silicic acid ether, 133, 299
Lamansky, S., limits of the sensitiveness of the eye for spectrum colours, 229
Landolt, H., detection of pheno by bromine-water, 217
Lamy, Dr., unity of matter, 216
Lantern, vertical, 92
Lartet, E., biography of, 194
Latschinow, P., miscellaneous researches, 157
Lavoisier, letters from to Dr. Black, 272
Law of compound proportion, 253
Lea, R. H., atomic weights of cobalt and nickel, 234
Lead, argentiferous, separation of silver from, 45
shot, melting of when fired against an iron target, 133
Leaden pipes coated inside with tin, 276
influence of water on, 22
Le Bel, M., petroleum oils of the Bas Rhin, 145
Lebon, G., xanthine detection in vesical calculi, 45
Leconte, J., binocular vision, 288
phenomena of binocular vision, 86
Leclanché battery, 166, 181
Lecture experiment, 30, 81
Lectures at the Franklin Institute, 1871-72, 239
Lefort, J., alteration of well-water by the proximity of burial-grounds, 288
Leist, A., combinations of oxide of bismuth with sulphuric acid, 265
Lemoine, G., researches on phosphorus, 181, 204
Letheby, Dr., quality of the gas supplied to the metropolis, 33, 192
Letters from Lavoisier to Dr. Black, 272
patent, publication of abridgments of, 20
Leuchs, G., relation between the specific gravity of and quantity of pigments in indigo, 313
Leukaniline, 205
Leyden jar, nature and duration of the discharge of, 167
L'Hote, L., gases formed by explosion of nitroglycerine, 240
Libraries, valuable, loss of, 204
Lieben, A., conversion of formic acid into methylic alcohol, 157
normal valerianic acid, 73
valerianic acid, 109
Liebermann, C., chrysen, 34
colouring matter of cochineal, 172
Life, human, in a physiological sense, regulators of, 264
Light, action of upon chlorine and bromine, 229
and electricity, 97
Lightning, gas-burner lighted by, 108
spectrum, 96
Lignites, composition of, 312
Lime, carbonate of hydrated, 33
phosphate, solubility of, 306
pyrophosphate, preparation of, 372
Linneman, E., conversion of dichloraceton into lactic acid, 145
Liquefaction of gases, 289

Liquid and gaseous states of matter, 1
Liquids, organic absorption of gases by, 194
superficial tension of, 35
supersaturation by their own vapours, 313
Lissaner, Dr., influence of water on leaden pipes, 22
Liversidge, A., process for the estimation of fluorine, 226
Logwood test for alum in bread, 98, 131, 134
Loiseau, M., sugar refining, 108
London Institution, 192
Lorain, M., freedom of superior instruction, 264
Lorin, M., preliminary notice on the formation of the amides of the fatty acids, 35
preliminary notice relating to etherification, 35
Lossen, W., chlorhydrates of hydroxylamin, 265
Lovén, S., tartar emetic free from arsenic, 301
Lovett, W. J., electrical phenomena, 169
Löwe, J., apparatus for determining the melting-point of organic substances, 145
diamond dust, 98, 110
Lucifer match industry at Marseilles, 205
Ludwig, M., comparative densities of elements and oxides, 21
Lunge, G., extraction of sugar from molasses by aid of baryta, 264
determination of chlorine in bleaching-powder, 5
Lute, 218, 230
Lwow, M., contribution to our knowledge on the quintanes, 157
Lydine, researches on, 193

MACALPINE, T., ethylen-protocatechutic acid, 192
Magnetic motive power, 155
Magnetism in mechanical units, 20
Magneto-electric explosion apparatus, 277
machine which produces a constant current, 205
Maiche, M., dry distillation of wood, 169
Mallet, J. W., meteoric iron, 86, 176
Malt liquors consumed in Paris, 181
Maly, R., preparation of hydrochlorate of creatinin from urine, 146
Manchester Literary and Philosophical Society, 164, 285
Manganese determination, 196
in blood, 230
minute traces of, 192
Manometer, new, 97
Manure, analysis, 19, 86
application to beet-roots, 86
for beet-roots, 312
Spence's process of treating mineral phosphates in the manufacture of, 277
use of felspar as, 216
Manures, fertilising substances which may be added to, 182
Mangon, H., resistance of air to motion of air balloons, 277
Markownikow, W., hydrocarbon and its derivatives, 157
products of oxidation of dichlorhydrine, 157
Marquart, P., on bryonicin, 300
Martin, E., screw propeller for sailing vessels, 134
Martius, C. A., methylisation of the phenyl group in aniline, 133
Maskelyne, N. S., localities of dioptase, 99
on Andrewsite, 99
Mason, C., American view of patent laws, 107
Massart, H., zinc metallurgy, 182
Massey, A. H., Herreshoff's method for valuing bleaching-powder, 271
Masure, F., analysis of arable soil, 182
Matter, the oneness of, 131, 216
Maumené, Dr., saccharine substances, 216
Mayor, J. H., distillation of wood, 74
Mayrhofer, J., behaviour of arsenic acid with hydrochloric acid, 35
Meat extract, new base in, 35
extracts, 205
preserving, 20, 22
Méhay, Dr., preservation and improvement of beet-root leaves to be used as fodder for cattle, 313
Méhu, C., iodated cotton, 168
Melolonthin, a new crystalline nitrogen- and sulphur-containing material, 217
Melsens, Dr., preservation of meat, 22
Mène, C., Bunsen gas-burner, 182
chemical researches on food substances, 229
Chenot's process of iron and steel manufacture, 169
clays of the coal formation, 204
continuation of the chemical researches on nutritive substances, 265
fertilising substances which may be added to manures, 182
Foucault's heliostate, 169
new use for silicate of soda, 312
on fermentation, 312
Mercadante, M., action of hydrobromic acid on citric acid, 73
Mercier, G., red-lead preparation 168
Mercury mines of Almaden, 74
Merrick, J. M., analyses of manures, 19
determination of copper, nickel, and zinc by the battery, 100, 172
Metallic objects, coating with a black-brown varnish, 217
Metallurgical industry, influence on by the cession of Alsace and Lorraine to Germany, 74
Metals, colours of, 223
separation of, 311
Meteor seen at Marseilles, extraordinary, 193
Meteoric iron, 86, 239, 288
from Augusta Co., Virginia, 176
stone of Searsmont, 146, 168
Meteorites, 299
seen in Italy during March and April of present year, 74
Meteorological observatory on the Azores, 21
Methaldehyde, conversion of formic acid into, 204
Methoxybenzoic acid and eugenol, 34
Methyl-diphenylamine, 181
Methylen iodide, 157
Metronome, electrical, 182
Metz, A., areometrical analysis of beer, 216
Meunier, C., calorific value of two samples of Welsh coal, 253
composition of lignites, 312
heat evolved by combustion of coal, 35
S., on the Widmannstätten figures, 312
Meyer, A. H., the betain of the phosphorus series, 133
E., gases occluded in coal, 271
V., benzols, 109
chemistry at the forty-fourth meeting of German natural philosophers and physicists, 218
Michaelis, A., new phosphorus oxychloride, the pyrophosphoric acid chloride, 217
sulphobromide of phosphorus, 217
Microscopical examination of dust blown into a railway carriage, 196
investigation of the pechstein of Corbitz, 167
Micro-mineralogy, 276
Milk, cows', analysis of, 312
sugar, 144
nitrogenous compounds of, 263
and blood, constitution of, 288
lactometers, 120
Mines of Sardinia, economic condition of, 182
Mineral, new, found in the tin-ore deposit of Montebras, 97
riches of Japan, 289
statistics of Italy, 169
water, chalybeate, 171
"Mineral Statistics of Victoria for the Year 1870" (review), 83
Mineralogical notice, 229
notes for 1870, 80
Mineralogico - chemical researches, 110
Mirus, R., poisoning bees by means of yeast, 73
Mizerski, K., action of hydriodic acid upon hydrophthalic acid, 22
Moigno, F., coals in Norway, 134
cultivation of waste lands, 97
exploration of the Baltic Sea, 193
extraordinary cold weather, 312
new volcano in Sicily, 134
nomenclature of the textile fibres in common use, 193
observatory on the Puy de Dôme, 312
salle de progrès, 97
steam-boiler incrustation, 241
very hard cement, 134
Moissenet, M., new mineral found in the tin-ore deposit of Montebras, 97
Molecular dissociation by heat of compounds in solution, 199, 209, 220
Molecules, dissociation of by heat, 123
Moleschott, J., regulators of human life in a physiological sense, 264
Molybdic acid, determination of as plumbic molybdate, 175
Monochloracetate and amido-acetate of phenol, 313
Monochlorcitramalic acid, origin and properties of, 264
Monochlorcrotonic acid, 133
Monochlorides of the bibasic acids, 45
Monochloro-acetic acid, behaviour of with methyl-guanidin, 275
Monamines, 167
Mond, L., recovery of sulphur from alkali waste, 289
Monier, E., on French and foreign malt liquors consumed in Paris, 181
Mono- and dinitro-naphthaline, 23
Monobenzyl-urea, 157
Mont Cenis tunnel, experiments in, 264
Montefiore-Lévi, M., phosphorus bronze, 46
use of divers alloys, 156
Moore, S. W., physiological chemistry at St. George's Hospital, 195, 219, 232, 249, 259, 271, 292
Morfit, C., "A Practical Treatise on the Manufacture of Soaps" (review), 82
Morin, A., gelatiniform matter or albuminose, exalbumine, and galactine, 181
Morris, W., adulteration of food, 197
Morton, H., fluorescent solutions, 77, 171, 291
the vertical lantern, 92
Moschini, L., action of sunlight upon olive oil, 230
Mouzot, Rev., use of felspar as manure, 216
Moussard, M., self-acting gas apparatus, 74
Muir, M. M. P., a native sulphide of antimony, 163
examination of samples of chloral hydrate, 130
Mulder, E., allantoine, 204
conversion of formic acid into methaldehyde, 204
electro-thermo-chemical experiments, 193
Müller, A., oxidised aniline-black paste, and aniline-china ink, 181
F. C. G., researches on the derivatives of β para-brom-sulpho-toluol, 193
C., conversion of dichlorhydrine boiling at 174° into that boiling at 182°, 97
K., glycerine and allyl compounds, 145
P., extracts of meat considered in a physiological point of view, 205
W., gold-ruby glass, 168
Münder, G., on the allyl group, 97
Munn, F. B., logwood test for alum in bread, 98, 134
Munroe, C. E., estimation of phosphoric acid, 18, 31, 167
porous cones in filtration, 77
Mustard seed, essential oil of, 252
Myers, J., sulphuretted hydrogen and arseniuretted hydrogen, 109

NAHAPETIAN, A., triethylcarbinol, 157
Naphthalic acid, 277, 289
Naphthalin and paraffin, 230
derivatives from, 265
group, aldehyde of, 192
Naphthol compounds, 133
Naumann, A., dissociation and restoration of carbamate of ammonium, 265
tension of dissociation of carbaminate of ammonia, 217
time required for the volatilisation and re-condensation of solid bodies, 72
Neubauer, C., tannin in oak bark, 300
Neubecker, M., a washing apparatus, 217
Neumann, P., milk and lactometers, 120
prevention of explosions when filling percussion caps, 289
Nicholson, E., ammonia process 180
Nickel, atomic weight, 86, 234
copper, and zinc, determination of by the battery, 100, 172
plating for photographic purposes, 174
Nickeling and cobalting by the wet way, 168
Niobium and ilmenium compounds, 73
and tantalum, composition of minerals containing, 275
native compounds of, 229
Nitric acid, 134, 146, 158
decomposition of by heat, 263
quantitative estimation of, 193
Nitro-ethal, and method of converting alcohols into corresponding nitric ethers, 156
Nitro-chlorophenols, 284
Nitro-glycerine, gases formed by explosion of, 240
use of in the working of marble quarries, 168
Nitrogen compounds of anthrachinon, 264
Nitrogenous compounds of milk sugar, 263
Nitrous acid determination, 237, 249
estimation of in nitro-sulphuric acid, 257
tests, 225
and hyponitric acid, 157
and nitric acids in rain water, 144, 299
Noble, Capt., pressure exerted by the gases generated by the explosion of gunpowder, 158

Nutritive substances, chemical researches on, 265

OAK bark, tannin in, 300
Obituary, 109, 216
Observatory on the Puy de Dôme, 312
Oil of orange-peel, oxidation products of, 147
olive, arachis oil in, 311
in the pips of grapes and raisins, 300
Oils, drying properties of, 299
essential, 283
Oil-seeds, value of, 46
Oleum residue from olive oil presses, 313
Olibanum, 23
Olive oil, action of sunlight upon, 230
presses, residue from, 313
Opium, alkaloids of, 132, 255
Oppenheim, A., on the allyl group, 73
Optical and crystallographical observations on the montebrasite and the amblygonite of Montebras, 299
Orange-peel, oxidation products of essential oil of, 147
Ores, hæmatite, working of, 104
Organic chemistry, elements of, 169
substances, melting-point of, 145
Organique chimie, elements de, 265
Ortho-toluidine derivatives, 157
Owen, J. D., subnitrate of bismuth, 46
Oxalic acid, dehydrating, 301, 313
ether, action of sodium amalgam upon, 34, 132
Oxaluric acid, synthesis of, 72
Oxides and elements, densities of, 21
Oxland, R., gun-cotton explosion, 131
Oxybenzoic acid, protocatechutic acid from, 72
Oxy-cannabin, note on, 77
Oxygen for pharmaceutical purposes, 181
Ozone, generating apparatus, 252

PAGNOUL, M., manure for beet-roots, 312
Palm oil, 146
Panification, new process of, 264
Papafy, M., telegraphic rockets, 253
Paper, arsenic in, 86
detection of woody fibre in, 168
Paper-making, pulp from wood for, 229
Papillon, M., changes in therapeutics and hygiène, 86
Paraffin, 187
and naphthalin, 230
and petroleum oils, 144
Paragenesis and derivation of copper, 229
Para-sulphobenzoic acid, 23
Parker, J. S., on the Bessemer flame through coloured glasses, 163
Parry, J., new form of gas apparatus, 282
the Bessemer process, 203
Patent law reform, 11
Patera, A., preventatives for the ignition of woven fabrics, 98
Paterno, E., and G. Pisati, action of perchloride of phosphorus upon bichloride of aldehyde, 230
Payen, the late Professor, 22
Peat to adulteration of chicory, 22
Peligot, E., repartition of potassa and soda in plants, 252
Peligot's process for sugar analysis, 9
Pelouze, T. J., eulogium on, 109
Percussion caps, prevention of explosions when filling, 289
Perkin, W. H., anthraflavic acid, 226
Permanganates, bleaching cotton, hemp, flax, jute, and other vegetable fibres by, 229
Periodides of the alkaloids, 73
Petersen, T., artificial alizarine, 217
and R. Bœttger, nitrogen compounds of anthrachinon, 264
Petit, A., neutral sulphate of eserine, 276
new theory of fermentation, 85
Petroleum, 167
and paraffin oils, 144
consumption, 47
oils, apparatus for combustion of, 312
of the Bas Rhin, 145
Pfaff, F., water and common salt contained in rocks and minerals, 229
Pfankuch, F., sulpho- and cyanoform, 157
Pfaundler, L., difference of energy displayed by phosphate of soda containing a different quantity of water of crystallisation, 217
Pharmaceutical Society of Great Britain, 115
Phenaconic and fumaric acids, 300
Phenol, certain reactions of the sulpho-conjugated acids of, 207
detection, 217
reaction, 299
monochlor-acetate and amido-acetate of, 313
Phenol-hydroxyles, reactions of, 145
Phenols, 299
Phenyl group in aniline, methylisation of, 133, 229
Phenylic ether, 145
Phillips, S. E., aldehyde and ammonium combinations, 195
Phipson, T. L., the gold ore of Nova Scotia, 99
on regianic acid, 119
Phosphate and arseniate, distinction between, 119
of lime, solubility of, 306
Phosphatic mineral deposits, 240
Phosphine of the methyl series, 34
Phosphor salt and borax, substances crystallised in fused beads of, 109
Phosphorescence produced by frictional electricity, 288
Phosphoric acid estimation, 18, 31, 33, 167
estimation by uranium, 233
removing and utilising from iron ores, 145
anhydride and phosphorus oxychloride, reaction between, 264
Phosphorite deposits, 167
Phosphorus, action of ammonia on, 241
bronze, 46
chloride, decomposition of by water, 35
chlorides, history of, 135
crystallisation of the oxychloride and the oxybromochloride of, 217
oxychloride of, 217
and phosphoric anhydride, reaction between, 264
perchloride of, upon bichloride of aldehyde, 230
poisoning, 253
researches on, 181, 204
spectra, 252
sulphobromide of, 217
Photographic image, invisible, researches on, 263
Photometry, 124
of coal gas, 37
Phthalic acid, 168, 263
Physiological chemistry at St. George's Hospital, 195, 219, 232, 249, 259, 271, 292
Picard, M., utilisation of waste leather cuttings which contain grease, 109
Picrotoxin, 230
Pierre, J., chlorides of propyl and butyl, 181
products of the oxidation of the principal normal alcohols, 168
propylic and butylic chlorides, 45
simultaneous distillation of water and alcohols soluble therein, 167, 181
solubility of chloride of silver, 252
Piesse, C. H., oxidation products of essential oil of orange-peel, 147
Pig-iron production and blast-furnaces, 264
Pigments and dyes known to and used by the Ancients, 134, 193
Pile, Wilson H., specific gravities indicated by Baumé's hydrometers, 28
Pinner, A., on fore-run, 218
Piperidine, 133
Piperine, 145
Piperonylic acid, synthesis of, 192
Pipes, sonorous, velocity of sound in, 288
Pisati, G., and E. Paterno, action of perchloride of phosphorus upon bichloride of aldehyde, 230
Pitticite, analysis of, 135
Plant and soil, comparison of constituents of, 73
Platinum bases, 73
chloride, action of sulphurous acid on, 109
salts, ethylen and protochloride of, iridium compounds analogous to, 280
Plumbic molybdate, 175
Poggiale, Dr., alteration of the bread intended for the army, 204
Polarised light for valuing cinchona barks, 132
Posepny, F., on the saline region of Siebenbürgen, 86
Potassa and soda, repartition of in plants, 252
bisulphite of, 181
chlorate, decomposition of when employed for making oxygen, 85
substances which aid the decomposition of, 204, 252
electrolysis of acetate of, 157
iodo-chromate of, 45
nitrate of, 35
permanganate of, action of in converting albuminoid matters into urea, 288
silicate of, 46
Potassium amalgam, 145
bromide of, 276
chloride, deposit of, 240
Potatoes, testing, 241
Popoff, A., oxidation of ketons, 133
Popp, O., potassium and sodium amalgam, 145
synanthrose, 46
"Practical Treatise on the Manufacture of Soaps" (review), 83
Precipitates, formation of, 252, 288
gelatinous, evaporation to dryness of, 270
President's address, British Association, 49
Prevost, E. W., monochlor-acetate and amido-acetate of phenol, 313
Prianichnikow, J., dimethyl-pseudo-propyl-carbinol, 157
Procter, H. R., relation of heat to electricity, 274
Propyl and butyl chlorides, 181
Propylen, 216
compounds, 34
Propylic alcohol, 110
and butylic chlorides, 45
Prosser's spreading fire nozzle, 108
Protein compounds, 204
Protocatechutic acid from oxybenzoic acid, 72
Protocatechu-aldehyde, new mode of formation of, 192
Protoplasmic life, 13, 37, 88, 138
Puchot, M., chlorides of propyl and butyl, 181
products of the oxidation of the principal normal alcohols, 168
propylic and butylic chlorides, 45
simultaneous distillation of water and alcohols soluble therein, 167, 181
Puller, R. E. O., estimation of arsenic, 300
Pulp from wood for paper making, 229
Pumpelly, R., paragenesis and derivation of copper, 229
Puscher, C., coating metallic objects with a very durable black-brown varnish, 217
Pyren, 34
Pyrocatechin, 300
Pyrophosphate of lime, preparation of, 312
Pyrophosphoric acid chloride, 217
Pyx of the Mint, trial of, 44

QUANTITATIVE analysis, 8, 213, 292
Quartz, smoky, colouration of, 133
Quekett Microscopical Club, 72
Quesneville, Dr., first idea of a dial telegraph, 205
Quintanes, contribution to our knowledge on, 157

RAILWAY-TRAIN, express, method of stopping in a short time, 253
Rain-water, alternating predominance of nitrous and nitric acid in, 144, 299
Ralstonite, a new fluoride, 86
Rammelsberg, C., composition of minerals containing tantalum and niobium, 275
hydrated carbonate of lime, 33
native compounds of tantalum and niobium, 229
Rammelsbergite, 277
Ranieri, A., hot springs and scalding sands of Ischia, 240
Raoult, F. M., caloric coefficients of the hydro-electric and thermo-electric currents, 240
conversion of cane sugar into glucose, 252
Red-lead preparation, 168
Regianic acid, 119
Regnault, V., new manometer for measuring high pressure of gases, 97
Reinsch, H., plant and soil, comparison of constituents of, 73
Remsen, I., action of fusing caustic potassa upon sulphoxybenzoic acid, 193
synthesis of piperonylic acid, and new mode of formation of protocatechu-aldehyde, 192
T., para-sulpho benzoic acid, 23
piperine, 145
Renard, A., arachis oil in olive oil, 311
"Reports of the Mining Surveyors and Registrars; Quarter ending March 31st, 1871" (review), 83
Resin, fossil, which perhaps belongs to the flora of the Amber, 276
Resorcin, azo-compounds of, 34
Respiration, phenomena of, 253
Retorts, gas, malleable iron, 46
"Retrospect of Medicine" (review), 70
Reverdin, F., on artificial alizarine, 205
Reynolds, J. E., action of aldehyde on the two primary ureas, 87
O., cometary phenomena, 285
Rheineck, H., fermentation, 289
separation of oxide of iron from oxide of uranium, and estimation of phosphoric acid by means of uranium, 233

Rheineck, H., volumetrical estimation of iron and ferrocyanogen, 264
water in some double sulphates, 289
Ribau, Dr., polariscopic rotatory power of the alcohols of the amylic series, 216
Rieckher, Dr., new method of preparing chloride of antimony, and production of an oxide of antimony uncontaminated with arsenic, 192
Richter, O., chemical constitution of glycolic alcohol and its heterologues, 279, 296
Ring vortices, 60, 70
in water, 154
Rinne, A., on the allyl group, 97
oxidation of allylic alcohol, 109
Ritter, E., conversion of albuminoid matters into urea by the action of permanganate of potassa, 288
Ritter's paper on the formation of urea, 311
Rockets, telegraphic, 253
Rocks in the Western Alps, 180
Roesler, Dr., and Blaukenhorn, Dr., varying quantity of alcohol met with in the wines produced in different countries, 229
Rood, O. N., nature and duration of the discharge of a Leyden jar connected with an induction coil, 167
Rosaniline, constitution of, 21
Rose, G., diamonds in the Ural, 299
formation of anhydrite, 168
H., sulpho-acids of benzol, 97
Rosenstiehl, A., synthesis of indigotine, 288
Rosolic acid, 110
Rossi, A., conversion of formic acid into methylic alcohol, 157
normal valerianic acid, 73
synthesis of normal propylic alcohol, 110
valerianic acid, 109
Rother, P., acetnaphthalid and some of its derivatives, 264
Roubaix, Association of Commerce and Industry of, 194
Rousseau, E., bone-black in sugar refining, 241
Rousset, E., biography, 134
chemical products of Italy, 169, 205
pigments and dyes of the ancients, 134, 193
soap-making, 108, 109
Routledge, R., elements, compounds, and mixtures, 227
valency or atomicity, 166
Roux, Dr., existence of copper in certain waters, 205
water of the artesian well at Rochefort, 216
Royal Institution of Great Britain, 263
Polytechnic, 263
School of Mines and College of Chemistry, 114
Society, 262
of Dublin, 299
Rudnew, W., dinitro-aniline, 23
Ruhmkorff, M., ozone-generating apparatus, 252
Russian chemistry, 300

SAAME, E., derivatives from naphthaline, 265
Sabanijen, A., action of water on chloride of antimony, 23
Sacc, Dr., biography of the late Ramon de la Sagra, 74
chemical laboratory of Neufchatel, 253
elements of organic chemistry, 169, 265
properties of drying oils, 299
researches on formation of gallic acid, 21
Saccharine substances, 216
Sachsse, R., nitrogenous compounds of milk-sugar, 263
Sadtler, S. P., iridium compounds analogous to the ethylen and protochloride of platinum salts, 280
Saint-Pierre, C., decomposition of bisulphite of potassa, 181
Salant, 288
Salet, G., spectra of tin, 204
spectrum of sulphur, 156
Saline region of Siebenbürger, 86
solutions for watering the streets, 215
Salkowsky, H., chrysanissic acid, 72
formation of aromatic amido-derivatives, 275
of the chrysanissic acid, and of an acid isomeric with it belonging to the meta group, 275
Salle de progrès, 97
Salleron, M., colorimeter, 276
Salt and acid, inequality and loss of near the poles of a galvanic battery, 35
common, to test potatoes, 241
Salts, anhydrous and hydrated, 253
constitution of, 88
freezing of aqueous solutions of, 110
transport of by electrical discharge, 45
Saltpetre industry, 35
Sandberger, F., Rammelsbergite, 277
Sands, scalding, and hot springs of Ischia, 240
"Sanitary Improvement of Towns, and the Utilisation of the Refuse" (review), 272
Sarnow, C., monochlor-crotonic acid, 133
Saytzeff, A., conversion of succinic acid in the corresponding diatomic alcohol, 73
Scheerer, T., analysis of commercial tin, 110
Schering, E., impurities in the reduced iron, 73
sulphuret of cadmium as a pigment for colouring soap, 86
Schertel, A., action of ethylen iodide upon acetylide of copper, 157
Scherzer, Dr., Chinese varnish, 98
Scheurer-Kestner, M., calorific value of two samples of Welsh coal, 253
composition of lignites, 312
heat evolved by combustion of coal, 35
use of gaize for the preparation of alkaline silicates, 21
Schiff, H., anilides of the so-called carbohydrates, 300
estimation of typical hydrogen in the ammonia bases, and reactions of free phenol-hydroxyles, 145
relation between tannic and gallic acids, 216
Schilling, Dr., apparatus for so-called cold gas manufacture, 299
consumption of petroleum, 47
method of improving spring water, 23
Schinz, C., blast-furnaces for iron works, 145, 181, 216, 241
continuation of the essay on the blast-furnaces, 193
studies on blast-furnaces and pig-iron production, 264
Schio liao, 86, 110
Schlœsing, T., comparison between two kinds of arable soil, 311
Schmidt, C., eatable earths, 206
galvanic battery, 193
hydrological researches, 206
Schools of chemistry, 111
Schlorlemmer, C., aurine, 34, 232
Schott, F., Scott's cement, 241
Schreiner, P., melolonthin, a new crystalline nitrogen, and sulphur, 217
Schulze, W., testing potatoes by a solution of common salt, 211
Schulze, W., influence exerted by secondary extract formation in fermenting wort, 194
Schwackhofer, F., phosphorite deposits, 167
Schweizer's coating for stereochromic and other purposes, 98
Scott's cement, 241
Screw propeller for sailing vessels, 134
Sea, temperature of, 35
Sea-water on the coast of Bohuslän, Sweden, 133
Seely, C. A., the colours of metals, 223
Secchi, Rev. A., experiments in Mont Cenis tunnel, 264
measuring the intensity of the sun's radiation, 253
new spectroscopic process, 74
relation in the sun between the faculæ, protuberances, and corona, 45
variable aspect of the protuberances and other remarkable portions of the sun's surface, 240
Selenium, new facts concerning, 20
sulphuret, 167
Sella, M., economic condition of the mines of Sardinia, 182
Selle, A., strong vegetable glue, 169
Senhofer, K., disulphobenzoic and dioxybenzoic acid, 72, 145
Sestini, F., contribution to our knowledge on sulphide of carbon, 230
Sévoz, M., mineral riches of Japan, 289
Sewage as a fertiliser, 307
system, Milanese, 277
Sézille, Dr., new process of panification, 264
Shepard, C. U., meteoric stone of Searsmont, 146
Sibon, Dr., glue, cements, lutes, 277
Sidebotham, J., microscopical examination of dust blown into a railway carriage, 196
Silicic acid ether, reduction of, 133
Silicium and boron, apparent volatilisation of, 144
chlorides, 156
hexabromide and hexachloride of, 240
spectra, 252
subchloride of, 144
Silico-heptyl series, 299
Silico-propionic acid and its ether, 146
Silk, black, solubility of, 301
Silk, wool, and vegetable fibres, separating, 85
Silva, Dr., action of chlorine on various bodies of the C_3 series, and substances isomeric with trichlorhydrine, 246
experiments to ascertain whether the two chlorinated propylens derived from the methyl chloracetol and the chloride of propylen are identical, 216
Silver and gold assay, 14, 42, 269
assaying in H.M. Indian mint, 243, 259
chloride, solubility of, 252
fluoride, 291
nitrate, corrosion of copper plates by, 76
reduction by charcoal, 10
ore analysis, 120
separation from argentiferous lead, 45
Silvestri, O., supposed new volcano in Sicily, 230
Sintenis, F., on benzyl-ether, 132
Skein silk, 74, 110
Smith, Dr. A., "Alkali Act, 1863" (review), 165
Smith, J. D., estimation of sulphur by barium, 61, 66, 171
J. L., composition of the meteoric stone near Searsmont, 168
meteoric iron, 288
W., distillation of wood, 227
isodinaphthyl, 183
Smoke and dust, 25
drainage, 275, 287
Smyth, John, improvements in chlorimetry, 75
Snaith, W. A., "Inorganic Chemistry for Elementary Classes" (review), 273
Snelus, G. J., composition of the gases evolved from the Bessemer converter, 159
Soap coloured by sulphuret of cadmium, 86
making, 108, 109
Soda and chlorine, manufacture, denaturation, and utilisation of the residues of, 182
from cryolite, 146, 158
manufacture, 134
phosphate, difference of energy displayed by containing a different quantity of water of crystallisation, 217
silicate, 46, 312
Sodium amalgam, 34, 145
action on oxalic ether, 132
as an explosive agent, 86
Soil and plant, comparison of constituents of, 73
arable, 311
analysis of, 182
Soils, arable, nitrous acid in, 85
Solaro, Rev. S., on the supersaturation of liquids by their own vapour, 312
Solutions, supersaturated, preparation of, 311
Sorbit, 75
Sorokin, W., chlor-iod-propylen, 157
Sound, velocity of in sonorous pipes, 288
Specific gravity, 28, 253, 265
of pure chromic acid, 228
Spectra exhibited by lightning, 229
of tin, 204
Spectroscopic process, new, 74
Spectrum of the aurora, 270
of carbon, boron, silicium, titanium, and zirconium, 167
of the corona, 198
of lightning, 96
of sulphur, 156
Spelter manufacture, 158
Spence, P., smoke drainage, 287
Spiller, J., nickel plating for photographic purposes, 174
Springmühl, F., application of sodium as an explosive agent, 86
Springs, hot, and scalding sands of Ischia, 240
Spirgatis, H., fossil resin which perhaps belongs to the flora of the Amber, 276
Staedel, W., action of chlorine upon ethyl-chloride, 23
Stahlberger, E., instrument for detecting and measuring intensity of earthquakes, 167
Stannum triethyl-phenyl, 145
Starch and dextrine, behaviour of towards iodine and tannic acid, 265
test, 277
Stas, M., statico-chemical researches, 246
Steam boilers, safety of, 46
economical method of application of, 169
Steam-gauge, 216
Stein, W., cobalt ultramarine, 73
estimation of sulphur in ultramarine, 229
theoretical observations on the colours exhibited by bodies, 229
Stenhouse, J., note on fucusol, 303
Stevens, C. R., skein silk, 74
Stevens's Institute of Technology, Hoboken, N.J., 44

Sticht, J. C., composition of argol, 86
Stoddart's plan of concentrating sulphuric acid, 82, 106
Stolba, F., cleaning glass vessels wherein petroleum has been kept, 168
nickeling and cobalting by the wet way, 168
Stone and brick decay, 297
Strecker, A., behaviour of some of the diazo-compounds with alkaline sulphites, 217
new base from strychnine, 263
Succinic acid, conversion of in the corresponding diatomic alcohol, 73
Suet of commerce, purification of, 312
Sugar, analysis of, 9
beet-root, 86, 145, 289
extraction of by baryta, 264
ordinary and inverted, influence of temperature on the optical rotatory power of, 241
refining, 46, 108, 241
Sulphates, double, water in, 289
Sulphide of carbon, some of the applications of, 194
and Canada oil, relative value of for extracting oils from seeds, 168
Sulpho-acids of benzol, 97
Sulpho- and cyanoform, 157
Sulpho-nitro-bibrom-benzol, nature of, 193
Sulphotoluol, 73
and brom-sulphotoluol, 97
Sulphoxybenzoic acid, action of fusing caustic potassa upon, 193
Sulphur compounds, 157
crystallites, 229
dichloride, existence of, 159
estimation of by barium, 61, 66, 140, 171, 220
in ultramarine, 229
in coal and coke, 76
recovery from alkali waste, 289
spectrum, 156
Sulphuretted hydrogen, contaminated with arseniuretted hydrogen, 109
quantitative estimation of mixed with carbonic acid, 300
Sulphuric acid, cement to resist, 194
plan of concentrating, 82, 106
Sulphurous acid, action of upon platinum chloride, 109
Sun, relation existing between the faculæ, protuberances, and corona, 45
Sun's radiation, measuring the intensity of the, 253
surface, variable aspect of the protuberances and other remarkable portions, 240
Sunlight, action of upon olive oil, 230
Supersaturated saline solutions, behaviour of when exposed to the open air, 64
Sutton, F., "Systematic Handbook of Volumetric Analysis; or the Quantitative Estimation of Chemical Substances by Measure Applied to Liquids, Solids, and Gases" (review), 311
Swager, M., soda manufacture, 134
Swartz, Th., adulteration of chicory, 22
Synanthrose, 46

TALLOW refining and bleaching, 253
Talpa marina, 193
Tamm, H., estimation of antimony, 207, 221
of oxide of chromium in chrome-iron ore, 305
estimating zinc, 148
the uses of a new precipitating reagent of copper, 91
Tannic acid and iodine, behaviour of starch and dextrine towards, 265
and gallic acids, relation between, 216
Tannin as a substitute for hops in beer, 46
in oak bark, 300
Tantalum and niobium, composition of minerals containing, 275
native compounds of, 229
Taps, wooden, rendered impervious for liquids, 45
Tartar emetic free from arsenic, 301
Tartaric acid to prevent fungi, 246
Taxation, 85
Tech, O., application of various kinds of manure to beet-roots, 86
"Technical History of Commerce or Skilled Labour Applied to Production" (review), 96
Telegraph dial, 205
Telegraphic rockets, 253
Tellier, C., ammonia engine, 169
new apparatus for heating wines, 229
taxation by one single impost, 85
Temperature of the end of May and first days of June last, 21
of the human body, variations of, 288
Terry, A., test for starch, 277
Terry, N. M., brom-sulphotoluol and sulphotoluol, 97
sulphotoluol, 73
Teschemacher, E. F., estimation of sulphur by barium, 61, 66, 171
Textile fibres in common use, nomenclature of, 193
Therapeutics and hygiène, 86
Thermal researches on mixtures, 180
on the energy of the galvanic current, 240
relating to crystalline dissociation, 288
Thermo-chemical researches, 228
Thermo-dynamics, 289
Thiercelin, M., substances which yield nitrate of potassa, 35
Thirion, Rev., stopping an express train in a short time, 253
Thomas, P., the late Professor Payen, 22
Thomas's gas burner, report on, 109
Thompson, J. B., electro-decomposition of aluminium and other metals, 194
Thomsen, J., thermo-chemical researches, 228
Thomson, Sir W., inaugural address British Association, 49
Thorpe, T. E., existence of sulphur dichloride, 159
history of the phosphorus chlorides, 135
Thüssing, Dr., Flückiger's reactions of water-glass, 46
Tichborne, C. R. C., dissociation of molecules by heat, 123, 199, 209, 220
Timber, preservation of in mines, coal-pits, and quarries, 264
relative goodness and durability of felled in winter or summer, 264
Tin and titanium compounds, crystallising from glassy fluxes, 313
coating inside leaden pipes, 276
commercial, analysis of, 110
from antimony, 207, 221
metallic use of finely-divided, 45
spectra of, 204
Tobin, T. W., the "diamond matrix," 191
Toczynski, F., platin-cyanide and tartrates of glucinum, 158
Tœpler's electrical machine, 265
Tollens, B., conversion of allylic alcohol into acrylic acid, 193
estimation of chlorine, bromine, and iodine by Carius's method, 97
on the allyl group, 97
oxidation of allylic alcohol, 109
Toluol derivatives, chemical position of, 35
Tomlinson, C., behaviour of supersaturated saline solutions when exposed to the open air, 64
Tommassi, F., thermo-dynamics, 289
Tornadoes, 146, 241
Tramways for agricultural use, 169
Tresca, M., leaden pipes coated inside with tin, 276
Tribe, A., corrosion of copper plates by nitrate of silver, 76
on a law in chemical dynamics, 4, 63
Trichloracetates, metallic, 145
Trichloracetic acid, 85
Triethyl-carbinol, 157
Trimethyl-carbinol, 157, 206
Trinitro-thymo-methol, 96
Troost, L., apparent volatilisation of silicium and boron, 144
calorimetry, 108
subchloride and oxychloride of silicium, 156
Tuchschmid, C., influence of temperature on the optical rotatory power of ordinary sugar and inverted sugar, 241
Twaddell and Beaumé, 265
Tyndall, J., on dust and smoke, 25
Typo-nucleus theory, 279, 296

ULTRAMARINE, 169
estimation of sulphur in, 229
moist. action of upon silver, 98
Umbelliferon, 22
University College, 113
of Cordova, 22
of London, 71, 111
of Strasburg, 73
Uramido-benzoic acid ethyl-ether and carboxamido-benzoic acid ethyl-ether, 264
Uranium, estimation of phosphoric acid by, 233
oxide, separation of oxide of iron from, 233
Urea, a product of the spontaneous decomposition of an aqueous solution of hydrocyanic acid, 230
conversion of albuminoid matters into, 288
excretion of by the kidneys, 264
formation, 311
Ureas, action of aldehyde on, 87
Urine, hydrochlorate of creatinin in, 146
"Useful Chemical Tables arranged for the Use of Teachers and Students" (review), 107
Utilisation of manufacturing residues, 109
Uloth, Dr., analysis of the water of the "Karlsbrunnen" at Nauheim, 192

VALENCY or atomicity, 156, 166, 189
Valerianic acid, 73, 109
Valson, C. A., thermal researches relating to crystalline dissociation, 288
Van Dorp, W. A., colouring matter of cochineal, 172
Vapour-densities, 227
Vapours, noxious, condensation of, 312
Varnish, black-brown, coating metallic objects with, 217
Chinese, 98
Viand-Grand-Marais, A., treatment of adder-bites, 45
Vibration, phenomena of, 33
Vienna yeast, 276
Vieweg, MM., new edition of a highly valuable work, 193
Vigla, Dr., Vienna yeast, 276
Villari, E., elasticity of caoutchouc, 134
Vitality of disease germs, 191, 203
Vitriol, oil of, manufacture, 237, 249
Vivien, A., animal charcoal in sugar refining, 46
beet-root sugar, 289
Vogel, A., sulphuric acid a product of the combustion of coal-gas, 192
fat in beer-yeast, 276
influence of the germination process on the fat contained in the seeds, 277
researches on the invisible photographic image, 263
spectra exhibited by lightning, 229
use of lactic and carbonic acids in beer, 120
Vogelsang, H., sulphur crystallites, 229
Vogt, G., secondary monamines, 167
Vohl, H., analysis of a manure, 86
arsenic in note-paper, 86
extraction of animal fats, 145
relative value of Canada oil and sulphide of carbon for extracting oils from seeds, 168
value of oil-seeds, 46
Voit, Dr., ash-constituents of the animal body, 252
Volatilisation and re-condensation of solid bodies, time required for, 72
Volcano, new, in Sicily, 134, 230
Volta air-balloon, 156
Voltaic action, on clean and unclean surfaces in, 123
Vom Rath, G., earthquake of Cosenza, 133
Von Gegerfelt, H., glycerin-ether, 300
Von Gorup-Besanez, E., pyrocatechin met with as a constituent of a living plant, 300
Von Kobell, mineralogico-chemical researches, 110
Von Lasaulx, A., micro-mineralogy, 276
Von Richter, V., Russian chemistry, 300
Von Schwarz-Senborn, Dr., General Exhibition at Vienna, 1873, 216
Von Zotta, V., conversion of dichloracetone into lactic acid, 145
Vortices, ring, 70, 154
Vorwerk, Dr., mixtures for keeping furs, woollen fabrics, and carpets from being injured by moths, 192

WAGNER, Dr., quantitative estimation of nitric acid, 193
production of bismuth in Saxony, 181
Wahl, W. H., mineralogical notes for 1870, 80
Wallace, Dr., photometry of coal gas, 37
Wanklyn, J. A., ammonia process of water analysis, 203
constitution of salts, 88
history of the ammonia process, 10, 32
watering the streets with saline solutions, 215
Washing apparatus, 217
Water, action of on chloride of antimony, 23
air in, 133
air-pump, use of for scientific purposes, 192
alteration in wells by proximity of burial grounds, 288
analysis, ammonia process, 203
curiosity in, 206

Water and common salts contained in rocks and minerals, 229
a new Scotch acidulous chalybeate mineral, 171
expansion on freezing, 169
freezing of, 84
influence of on leaden pipes, 22
in some of the double sulphates, 289
of the artesian well at Rochefort, 216
simultaneous distillation of, 167, 181
spring, method of improving, 23
Water-glass, Flückiger's reactions of, 46
neutral, for washing wool, 46
Watering the streets with saline solutions, 215
Waters, copper in certain, 205
Watson, C. J., phenomena of vibration, 33
H. W., "Elements of Plane and Solid Geometry" (review), 107
Watts, W. M., vapour densities, 227
Weather telegraphy, 146
Weaver, R., alum in bread, 154
charring-point of textile fabrics, 166
Weaver's glue composition, 168
Weidel, H., carnin, a new base met with in the extract of meat, 35
Weselsky, P., azo-compounds of resorcin, 34
Wharton, J., introduction of the manufacture of spelter into the United States, 168
Whitfield, H. S., tornadoes, 146
Wiemanstätten figures, 312
Wiesnegg, M., apparatus for combustion of petroleum oil, 312
Wiesner, J., detection of woody fibre in paper, 168
Wilbaux, A. A., engraving on glass, 205
Wild, H., method of filling barometer tubes, 276
Williams, R. D., nature of sulpho- and sulpho-nitro-bibrombenzol, 193
C. P., solubility of phosphate of lime, 306
W. C., oxychlorides of antimony, 234
W. M., gases from the Bessemer converter, 173
Willm, M., substances which yield nitrate of potassa, 35
Wine, varying quantity of alcohol met with in, 229
Wines, heating, new apparatus for, 229
Wilson, W. J., heat and electricity, 262
Wittstein, Dr., contamination of chloride of barium with hyposulphite of baryta, 46
freezing of aqueous solutions of salts, 110
Wolff, F. A., action of water air-pump, its application to boiling, evaporation, distillation, filtration in vacuum, and for drying herbs and crystals, 192
Wölz, A., dibromo-benzol-sulpho-acid, 288
Wood, W. H., elements, compounds, and mixtures, 204
Wood, W. H., prevention of fungi in aqueous solutions of tartaric acid, 246
Wood distillation, 74, 86, 227
dry distillation of, 169
pulp for paper making, 229
Woody fibre in paper, 168
Wool, washing with neutral water-glass, 46
Wreden, F., camphoric acid, 33
Wright, J. E., elements, compounds, and mixtures, 227
C. R. A., opium alkaloids, 255, 267
oxidation products of essential oil of orange-peel, 147
valency or atomicity, 189
Wroblevsky, E., conversions of isomeric bromtoluidines, 23
derivatives of ortho-toluidine, 157
Wunter, G., compounds of tin and titanium crystallising from glassy fluxes, 313
Wurtz, A., chlorine action on aldehyde, 156
Wybouroff, Dr., chemico-crystallographical investigations on the ferrocyanides, 35

XANTHINE, detection in vesical calculi, 45

YARDLEY, H. B., vitality of disease germs, 191
Yeast, beer, fat in, 276
estimation of the mineral elements of, 97
poisoning of bees by, 73
Vienna, 276
Yeats, J., "Technical History of Commerce; or Skilled Labour applied to Production" (review), 96
Yoback, G., brewing industry of the Austro-Hungarian empire, 289
Young, C. A., spectrum of the corona, 198

ZAENGERLE, M., regularity of the atomic weights, 34
Zaliwski, Dr., cause of explosions, 97
Zenger, C. V., new steam-gauge, 216
Zettnow, E., chromate of chromoxychloride, 133
preparation of crystallised chromium, 228
preparation of pure chromic acid, 228
specific gravity of pure chromic acid and of some of its solutions, 228
Zinc, action on quadri-chlorobenzyl and other bromated and chlorated compounds, 206
estimation of, 148
metallurgy, 182
paint, 181
Zincke, Th., two modifications of benzophenon, 34
and A. Franchimont, hexylalcohol from heracleum oil, 263
Zinine, N., action of zinc on quadri-chloro-benzyl and some other bromated and chlorated compounds, 206
Zwenger, C., gallic acid ethers, 109

END OF VOLUME XXIV.

PRINTED BY WILLIAM CROOKES, CHEMICAL NEWS OFFICE, BOY COURT, LUDGATE HILL, LONDON, E.C.

ROYAL ENTOMOLOGICAL SOCIETY
OF GREAT BRITAIN